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INVESTIGATION OF HONEY PRODUCTION SYSTEMS, AVAILABLE POTENTIAL AND CHALLENGES IN HARAMAYA DISTRICT OF EAST HARARGHE ZONE, OROMIA REGIONAL STATE, ETHIOPIA

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This is to certify that the thesis prepared by Habamu Garomsa entitled "Investigation of honey production system, available potential and challenges in Eastern Hararge Zone Haramaya woreda, Oromia Regional State" presented in the partial fulfillment of Masters of Science (M.Sc) in Biology.

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Contents

List of Tables

Pages

List of Figures

Page

List Acronyms/ Abbreviations

AD	Agricultural Development
AEZ	Agro-Ecological Zone
ARD	Agricultural and Rural Development
CAC	Codex Aliimentarius Commission
CSA	Central Stoical Agency
DA	Developmental Agent
EARO	Ethiopian Agricultural Research Organization
FAO	Food and Agricultural Organization
FGDS	Focus Group Discussion
GDP	Growth Domestic Product
HBRC	Holeta Bee Research Centre
HH	House Hold
MBH	Modern Bee Hive
MOARD	Ministry of Agricultural and Rural Development
SNNPR	South Nation, Nationalities and peoples of Regional State
SPSS	Statically Package for Social Science
SS	Sample Size
TBH	Traditional Bee Hive

Abstract

The study was conducted to investigate honey production system, available potential and beekee ping practices at Haramaya districts. The main purposes of the investigation were to identify and document the existing honey production system, opportunities, challenges and beekeeping mana gement practice of the district. For this purpose, data were collected from six Kebeles selected p urposively and the respondents were selected based on simple random sampling techniques.Thus ,39,36,29,25,11 people and 10 bee keepers were selected from finkile, tinike, ganda haaji, ifabate, ganda shangale and adele, respectively using proportional allocation giving a total of 150 bee keepers and interviewed using questionnaires, focal and group discussions. The data was analyzed by descriptive method of data analysis (percent, frequency, mean, standard deviation) using Microsoft excel and SPSS. From this study, two types of beekeeping systems wer e documented, namely traditional beekeeping systems and Modern beekeeping systems. About 98 % of respondents practiced traditional beekeeping. Only 2% of the respondent practiced traditio nal and modern beekeeping system. The mean bee colony holding size of the respondent was abo ut 66.2 house hold. There was one major honey flower season in the study area (November to D ecember). Based on the results of this study, the major challenges of beekeeping were pests and p redators, agro-chemical, lack of beekeeping equipments and materials, gender factor, long dry s eason and poor infrastructure.The opportunities sourced from the study area includes, flowering bee plants, perception of the societies, endogenous knowledge and presence of bee colonies i.e. The presence of all those things make the research more simpler. Due to high potential for ho ney production it is recommended to exploit the potential of the district more efforts should be pu t to create awareness of people on beekeeping, encourage farmers to practice hand weeding inst ead of using herbicid chemicals and integrate the indigenous knowledge with main stream scienc e and introduce new practice in the area where by farmers knowledge is not productive and sust ainability guarantees. There is high honey production in the area but the societies found in the district need awareness about the uses of honey.

Key words; Honey bee, Haramaya, Finkile and Gandashsnga

CHAPTER ONE

1. INTRODUCTION

1.1 Background

Honey producing system in Ethiopia is a deep-rooted traditional practice. Of all the countries in the world no country has a longer tradition of honey producing than Ethiopia. Honey has been used by mankind for many years as a source of medicine, food and for religious and cultural ceremonies (Cartland, 1970; Mcinerney, 1990; Molan, 1999). Honey provides sustainable lively hoods to many small- scale farmers and other rural and urban people (FAO, 2012). In addition, Takele Gina (2014) reports 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. Specially, Ethiopia is the largest and leading honey producer in Africa and tenth largest honey producer in the world. About 4,601,806 hives exist in Ethiopia, out of which about 95.5% was traditional, 4.3% transitional and 0.20% frame hives (Beyene and Davide, 2007). Beekeeping does not require fertile land and uncultivated area is suitable for-beekeeping for landless farmers, having apiary site is sufficient for engaging of the activity (Workneh, 2007).

In the East Hararge Zone two types of stingless bees (Meliponinae) are known, which are ground nesting and hollow tree nesting. Ground nesting comprises 30% of the total population of stingless bee in the area and is known for their better productivity. The major harvesting time is similar to that of honeybee's honey, which is February and, sometimes betwee n Junes to August. At one harvest an average of 4L of honey/per nest can be obtained. During harvesting the hunters dig in to the ground up to 10 to 15 cm below the nest. Moreover, stingless bee's honey hunters recognize the entrance diameter as wide and narrow and they believe in that the wider one is with more population and more productive. Around 20 % of the beekeepers of the respondents have a chance and tradition of harvesting stingless bee honey every year. Stingless bees are useful in maintaining the ecosystem through pollinating different forest trees and cultivated plant species (Kwapong*et al.*, 2010).

Despite the long tradition of beekeeping in Ethiopia, having the highest bee density and being the leading honey producer as well as one of the largest beeswax exporting countries in Africa, the

share of the sub-sector in the GDP has never been commensurate with the huge numbers of honeybee colonies and the country's potentiality for beekeeping. Productivity has always been low and leading to low utilization of hive products domestically (Nuru, 2002). This constraint in Ethiopia was further aggravated by inadequate extension coverage, lack of skills, limited beekeeping training and research in the beekeeping sector. Because of these and other related factors the region and the rural beekeepers; have not sufficiently benefited from the beekeeping subsector (Gidey and Mekonen, 2010). The most well known and utilized harvestable products from honey bee is honey, which is the sweets substance produced by honeybees from the nectar of blossoms or from the secretions on living plants which the bees collect, transforms and stores in honey combs (CAC, 2001). Ethiopia having the highest number of bee colonies and surplus honey plants is the leading producer of honey and beeswax in Africa. Ethiopia produces about 54,000 metric tons of crude honey per year.

The main constraints that affect the beekeeping sub-sector in Ethiopia are lack of honey producing knowledge, shortage of skilled man power, shortage of bee equipments, pests and pred ators' pesticides threat, poor infrastructure development, shortage of bee forage and lack of research extension. During shortage of bee forage different supplementary feed for honey bees applied including sugar, barley flour, peas and bean flour. Shortage of bee forage, lack of land use policy and demand for farm lands for crop cultivation are the biggest hindrance in beekeeping. Moreover, destroying of forest land for expansion of farm land could trigger a reduction of honey producing flora and foraging areas. The cutting off nectar and pollen producing tree species in many areas makes it difficult to maintain bee colonies (Kerealeet al., 2005). Shortages of bee forage cause the honey bee colony to abscond. Lack of feed, honey bee pests and drought are the main problems that cause absconding of honey bees (Gidey et al., 2012).Workneh (2007). Moreover, *Bidensprisnaria, Guzotiascrabra, Trifoliumspp, Oil crops,* pulses were documented to be a major source of honey in central high land and *cayluseaabyssinica,Eucalyptusglobules,vernoniaanydanila,cartonmacrostachys, and carissaedul is were the* most common weeds in Ethiopia and they were mentioned as important source of nectar of honey(Admasu 1996,Nuru,2002).According to Tessema(2009),beekeepers of Haramaya district have no indigenous knowledge to planting bee forage, but they plant for their own purpose to income generation, which serving as honeybee pollen and nectar sources for honeybees. The diversified Agro climatic conditions the country creates environmental

conditions conductive for growth of over 7000, species of flowering plants of which most are bee plants (Nuru, 2002). As a result, the country is with the largest honey bee colony population and the leading honey and bees wax producer in Africa. Even though, the country is with high potential and leading bee products producer, the benefit obtained from the sub-sector to the nation and bee keepers is not commensurate with its huge potential (MoARD, 2006). Honey producing system serves as economic, social, cultural and nutrition benefit all actors in the value chain. Moreover, farming system is recognized as the most appropriate method used to describe, diagnose and gain knowledge of the technologies and facto affecting production at farm level(Amor and knipscheer,1989).Therefore, this study was aimed to investigate honey system and the main constraints of beekeeping at Haramaya district.

1.2 Statement of the Problem

The study area was part of Haramaya district in Eastern Hararghe Zone Oromia regional state with potential honey production development and a number of people where involved in honey production activity to obtain benefit from the practices. However, there was no adequate information on the honey producing system, honey producing challenges, honey producing opportunities bee keeping management and extension practices of the districts that leads to broad recommendation on the determinants of the technology. So far in Haramaya there was no complied and reliable scientific information on honey production system and beekeeping practice. Therefore this study was conducted to identify the existing honey production system, constraints potentials and bee keeping management practice to suggest possible intervention measures for feature improvement in honey production through documenting some information of the study which helps the district office and societies at Haramaya district, East Hararghe Zone Oromia regional state, Ethiopia. This study would also be used as a base for further investigation by other researcher about the bee keeping development program.

1.3 Objectives

1.3.1 General objective

To investigate the honey producing systems, challenges and opportunities in the case of Haramaya district, East Hararghe Zone.

Specific objectives

- To determine the honey production management practices of the study area.
- To determine major constraints that hinder honey production.
- To identify available potentials for honey production activities in the study area.

1.3.2 Research question

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

1.4 Significance of the study

The significance of the study would be investigating and documenting important information on the sub sector about honey producing system, opportunities and challenges in order to improve the potential of honey producing activity and appropriate honey production development strategy plan through implementation of the documented study recommendations by the sub sector of the district. since as such type of study had not yet been carried out in the study area it may be used secondary data farther investigation. The recommended idea in this study may be helps as supplementary information when the district office as the program of educating the bee keepers on honey producing program.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Honey bee

A honey bee is any member of the genus Apis, primarily distinguished by storage of honey and the construction of perennial, colonial nests from wax. Currently, only seven species of honey bees are recognized, with a total of 44 subspecies (Michaels & Engel, 1999). Though, historically six to eleven species were recognized. The best-known honey bee is the western honey bee which has been domesticated for honey production and crop pollination. Honey bee represents only a small fraction of the roughly 20,000 known species of bee. Some other types of related bees produce and store honey, including the stingless honey bees, but only members of the genus Apis are true honey bees. Honey bee is one of the most well-known, popular and economically beneficial insects. For thousands of years, man has depended on honey bee colonies to get honey and bees wax which are two major products; honey being the nectar or plant sap ingested by bees (International Bee Association, 1992).

Bees of all kinds belong to the order of insect known as Hymenoptera literally membranous wings. This order comprising some 100,000 species also includes wasps, Ants, ichneumon and sawflies of the 25000 or more described species of bees (more recognized every year) the majorities are solitary bees most of which lay their eggs in tunnels which they excavate themselves. In some species small numbers of females may share a single tunnel system and in other cases there may be a semi social organization involving hierarchical order among the females.

Honey bees belong to the family of social bees which include bumble bees and the tropical stingless bees of the genus Meliponinae. The social bees' nest in colonies headed by a single fertile female the queen, which is generally the only egg layer in the colony. Foraging for nectar and other tasks such as feeding the queen and the larvae, cleaning broad cells and removing debris are carried by a caste of females the workers. Honey and pollen were stored and larvae reared in cell made from wax secreted by the worker bee. The honey bees comprise a single

genus, Apis, which is characters by the building of vertical combs of hexagonal cells constructed bilaterally from amid rib, using only the wax secreted by the worker bees

2.2 Bee biology

Honeybees belong to the order Hymenoptera, which includes other bees, wasps, and ants. Most Hymenoptera have two pairs of clear wings; all have chewing mouthparts. Some, including the honeybee, can suck up liquids. These insects undergo complete metamorphosis, or change in form, during their development. The four life stages are: egg, larva, pupa and adult.

Bees are perfectly equipped to collect pollen and nectar. They are covered with finely branched hairs that trap pollen as they visit flowers. While visiting flowers, the bees gather pollen from their hairs and store it in pollen baskets on their hind legs. A tongue-like portion of the mouthpart sucks up nectar. Honeybees are social insects, living together in highly organized colonies. Each member has a specific job to do. A single honeybee cannot grow or survive by itself. The three distinct kinds of honeybees in a colony are queen, worker, and drone.

2.3 The Queen

The longest bee in the hive but has the shortest wings. She is the mother of all the other bees. Her most important job is to lay eggs. Her productivity depends on the amount of food the workers bring in and the amount of brood space in the colony. She can lay more than 1,500 eggs a day. A good queen does not waste any space. She lays a solid pattern of brood, meaning one egg in every cell. Few eggs scattered among many empty cells or several eggs per cell are signs of problems. The queen might be missing or old, or parasites or disease might have weakened the colony. It can take some detective work to solve the problem. Worker bees usually rear new queens for one of three reasons: 1) the former queen left with a swarm; 2) the queen is laying increasingly fewer eggs; 3) the colony is overcrowded and has no place to expand. A colony that loses its queen suddenly is very upset but soon starts to rear a new one. Worker eggs or larvae less than three days old are raised in quickly built queen cells which hang vertically and are about the size and shape of a peanut shell. A fertilized egg hatches in about three days. The larva eats a special food called royal jelly. After growing rapidly for about six days, the larva pupates in the cell. The queen emerges about eight days later. A newly emerged queen stings the

remaining queen cells in the colony and fights any other queens she finds. The former queen is killed if she is still in the hive. Usually she has already left with other bees in the colony. Six to eight days after emergence, the queen takes nuptial flights and mates high in the air with the male (drone). Then she settles down and lays eggs. She will leave the hive only with a swarm. (Swarming is the natural way by which colonies are established at new locations).Queens live about five years with some living as long as nine, but egg-laying drops off significantly after two years. Many beekeepers keep a queen longer than that; others replace the queen every year to keep the colony strong. Colonies with older queens are more likely to swarm. Swarming usually occurs just before the main nectar flow. Hives that swarm have drastically reduced honey production.

2.4 The Worker

Workers are smaller than the queen and drones, but there are lots of them. There might be only a few hundred during winter and early spring, but there are usually many thousands during summer when pollen and nectar are plentiful. A strong colony at full strength can have close to 100,000 workers. These bees keep the colony going. Life begins as a fertilized egg. Laid singly in cells, each egg is attached to the bottom of the cell and stands upright. Eggs hatch in about three days. Each larva is fed royal jelly for three days then pollen and honey for three more. Pollen and honey are not as rich as royal jelly, so the larva becomes a worker instead of a queen. The white grub-like larva molts (sheds its outer covering) five times during the six days. Just before maturity, house bees cap the cell. The larva then spins a cocoon and becomes a pupa. The adult emerges 12 days later. It takes about three weeks to mature from the egg to an adult bee ready to go to work.

Workers' jobs change with their ages. Young bees, called house bees, do the hive chores. They produce wax and shape it into combs (structures of cells containing honey and brood) and use propels (a gummy substance gathered from plants) to seal cracks or cover rough edges in the hive. House bees also fan their wings to ventilate the hive in summer, controlling temperature and humidity, and they provide heat in winter. Some guard the hive to keep out raiders. Many produce honey and royal jelly. A lot of time is spent feeding brood and cleaning and repairing cells. House bees also feed the queen, the drones, and each other. Older workers, or field bees,

gather nectar, pollen, and water. The average adult worker lives less than a month during the busy season; overwintering bees live several months.

2.5 The Drone

Drones are larger than workers but not as long as queens. A drone has large eyes that touch each other at the top of the head. Drones do not have stingers, pollen baskets on their legs, or glands for producing wax, and their mouthparts are too short to gather nectar. Moreover, they do not even do jobs they could like ventilating the hive. Their only function is to fertilize the queen, and they die in the process. Drones are banished from the hive before winter begins.

While queens and workers develop from fertilized eggs, drones develop from unfertilized eggs. Drone cells are slightly larger than worker cells. This stimulates the queen to lay only unfertilized eggs in them. Drone eggs are also laid in worker cells that have become enlarged because of stretched or sagging combs. Small drones develop in worker cells if a queen gets old and loses her ability to fertilize eggs. Total time from egg to adult is 24 days.

2.6 Honey production in Ethiopia

Honey production, which is today, practiced over a greater area of the earth's surface than perha ps any other single branch of agriculture, and passed through different stages of development. Honey hunting, traditional (forest and backyard) and improved (movable-frame and movable top-bar) methods of beekeeping. Africa has many rock paintings about honey hunting than any other continent and some of the countries, which can be mentioned are South Africa (Natal), Zimbabwe, Morocco, Libya and Tanzania (HBRC, 1997). Crane (1990) reported that by 2500 BC, before forest beekeeping is known to have existed, fully fledged bee producing was being practiced in ancient Egypt and the earliest written records that relate to the keeping of bees in hives are from about 1500 BC.

The pattern of modern beekeeping was thus established between 1850 and 1900 AD. Because of the long tradition of beekeeping in the country, beekeepers have developed indigenous technical knowledge on traditional hive construction from different locally available materials, on honeybee management practices like honey season identification, swarm catching and attractant methods, swarm control method, honeybee enemy protection, traditional methods of sting protec

tion and reduction of pain (Workneh,*et al*.,2006). For advanced beekeeping one should have a good grasp of bee biology and behavior of bees for better colony management (Gichora, 2003). The involvement of illiterate in beekeeping activities could be attributed to the cultural influence existing in the study area. The low productivity and poor quality of bee product in Ethiopia was due to the lack of management of bees and bee products (Nuru, 1999).

According to MoARD (2003) the most important honey and beeswax production areas in Ethiopia are Oromia (about 46% of the total production), South Nation, Nationalities, and Regional state, SNNPR (22%), Amara (25%) and Tigray (5%). In south western parts of Ethiopia, some households entirely depend on honey hunting and forest beekeeping for their entire livelihood. In order to start beekeeping extension activities, the prepared program was first to make trials of improved hives in selected sites (Keralem, 2005). According to Holeta Bee Research Centre or HBRC (2004), there are four different types of beekeeping practices in Ethiopia namely, traditional forest, traditional backyard, transitional and improved beekeeping. Beekeepers who are involved in honey production had an average age of 30 years old. The farmers in the most productive age are actively engaged in beekeeping activities with the average of four years (Gebretsadik,et al,2016). The honey harvesting season was once or twice in Tinike and finkile district respectively (Tessaga, 2009 and Chala, 2010), and the majority honey flow season was November to December in different part of Ethiopia (Mathewose et al,2004 and CSA,2008).

2.7 Honey production in Northern Ethiopia

Indigenous technical knowledge of beekeepers varies from region to region in the country. As a result, bee producer's practices also show differences. Accordingly, honey producer of the northern Ethiopia has well developed indigenous technical knowledge on bee production (Nuru, 2002). The same source indicated that bee producer in the northern region keep their bees in backyard either under separate shelter or around the house wall or even inside the house i.e. with domestic animals and family members without any problem (Keralem*et al.*, 2009). They hang their beehives inside their living rooms and provide entrances on the sides of the walls. The beekeepers of the area construct beehives for different purposes; for instance, small hive to

induce reproductive swarming and big hives for honey production. The beekeepers also practice feeding and moving their colonies to other places for searching bee forage.

According to Gichora (2003), accumulating experience by seeking technical advice from fellow beekeepers and development agents (DAs) whenever necessary, and similar study undertaken by Assefa (2009), and Workneh (2007), beekeepers with longer beekeeping experience were able to adopt the use of improved box hive than beekeepers with shorter beekeeping experience. Honey production in Southern Ethiopia as the other part of the country, bee producers are one of the oldest agricultural practices in this area. Traditional, transitional and improved bee producing management is being practiced. As noted by Amsalu (2002) in the south western part of the region particularly (Mash area indeed this area is categorized as "south-western") farmer bee producer use natural forest only for bee producing purposes. The forest is distributed among bee producers and one cannot use for bee producing without the permission of the forest owner (bee producer). In some areas of the region as revealed by Nuru (2002), every family has its own forest land to use for traditional honeybee producing system, which is known as kobo. According to kobo system one cannot be allowed to cut a single stick or to hang hives in the forest which is not belonging to him. The practice is contributing much for high forest conservation in the area. Generally, in the area, traditional forest beekeeping is predominant. A bee producer can have 10-200 honeybee colonies. The beekeepers get honeybee colony mainly through trapping swarms. In relation to honeybee management, no attention is paid to honeybee colonies. Bee producer visit their honeybee colonies only during honey harvest. The honey harvesting practice requires climbing up big tree and sending the hive with rope or dropping it then harvesting the honey with the mixtures of pollen and beeswax. There are mainly two honey flow seasons in that area, namely April to May and September to November. The bee keepers are mainly selling their honey to "Tej" (local beverage) makers and few honey collectors.

2.8 Beekeeping in Southern Ethiopia

As the other part of the country, beekeeping is one of the oldest agricultural practices in this area. Traditional, transitional and improved beekeeping management is being practiced. As noted by Amsalu (2002) in the south western part of the region particularly (Mash area, indeed this area is categorized as "south-western") farmer beekeepers use natural forest only for beekeeping

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2.9 Honey production in western Ethiopia

In the western of Ethiopia there are better natural forest and cultivated crops with suitable climatic condition for beekeeping (MoARD, 2003). As a result, large honeybee population exists in the area. In the area bee production is mostly practiced in the forest by hanging hives on very big trees. It is common to observe up to 50 honeybee colonies in one tree. The honey harvesting method is similar with southern part of the country. However, in this area after honey harvest, they shake down the bees and store the empty hives until the next swarming season. In the region there is cultural belief of the beekeepers that once the colony is touched for honey harvest, the colonies tend to abscond and never stay in their hive (Nuru, 2002). The same source showed that bee production in the area has constraints of traditional practices like hanging the hive on tall trees that causes difficult to manage the bees properly, make difficult work for women and old man to climb long tree, wastage of bee colonies by shaking the bees during honey harvest that causes the loss of thousands of colonies every year, forest fire in dry seasons, and the like. In this region, transitional, improved and honey hunting practices are also being undertaken. There are also bee producers that keep their bees under the roof and use the colony for a long time. However, the honey production is very traditional which is practiced mainly by hanging traditional hives on tall trees in the dense forest far from human settlement areas and the

men jobs in Ethiopia (Hartman, 2004), and beekeeping is as main activity of male in Bale highlands of South East Ethiopia (Solomon ,2009).

2.10 Honey production in Eastern and Central highlands of Ethiopia

In central and eastern highlands honeybee colonies are kept in backyard and in the forest. Backyard beekeeping using traditional beehives are more predominantly exercised in the area and the traditional beehives are made up of pot, bamboo, locally available shrubs and trees (Amsalu, 2002). According to Solomon (2009) most of the south east and central highland of the bee producer put baiting hives on branches of trees in the forests, valleys and around river banks to catch the swarm. However, some of them did not take their baiting hives out of their apiaries for such purposes. According to Kerealem*et al.,* (2006), most of the bee producer in the central Ethiopia had got their bee colonies by trapping swarms using baiting hives. Method of fumigating the new hive is by digging the hole and preparing the smoke and digging another hole adjacent to the first hole then connecting the two holes internally by producing small hole which helps to pass smoke and putting the new hive upside down on the hole which has no fire. The new hive may be fumigated until the internal color of the hive gets brown. Bee producing management such as regular visiting of colonies, feeding, watering and protection from honeybee enemies are being under taken in the area. Beekeepers also practice migratory beekeeping i.e. moving their colonies to place where plenty of bee forages are available. As elsewhere in the country, the management for honeybees is very minimal in the study area (Kidane, 2014). Honeybee colonies exploit scattered resources by moving from area to area. This means that some hives remain empty for parts of the year especially under adverse weather conditions. Management of the hives and colonies is adapted to the seasonal nature and semi migratory habit of the bees.

2.11 Honey producing system in Ethiopia

Ethiopia is blessed with adequate water resources and various honeybee floras, which create fertile ground for the development of beekeeping. Honey hunting and hunting producing have been practiced in the country for the exploitation of honey (Girma, 1998). In places where wild colonies of bees living in hollow trees and caves are found, honey hunting is still a common

practice in Ethiopia. Currently in the country bee husbandry has been exercised; Traditional bee keeping system, transiently bee keeping system and Modern hive.

2.12 Traditional Bee keeping

Predominantly bee keeping in Ethiopia was traditional practice (Amsalu*et al.*, 2004). More than 95% of the honeybee colonies in Ethiopia are managed using traditional local methods (MoARD, 2012). Traditional beekeeping is of two types: forest beekeeping and backyard beekeeping. According Alemayehu (2011), the beekeepers keep their bees in backyard, under the roof, or hanging on trees near homestead and in separate house constructed for bee colonies, such apiary sites are appropriate for daily follow up activities of beekeeping. Whereas, some of the sample respondents keep their colonies inside house constructed for bee hive sitting. In some places, especially in the western and southern parts of the country, forest beekeeping by hanging a number of traditional hives on trees is widely practiced. In other most parts of the country backyard beekeeping with relatively better management is common (Nuru, 2002). The types of hives and the way of producing bees vary from area to area. Based on locally available materials used for construction of hives, environmental conditions and positions used to keep bees, the following variants of basic design are found throughout the country: hollowed logs, bark hive, bamboo or reed grass hive, mud (clay) hive, animal dung (mixed with ash) hive, woven straw hive, gourd hive, earthen pot hive. This in agreement with the report by Fichtl and Admasu (1994) who reported the traditional hive was made from locally available materials such as tree l ogs, Bamboo, grasses and other (Fichtl and Admasu, 1994). According to (Tessega, 2009) and Chala 2010), reported that, beekeeper of Bure district of Amahara region and Gomma district of Jimma one establishing bee colonies by catching swarms, buying, gift (from parent), training and Agricultural office. The bee producers that are experienced and skillful in using these hives could do many operations with less facility. Under Ethiopian farmers' management condition, the average amount of crude honey produced from traditional hive is estimated to be 5 kg / hive / year (Gezahegn, 2001).The yield obtained from traditional hive increase as compared to the survey result in west, south west and north Showa zone which was about 6.2kg (Worknehe*t al.* 2006). Beekeeping is an indigenous activity inherited from father to son in southwest Ethiopia (Hartmann, 2004). The traditional hive easily constructed from locally available materials. According to Werkineh et al.,(2006), who reported that beekeepers of west south, western and

Northern showa zone smoke new hives with kusaye (Lippiadoensis), Ejersa (Oleaafricana), Sombo (Ekebergiacapensis), Bessobila (Ocimum sanctum), Itan (Bosweliapapifera), and wanza (Cardia Africana) to attract bee colony. In the study area beekeepers have good indigenous knowledge of traditional beekeeping. According to the responses of the sample respondents, the indigenous knowledge used by the interviewed beekeepers were smoking baited hive by swarm attractant materials, honey harvesting time by smelling, observation at the bee hive entrance for what resources the honeybees are collecting and insert stick to beehive to check for honey presence, controlling reproductive swarming by removing brood, strengthening of colony by feeding with honey as local medicine, control of honeybee enemies by different means like cleaning around apiary and using metal swarm catching, identification of adulterated honey by smelling, tasting and looking color of honey (Gebretsadik et al ., 2016).

2.13 Transitional Beekeeping practice

It is a type of beekeeping intermediate between traditional and modern beekeeping methods. 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 bars of fixed width, 32 mm for east African honeybees (Segeren, 1995; Nicola, 2002). Adjare (1990) and IBRA (1997) suggested that for technical and economic reasons, most African countries are not yet in the position to use movable- frame hives, and for them top-bar hive represents a satisfactory compromise. Although movable frame hives are recommended for experienced beekeepers that want to optimize honey production, the Kenya top-bar (KTB) hive has been proved to be most suitable because of its low cost and the fact that the beekeepers or local carpenters can easily construct it. Transitional beekeeping started in Ethiopia since 1976 and the types of hives used are: Kenya top-bar hive, Tanzania top-bar hive and Mud- block hives. Among these, KTB is widely known and commonly used in many parts of the country (HBRC, 1997). The advantages of KTB over fixed comb hive and movable frame hive is discussed by Segeren (1995), Nicola (2002) and SOSS (2002). Top-bar hive in an ideal condition can yield about 50 kg of honey per year, but under Ethiopian condition, the average amount of crude honey produced would be 7-8 kg/hive/year (Gezahene, 2001). However, at zone level (North Wello) it has been reported that production of 24-26 kg/hive/year crude honey (SOS, 1999), and about 8 % as much beeswax per kilogram of honey is likely to be obtained.

2.14 Modern beekeeping practice

Modern or frame beehive honey production methods aim to obtain the maximum honey crop, season after season, without harming bees (Nicola, 2002). Modern or frame hive consists of precisely made rectangular box hives (hive bodies) super imposed one above the other in a tier. Later on, different countries developed their own movable frame hives (for instance Zander, Dad ant) and Lang troth was the prototype of movable frame hives used today. In many countries Lang troth hive boxes have proved to be convenient for handling and management. In Ethiopia, about, 5 types of movable frame hives were introduced since 1970 (HBRC, 1997) and the most commonly used are: Zander and Lang troth style hives. Based on the national estimate, the average yield of pure honey from movable frame hive is 15-20 kg/year, and the amount of beeswax produced is 1-2% of the honey yield (Gezahene, 2001). However, in potential areas, up to 50-60 kg harvest has been reported (HBRC, 1997). Movable frame hives allow colony management and use of a higher level of technology, with larger colonies, and can give higher yield and quality honey but likely require high investment cost and trained manpower. About 67% of the non-users of modern hives mentioned that lack of know-how on how to operate modern hive and lack of awareness about its benefits are main reasons for the dependence on the use of traditional hives (Kebede and Lemma, 2007).Honey production does not compete for resources with other agricultural endeavors and can be run integrally with other agricultural activities. Man cannot harvest and utilize nectar and pollen in the absence of bees. Bees' culture does not disturb ecological balance, as cultivation of crops and practices of animal husbandry. Honey production has many advantages that help farmer beekeepers to improve their wellbeing. It has a significant role in increasing national food production and regeneration of plant species. Honeybees are the prime pollinating agents in the world. Their service in pollination is estimated to be worth over 15 times the 11 value of all hive products together, although it is much more difficult to quantify their benefit (EARO, 2002).

2.15 Importance of Beekeeping in Ethiopia

Bee producing (bee keeping) in Ethiopia plays an important role in income generation for beekeepers. Moreover, honey production of the country meets beverage requirements of the urban and rural population. It is also demanded for its nutritional and medicinal values. In

addition, honeybees play a great role in ecological environment by pollinating both natural and cultivated plants. Particularly, self-sterile plants should get pollinating agents to maintain viable seed. The yield of plants pollinated by honeybees can be increased in quality and quantity. Honeybees can increase the yield of *Citrus sinensis* by 30%, water melon by 100% and tomatoes by 25% (Crane, 1990). Amsalu*et al.* (2004) also reported that onion yields had increased by 94% due to honeybee's pollination. In addition, bee producing sub-sector has a lot of relative advantages. For instance, it does not require fertile land as well as large area. Males and females of all working age groups can practice it with little initial capital.

2.16 Honey Production

Honey is the natural product of honeybee which has many times been described as man's sweetest food. It is an excellent energy source because it contains simple sugars that are ready for assimilation immediately on reaching the intestine. There is a strong local demand for honey due to its use for the production of traditional beverage 'Tej*' (*honey mead). In Ethiopia, much honey has traditionally been fermented to make 'Tej'and according to Edessa (2005) 85% of the total honey estimated to be brought for market is used for 'Tej' production and 15 % of the total honey produced is consumed at home.

2.17 Beeswax Production

In several regions of the country, beeswax collection is not significant and the beeswax produced by bees, which could be harvested by beekeepers is wasted. The beeswax is mostly left or thrown away because beekeepers do not bother to collect it since it is of little practical value for beekeepers (Fichtl and Admasu,1994) and the people do not know the local bees wax in generating income. However, the national estimate for the beeswax production of the country shows about 5000 tons (MoARD, 2012). This makes Ethiopia the fourth largest beeswax producing country in the world after China, Mexico and Turkey. Beeswax supports the national economy through foreign exchange earnings. Presently, beeswax is one of the major exportable agricultural products. Ethiopia is the third largest beeswax exporter in Africa and the annual average value of beeswax is estimated at about 125 million Birr (Nuru, 2002). Like honey, beeswax is also a multipurpose natural bee product, which is used in the manufacture of more

than 300 commodities. Honey and beeswax also play a big role in the cultural and religious life of the people of the country.

2.18 Other beehive products

Royal jelly, pollen and bee venom are also in very high demand globally. However, these Produc ts have never been utilized in the Ethiopian context (Ayalew and Gezahegn 1991). Additional benefits from bee producing are associated with the purely biological nature of bees, such as plant pollination and conservation of natural flora. Because of it relatively low labor requirements, bee producing can coexist almost effortlessly with regular farming activities, such as crops, horticulture production and animal husbandry (USAD, AGP-made, 2012).

2.19 Ecological importance honeybee

Bee producing is a sustainable form of agriculture that is beneficial to the environment and provides economic benefits for the retention of native habitats and potentially increases yield from food and forage crops (Jones, 1999). Bee producing has various relative advantages and some of them are as follows (Robinson, 1980). Bees are Cosmopolitan i.e. they adapt to wide range of environment. They can survive at altitude below 400 m as where cattle production may be severely constraints due to tsetse or other reasons. Small holders and landless peasants can practice beekeeping. The hive occupies very little space and bees can collect nectar and pollen from anywhere they can get. Bee producing does not compete for resources with other agricultural endeavors and can be run integrally with other agricultural activities. Man cannot harvest and utilize nectar and pollen in the absence of bees. Bees' culture does not disturb ecological balance, as cultivation of crops and practices of animal husbandry. The investment and running costs are relatively low with minimal risk. Bee producing is a very long-standing and deep-rooted practice in the rural communities of the country and around one million farmers are estimated to keep bees (Gebereyesus, 1973). Beekeeping has been and still plays a significant role in the national economy of the country as well as for the subsistence smallholder farmers. Beekeeping has many advantages that help farmer beekeepers to improve their wellbeing. It has a significant role in increasing national food production and regeneration of plant species. Honeybees are the prime pollinating agents in the world. Their service in pollination is estimated

to be worth over 15 times the 11value of all hive products together, although it is much more difficult to quantify their benefit (EARO, 2002).

2.20 Challenges of Ethiopian honey production system

There are a number of constraints to be mentioned as reasons for inefficient application of improved techniques and less expansion of improved technologies. These includes: limited knowledge and skills of farmers on moveable frame hive beekeeping, indiscriminate application of agrochemicals, shortage of trained extension staff, lack of adequate training institutions and training facilities, limited distribution of improved beekeeping equipment, inadequate production and high prices of moveable frame hives and its accessories, lack of appropriately-trained support personnel or information materials, inadequate organizational support, lack of access to, or non availability of credit and inadequate research centers to address the problems in different agro ecologies in the country. Furthermore, the existence of poor coordination between stakehold er's research, extension and farmers, including other sectors like the horticulture, forestry, health, and environment sectors (MoARD, 2007).

The major constraints of honeybee production are frequent occurrence of drought, lack of bee forage, existence of pests and predators and pesticide poisoning in decreasing order o fimportance (Adeday G.*et al.*, 2012). As reported by Gidey et *al.*, (2012), the major pests and predators are honey badger, ant, wax moth, bird's spiders and lizards. With regard to the effects of ants (*Dorylusfulvus*) on honey bees agreed with different studies conducted so far (Desalegn and Amsalu, 2001 and Desalegn and Yoseph, 2005). Honey bees like all living animals can be infected with disease and attacked by parasites and pests endangering their h ealth and life (Al Ghzawi *et al*., 2009). Hence, shortage of bee forage was highly responded problem to expand beekeeping activities in the areas. This is consistent with the study of Kerealem*et al*. (2009), who reported that shortage of bee forage due to population pressure, lack of land use policy and the high demand for farmlands put pressures on mountainous areas to be u sed for crop production and livestock grazing. According to Tesfaye (2007), in Adami Tullu Jid o Kombolcha district who documented those beekeepers had no special protection method to control disease. However, beekeepers protect their bee colony by simple protection measure by their experience. The promotion of some agricultural inputs such as pesticides as well as the use

of deadly chemical for malaria program has substantially reduced honey production Gezahegn (2001).

2.21 Opportunities of honey production in the study area

There are many opportunities for honey production improvement. According to Taye, B. (*et al.*, 2014), the major opportunities for beekeeping developments are presence of huge number of bee colonies; according to the Wonchi district bee expert, there are about 8500 traditional, 330 transitional and 1145 modern bee hives in the district, availability of tourists in the area, diversity and seasonal availability of bee forages and availability of eager bee keepers are the major opportunities. The opportunities relied on for development of bee keeping and productivity of bee hive summarized as seasonal availability of bee forages, availability of eager respondents to accept new technology, presence of huge number of bee colonies Tourist availability and presence of Wonchi bee keepers association (Taye, B., *et al.*,2014). Honeybee hive management issues include placement of bee colonies in appropriate site, keeping them disease free; guarding the hive from external predators; and maintaining or increasing bee population and honey production. Disease and predators can be managed with proper hive inspection and approved treatments (Alemayehu, 2011).

CHAPTER THREE

3. MATERIALS AND METHODS

3.1 Description of the study area

The study was conducted in Haramaya district, East Hararge Zone, Oromia Regional State which is found at 519km away from Addis Ababa. Haramaya district is bordered on the south west by Karsa, on the North West by Dire Dawa, on the north by Kombolcha woreda, on the north east by Harari region and on the south east by Burka. The major crops grown in the study area include maize, sorghum, chat, sweet potato. According to the information obtained from Haramaya district ARD office, (2020), maximum rainfall reaches 1500mm from may up to September. The average annual temperature of the area is 21.2 C^0 the maximum temperature, 22.6$C^{0\ is}$ recorded in March and April, while the minimum temperature 12.9C^0 was recorded in July and August. Topographically Haramaya district has latitude of 8°32'-8.51°N and 36°28'---36° 54E. It has an altitude at highland (12%) which ranges from 2400m to 3000m, Midland (37%) ranging from 1800m to 2400m and Lowland (51%) ranging from 1650-1800m above sea levels with estimated area of 3031km^2 (Haramaya district, ARD office,2020).

3.2 Socio-Economic activities

The district is characterized by favorable condition for crop and livestock production having relatively better cultivated crops and artificially cultivated plant coverage, which are mainly bee forages. But the district is sustainable with small number of hived bee colonies. According to the information from Haramaya ARD planning office, the dominant cereal crops of the area are; barley, maize and wheat. Among the pulses, beans, field pea and lentil are the major dominant crops. The number of live stocks dominating the districts includes: 22,648 cattle, 201,212goats, 1081 sheep's, and 10817 Donkey, Poultry 99748, and Honeybee colony 26,708 (Haramaya district ARD office, 2020). In addition, there are about 64,469 hectares of land put under area enclosure, which is also an opportunity as bee forage plants growing areas. In the area enclosure, it is possible to integrate bee forage; which is contributing much, to honey production of the area.

Table1: Pattern of land at Haramaya District (2020).

Land type	Unit	amount	Percent (%)
Cultivated land	Hectare	17407	27
Ready cultivated	“	33623	52
Grazing land	“	6647	10
Forest land	“	1289	2
Investment land	“	5503	9
Total		64469	100

Source: Haramaya ARD Office report, 2020

3.3 Population Study

According to the information from the district ARD office (2020) has a total population of 64,775 of which 31,817 and 32,958 were males and females respectively. A total of 10255 of households were engaged in honey production system out of the total population of the districts.

3.4 Survey and study design

The study was conducted in honey producing potential areas of Haramaya district, Oromia region. The study area was surveyed once formally with key informants to gather information and the study design was based on community-based cross-sectional. This included the representative respondents from beekeepers of selected Kebeles and key informants also participated in giving important information on beekeeping practices, opportunities and constraints. According to the information from ARD, the district consists total of twenty-three rural kebeles. According, six representative kebeles(two kebeles from each of the three agro ecologies) were purposively selected out of 23, rural kebeles based on the potentials of honey production and the existence of MBHs.

3.4.1 Sample size and sampling technique

Based on the information obtained from formal survey and semi- structured questionnaires was developed and pre-tested for its consistency and applicability to the objectives of the study.

The total Sample Size (SS) from the three agro ecological zones (AEZs) were calculated using *K othari*sample size formula (2004) and then, random sampling technique was used in selecting of respondents. Proportionate sampling was used to determine the number of sample households fro m eachAEZs and the selected kebeles. Single household respondent was used as sampling unit in this study.

$$n = \frac{NZ^2 \times (0.5)^2}{d^2(N-1)+(z^2 \times (0.5)^2}$$, *(Kothari sample size formula)*

Where: N = total population size in all AEZs

n = sample size required from all AEZs

d = precision level (0.08)

Z = number standard deviation (1.96)

The total sample sizes from all AEZs were calculated as follows;

$n = \frac{NZ^2 \times (0.5)^2}{d^2(N-1)+(z^2 \times (0.5)^2}$; Total rural population size from the three AEZs (N) = 59933.

$$n = \frac{59933 \times (1.96)^2 \times (0.5)^2}{(0.08)^2 \times (59933 - 1)+(1.96)^2(0.5)^2} = 150$$

Therefore, 150, represents the total SS from the three AEZ -which is used to determine SS of each AEZ and the sample size of HHs from each selected kebeles who were involved in honey production. The required HHs involved in honey production from each AEZ (i.e. Lowland have 5128 HHs, mid land has 3662 HHs and high land have 1465HHs) as bee keepers of the woreda.

$$n_h = \frac{nN_h}{N}$$

Where; n_h = Sample size from each AEZ (each kebeles)

N_h = Total HHs involved in honey production in each AEZ (each kebeles)

n = Total sample size from all AEZs (Kebeles)

N = Total HHs involved in honey production in all AEZ

To determine the sample size of each AEZ;

Low land SS; $n_h = \frac{nN_h}{N} = \frac{150 \times 5128}{10255} = 75$

Mid land SS; $n_h = \frac{nN_h}{N} = \frac{150 \times 3662}{10255} = 54$

Highland SS; $n_h = \frac{nN}{N} = \frac{150 \times 1465}{10255} = 21$

The sample sizes were from low land 75, SS from mid land 54, and SS from high land 21. The sample sizes of selected kebeles from each AEZ were calculated from the sample size of the

corresponding AEZ total HHs size of that kebeles and total HH size from the same AEZ. The HHs size of; low land kebeles (Finkile= 390 and Tinike =366), mid land kebeles (Ganda Haji =384 and Ifa Bate= 326) and high land kebeles (Ganda shangale =356 and Adele= 314).

$$\text{FinkileSS};n_h = \frac{nN_h}{N} = \frac{75\times390}{756} = 39$$

$$\text{TinikeSS; nh} = \frac{nN_h}{N} = \frac{75\times366}{756} = 36$$

$$\text{Ganda HajiSS; nh} = \frac{nN_h}{N} = \frac{54\times384}{710} = 29$$

$$\text{Ifa BateSS; } n_h = \frac{nN_h}{N} = \frac{54\times326}{710} = 2$$

$$\text{Ganda shagalleSS; nh} = \frac{nN_h}{N} = \frac{21\times356}{670} = 11$$

$$\text{Adele SS; } n_h = \frac{nN_h}{N} = \frac{21\times314}{670} = 10$$

Table 2: Sample size determination at Haramaya district (October, 2018 to June, 2019).

Agro ecological zones	HH size of each AEZ of the selected kebeles	Sample size of HHs in each AEZ	The selected kebeles in each AEZ	HHs each selected kebeles	Sample from each selected kebeles
Low land	756	75	Finkile	390	39
			Tinike	366	36
Mid land	710	54	Ganda haji	384	29
			Ifa Bate	326	25
High land	670	21	Ganda shangale	356	11
			Adele	314	10
Total	2136	150		2136	150

3.4.2 Methods of data collection

Before understanding field survey and better work process the woreda DAs select the sites of study area. Based on the information of district livestock resource Development and DA 150 bee

keepers were selected using random sampling techniques from three agro-ecologies (highland, midland and lowland) to collect the required information. The primary data were collected from sample respondents one time per month from November, 2019 to June, 2020, through semi-structured questionnaires to generate data on respondent's circumstantialities (age, educational level. Honey producing experiences, type of beehive, placement of beehive, potential and the constraints). In addition, the primary data also were collected using; focus group discussions (FGDs) and visual observation of the apiary management required having fundamental information.about honey production from the respondents. The researcher adequately administer ed and supervised the data collection processes by data collectors and checking the quality of the returns to avoid bias and errors of the collected data.

3.4.3 Semi-structured questionnaires

Based on the information obtained from informal survey, a semi structured questionnaire was developed and pretested for its consistency and applicability to the objective of the study. The primary data was collected from sample respondents through the semi structured questionnaire. The developed and used semi structured questionnaire was prepared in English language and developed for interviewing the sample respondents may not read and write to fill the questionnaires. On the basis of information obtained during pretesting and modification has been made on the questionnaire. Information obtained during pretesting has been including to the questionnaires and the final questionnaire has been translated in to Afaan Oromo. The information was collected through field surveys made to the target honey producers from the three agro ecological areas. After taking the list of honey producers, the respondents were randomly selected to source information about honey production system, challenges in honey producing managements and opportunities. The researcher adequately administered and supervised the data collection process by data collectors and checking the quality of the returns to avoid bias and errors of the collected data.

3.4.4 Group discussion (FGDs)

The obtained relevant information on honey producing; focus group discussion was conducted with potential beekeepers, extension workers and from kebele administration of each agro-ecology of the woreda. The bee keepers who was for focus group discussion was those bee keepers who were not included in sample respondents and are known by their honey producing performance and selected with the help of DA. Focus group discussion meeting with key informants was carried out when the woreda had the program of meeting with them.

3.4.5 Interview

The interview activities were conducted through translating the constructed semi- structured questionnaires in to *Afan Oromo* and the selected respondents were interviewed to suggest their opinion about honey production system, constraints, opportunities and bee keeping managements. The qualitative information collected through FGD was used to supplement and cross-checked the data obtained through the house hold survey and/or interview.

3.5 Methods of data analysis

The primary data such as socio demographic characteristics of respondents, number of bee colonies, type of bee keeping, honey production potential, honey production constraints and bee keeping management were collected through semi-structured questionnaire and translation. On the other hand, the data were collected through interview and analyzed through tabulating and interpretation. The data were analyzed in descriptive statistics such as; percentage, frequency, means, standard deviations and represented using tables, figures, charts and rank order was used for analysis.

3.6 Research Procedures

This research has been carried out in different working chapters. At the beginning, different literatures had been reviewed. The next step was deciding the instruments of data collection. After then the proposal was submitted. The other steps were the tasks related to field work like gathering, organizing and interpreting data and reviewing literature for further information.

3.7 Ethical Consideration

The most prominent ethical issues were considered in conducting this research to protect the rights and authority participants. The principle of voluntary participation requires that people should not be forced to participate in a research. Closely related to the notion of voluntary participation is requirement of informed consent. That is, prospective research participants will be fully informed about the procedures and risks involved and give their consent to the participants. The researcher will not put the participants on risk that harm because of their participation. The other one is guaranteeing the participants 'confidentiality, they assured that identify information not be available to anyone who will not directly involved in the study

CHAPTER FOUR:

4. RESULTS AND DISCUSSION

4.1 Socio-demographic characteristics of respondents

As expressed in Table 3; response related to the age of respondents revealed that the high percentage age of the respondents engaged in honey production was ranging from 38-47years (34.0%), 28-37 years (28.7%). This showed that most of the respondents were in their active and productive age group engaged in honey production activities. For instance beekeepers who i nvolved in honey production had an average age of 30 years old. The farmers in the most productive age are actively engaged in beekeeping activities (Gebretsadik, *et al*., 2016).

A total of 150 respondents were interviewed about their gender. From this 147 (98%) were males and 3(2%) were females (Table; 3). This indicated that in too small number of females involved the job of honey producing activities. The main reason for very limited contribution of female in honey production is that; in the study area honey producing activity is mostly practiced with the traditional method of honey production. Culturally females in the study area could not allowed to climb up trees during beehive hanging and they are sensitive to afraid of bee swarm because the study area was not fashioned with protective materials from the effect of swarm bees. This was in line with the reports of Hartmann (2004), indicated beekeeping as the man's job in Ethiopia and Solomon (2009), who indicated beekeeping as main activity of male in Bale highlands of South East Ethiopia.

Table3: Socio-demographic characteristics of respondents at Haramaya district (October 2019, to Jun, 2020).

Respondents status	Variable categories	Frequency	Valid percent	Cumulative percent
Gender	Male	147	98.0	98.0
	Female	3	2.0	100.0
	Total	150	100.0	
Age	18-27 years	29	19.3	19.3
	28-37 years	43	28.7	48.0
	38-47 years	51	34.0	82.0
	48-57 years	25	16.7	98.7
	58-67 years	2	1.3	100.0
	Total	150	100.0	
Marital status	Single	7	4.7	4.7
	Married	141	94.0	98.7
	Divorced	2	1.3	100.0
	Total	150	100.0	
Religion	Muslim	73	48.7	48.7
	Orthodox	20	13.3	62.0
	Protestant	48	32.0	94.0
	Wakefata	9	6.0	100.0
	Total	150	100.0	
Education level	Read and write	6	4.0	4.0
	Illiterate	58	38.7	42.7
	First cycle	31	20.7	63.4
	Second cycle	49	32.7	96.1
	High school	4	2.7	
	Preparatory	2	1.3	100
	Total	150	100.0	

94% of the total respondents were married while 4.7% and 1.3% were single and divorced respectively (Table;3).This is because the respondents reported that honey production done since it has economic and nutritional value and also used to help their family to educate children for other purposes. The percentage of the respondents with regarding to religion was because of the

religion proportionality of the respondents (48.7%) were Muslims; which was the highest percentage religion involved in honey production comparatively with the other religion of the respondents,13.3%, 32%, and 6% were Orthodox, protestant and Wokefata respectively (Table; 3). This result showed that honey producing could be practiced by any person coming from any religion in the study area. The educational level characterization of the respondents graded as, 38.7% of the respondents were not educated and 4% of the respondents were skilled with reading and writing for the reason of adult education. While about 57.4% of the respondents were educated through formal education; specifically 20.7%, 32.7%, 2.7 % and 1.3% attend 1^{rst} cycle(1-4),2^{nd}cycle(5-8), high school(9-10)and preparatory school (11-12) respectively(Table; 3). The higher literacy level might be enable bee keeping to access relevant information that would be stimulate honey production and stimulates better bee colony managements, but the involvement of illiterate in beekeeping activities could be attributed to the cultural influence existing in the study area. As cited by Gichora (2003), for advanced beekeeping one should have a good grasp of bee biology and behavior of bees for better colony management.

4.1.1 Land utilization and honeybee colonies

The respondent information pertaining to the number of honey bee colonies and land utilization revealed in (Table;4). The average numbers of honey bee colony owned by the respondent shows that 66.2±3.7 and ranges from 10-128 honey bee colonies which indicates the respondents in the study area was having more number of honey bee colonies.

Table 4: Honeybee colony holding and land utilization at Haramaya District (October, 2019 to June, 2020).

Respondents status	Variable categories	Minimum	Maximum	Mean ±std deviation
Honey bee colony		10.0	128	66.2±3.7
Utilized land size in	Farm land	.00	2.25	.9±0.6
	Grazing land	.00	1.25	.4± 0.2
	Forest land	.00	0.25	.±0.0

During the time of survey in the study area as a result of large population density shortage of land utilization was suggested by the respondents particularly for arable land, grazing land and forest land in prevailing of farming system (Table; 4). Of the respondents 96% had privet land

and; the rest respondents were not characterized with having of privet lands; for cultivation of crops, grazing land for their livestock and forest land. The average land size (in hector) utilized by the respondents were with the mean measure of 0.9 ± 0.6, 0.4 ± 0.2 and 0 ± 0 as farm land, grazing land and forest land respectively showed in (Table;2) .This indicated that the respondents holding very limited land and according to the information from the respondents having no private land or holding very limited land utilization might be affected honey production. In contrast to this beekeeping does not require fertile land and uncultivated area is suitable for-beekeeping for landless farmers, having apiary site is sufficient for engaging in the activity (Workneh, 2007).

4.1.2 Honey producing experiences of the respondents

This result showed that 47.3% of the respondents were experienced with honey production from 6-10 years and 18% of the respondents had an experience of 16-20 years old ranging from 1 to 25years (Figure 2). Based on the exposure of this long experiences of the respondents were supporting the fresh beekeepers to gain valuable information about the technical work of honey production. Similar result was also reported by Gichora (2003), accumulating experience by seeking technical advice from fellow beekeepers and development agents(DAs) whenever necessary and similar study was undertaken by (Assefa,2009) and (Workneh,2007), who documented that beekeepers with longer beekeeping experience were able to adopt the use of improved box hive than beekeepers with shorter beekeeping experience.

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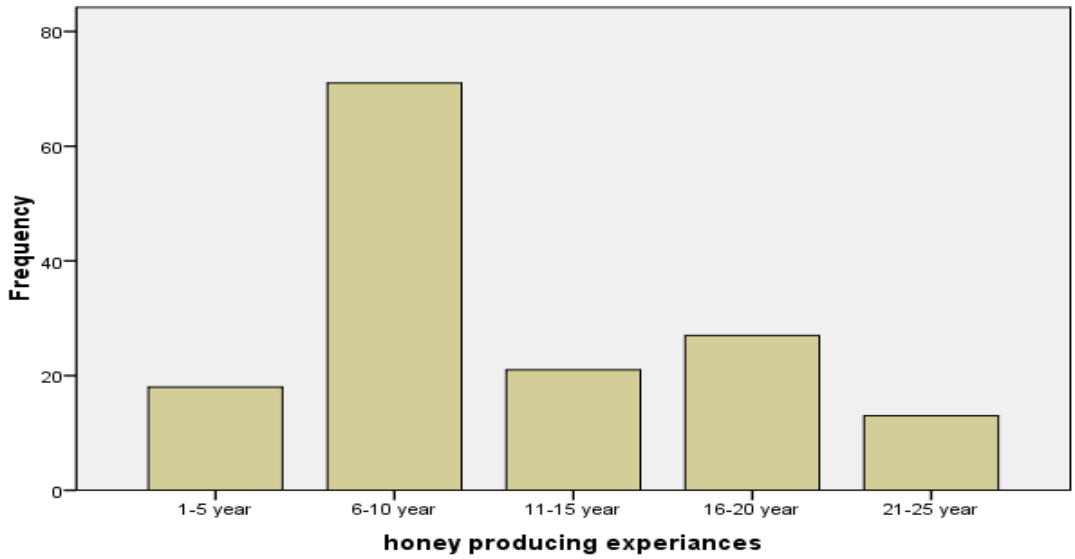

Figure 1: Honey producing experiences at Haramaya district (October, 2019 to Jun, 2020).

4.1.3 Bee keeping management practices

Regarding honey bee management no attention is given to colonies in the study area and 95.3% of the respondents would have very poor bee keeping management through visiting colonies only in the honey flow period as a result some bee hives were not settled with bee colonies or empty under the condition of improper placement of honeybee hive. The result agree d with the study of Kidane (2014), who reported that the management honey honeybees is very minimal in the study area. Honeybee colonies exploit scattered resources by moving from area to area. This means that some hives remain empty for parts of the year especially under adverse weather conditions. Management of the hives and colonies is adapted to the seasonal nature and semi migratory habit of the bees. Only 4.7% of the respondents were managing their bee hive through using their indigenous knowledge they properly placed their beehive, protecting bee colonies from the effect of pests by dusting ash around the area of apiary, painting the stands of hive, increasing bee colonies and chasing honey bee predators by using dogs. This study was in line with the finding of the study by Alemayehu (2011), honey bee management issues includes placement of bee colonies inappropriate site, keeping them disease free, guarding the bee colonies from external predators and maintain or increasing bee populations. Generally internal hive inspection was totally unknown for traditional hives by the respondents. This might be due

to the lack of knowledge on improved way of bee keeping managements and awareness about keeping hives. The respondents also responded that as means of managing their bee colonies in order to stay bees in the bee hives they cut down the wing of queen bee and supplying the colonies with additional foods in order to again sting the absconding of bees living out the hive.

4.1.4 Placement of honey bee colonies

Majority of the respondents were keeping their bees in backyard, and under the roof, which accounts for 36%, and 40.7%, respectively (Table; 5). Such apiary sites are appropriate for daily make up inspection of bee colony and other hive management activities were easier as compared with that of tree or forest apiaries .Conversely the housing of bee hives under the roof or in backyard might result in negative effects on domestic animal and human beings by the swarms. Only few beekeepers put traditional beehives in the forest and/or on trees near homestead. This type of apiary is not comfortable for inspection of honey bee colonies and hive management activities.

Table5: Different types of apiaries at Haramaya district (October, 2019 to June, 2020).

Types of apiary	Frequency	Valid percent	Cumulative percent
Under the roof	61	40.7	40.7
Backyard	54	36.0	76.7
In the forest	16	10.7	87.3
On trees near homesteads	19	12.7	100.0
Total	150	100.0	

Most of the respondents in the study area protected their hives improperly in the back yard and under the roof without consideration of rain, wind direction and cleaning the environment of bee colonies (Plate1). This improper placement of bee hive might be lowering the productivity of bee hive. Some of the respondents have the experiences of placing their traditional hives; in the forest; on branched big trees, under the roof, in the house of honeybees (backyard) and on trees near home stead and the main rain and wind directions were some of mostly recommended criteria in small scale respondents in study area. Similar result also reported by Alemayehu (2011), who showed that beekeepers keep their bees in backyard, under the roof, or hanging on

trees near homestead and in separate house constructed for bee colonies, such apiary sites are appropriate for daily follow up activities of beekeeping.

Figure 2: Hives placement at, Haramaya (October, 2019 to June, 20220).

4.1.5 Source of honeybee colonies to start beekeeping

The study showed that the knowledge of bee keeping differs from respondent to respondent and from area to area based on their experiences. The information sourced from the respondent's explained how they could start honeybee keeping (Table;6). The main source of honey bee colony responded by 62% of respondents were used by traditional way to increase bee colony through hanging new hive on a tree or under the roof after smoking the hive and the wild nest bee swarm were used for establishment of bee keeping. About 24% of the respondents were having the experiences of sourcing bee colonies from their parents. This in agrement with in the finding of Hartmann (2004), the main reason to start beekeeping from the family was experience d during the early stage. For instance beekeeping is an indigenous activity inherited from father to son in southwest Ethiopia. While14% of the respondents was reported that they were learned from others alternative ways such as; neighboring (Table; 6).

Table 6: Source of honey bee colony at Haramaya district (October, 2019 to June, 2020)

Source of honeybee colony	Frequency	Valid percent	Cumulative percent
Traditional way	93	62	62
Parents	36	24	86
Neighboring	21	14	100
Total	150	100	

4.1.6 Detection of Honey ripeness and Honey harvesting technique

The respondents in the study area were used different indicators for detection of maturation time of honey to harvest. The traditional bee keepers of the respondents could identify the time of honey harvesting through undertaking external detection. About 94% of the respondents made external detection to check the readiness of honey harvest when; bee colonies were wiggled in front of the hive by associating with end of flowering season and weighing the hives through hanging by hand, and some of the of the respondents could analyzed honey ripeness by inserting a thin sized stick in to the hive (Table;7). If the honey comes out with the stick might be indicated the time of honey harvesting. These methods of indicators are not efficient in exactly detecting whether the honey is ready or ripe enough to be harvested. Therefore the respondents who practiced keeping of bee in MBH was also detected the maturity of honey by lifting up the top bar and the frame of MBH and honey ripeness could be easily visited through the action of internal inspection. Internal inspection might be difficult for TBH to inspect comb for honey harvest and brood disease as it can be in the transitional and modern hives.

Table7: Honey ripeness detection mechanisms (October, 2019 to June, 2020).

Type of inspection	Sub- categories of inspection	Frequency	Valid percent	Cumulative percent
External inspection	Bee colony wiggling in front of hive	141	94	94
	Weighing by hand through hanging	4	2.7	96.7
Internal inspection	Inserting of tiny stick and lifting up the top bars and the frames	5	3.3	100
Total		150	100	

According to the responses from the respondents of TBH and MBH users the honey harvesting techniques for both types of hives almost similar (i.e. there is no advanced method of honey harvesting for modern hive in the study area). The common information also sourced by the respondents in the study area about the techniques of honey harvesting which is controlled by traditional equipment such as traditional smoke using dry animal dung through firing so that the bees leave the honey combs and using" komogno" leaves to wipe off the bees from the honey comb surface were commonly used for traditional hive honey harvesting and spun might be used for harvesting of honey from modern hive. Through honey harvesting from TBHs they cut down the fixed honeycombs sequentially one by one from the wall of traditional hives and in the process of honey harvesting a limited amount of honey combs would be remained in the hive without being harvested which may helps the bees of that hive as a source of forage. Some of the beekeepers interviewed in the study area harvesting their honey from the hanged hives on the trees brought to the ground and harvest by using fired wood or dried fired animal dung for smoking. The use of this traditional smoker during honey harvest might be killed the bee colony as they missed fire in hive. In such tact of honey harvesting all the honey combs would be harvested without remaining anymore of honey combs in the hive for be forages. After the honey was harvested this hive would be maintained, re smoothed with animal dung and smoked with different tree bark and leaves, as mentioned above like smoking of new hive for attraction of honey bee swarms and sited again under the roof, on big trees or some were apiary. The respondents stated that honey from traditional hives was usually harvested at night in order to avoid the aggressiveness of the honeybee during day light. However, it is not easy to work well in the dark. Light must therefore be provided and this definitely requires an extra hand to assist in the operations and store the extracted honey in the locally existed container. In general during the study, honey producers who used MBH reported to have shortage of honey extractor and lack of access to strainer.

4.1.7 Type of honey producing system at different Agro- ecologies

In the study area the sample respondents of the existed Agro- ecologies was highly practiced traditional honey producing system and few of the respondents from lowland and midland land were engaged in practicing of modern honey production (Table; 8). Traditional beekeeping is the most predominant in the study area and no any HHs could be engaged in the practice of

transitional bee keeping practices during the observation time and as the respondents were suggested (Table; 8). This is due to the lack of knowledge, experience, lack training and low awareness to adopt the transitional and modern hives. This was in line with the finding of the study by Amsalu*et al*., (2004) who reported that beekeeping practice in Ethiopia was pre dominantly traditional. Based on different AEZ sample size proportion; 94.7% and 98.1% of the respondents from lowland and midland was respectively practiced only traditional honey producing system,(Table 8). In very limited number of respondents from both AEZ; Lowland (5.3%) and Midland (1.9%) were practiced mixed system of honey production (Traditional and Modern system) while the highland areas of the respondent were not adopted with the usage of modern system of honey production.

Table 8:Honey producing system at Haramaya (October, 2019 to Jun, 2020).

Hive type	Agro ecology						Total (N=150)	
	Low land(n =75)		Mid land (n=54)		High land (n=21)			
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Traditional hive	71	94.7	53	98.1	21	100	145	96.7
Traditional and modern hive	4	5.3	1	1.9	-	-	5	3.3
Total	75	100	54	100	21	100	150	100

4.1.8 Traditional bee hive (TBH) and its construction

Different AEZs of sample respondents was commonly experienced with only using of traditional hives for their honey production activities in large percent (Table; 8). This indicated that the respondents were not good knowledgeable of using improved bee hive. Through observation commonly the respondents were easily constructed and used TBH from locally available materials such as ; "Soyama"(Vernonia thomasoniana), "koso" (Hagenia abyssinica), Dhokonu" (Grewia ferruginea), Bamboo, grasses and other materials. This in agreement with the report by Fichtl and Admasu (1994), who reported that traditional hive, was made from locally available materials such as; Bamboo, grasses and other. In the study area the respondents were smoothened inner layer of TBHs with moisten cow dung and the outer part of the hive, were covered with the grass to protect from rain and wind.

Plate 3: Traditional hive at Haramaya districts (October, 2019 to Jun, 2020).

4.1.9 Modern Bee Hive (MBH) availability and its characterization

The conducted study showed that 3.3% of respondents (2.7% in lowland and 0.6% in midland Agro-ecologies) were allowed to having few MBH in addition to traditional hive. With some of the respondents who have MBHs were properly placed their MBH where as some respondents were placed their MBH in not appropriate apiary (Plate; 3). In general in the study area the availability of MBH was very limited. This might be the lack of technical support for the respondents, lack of training and lack of credit availability to buy modern hive.

Table 9: Characterization of modern hive at Haramaya District (October, 2019 to Jun, 2020).

Modern hive characterization	Frequency	Valid percent	Cumulative percent
Hive with honey bee colony	8	66.7	66.7
Hive without honey bee colony	4	33.3	100
Total	12	100	

Total number MBH =12

Regarding to MBH characterization in relation to bee colonies 66.7% of the modern hive were characterized by having honey bee colony and the rest MBHs (33.3%) was not colonized by honey bee (Table; 9). This because lack of awareness of the respondents how to use MBH in the apiary resulting in exposure of colonies to bee enemies. This factor might be limitin

g the respondents to use more number of TBH. Similarly Kebede and Lemma (2007) found out that 67% of the non-users of modern hives mentioned that lack of know-how on how to operate modern hive and about its benefits are main reasons for the dependence on the use of traditional hives.

Plate 4: Modern bee hive at Haramaya district (October, 2019 to June, 2020).

4.1.10 Honey yield from different types of beehive at different Agro-ecologies

The quantified honey yields were more of estimations by the respondents. This could be due to the fact that it was difficult to accurately determine (lack of measuring instruments) the honey produced in the study area as most of respondents were not correctly weigh the amount of honey harvested. The honey yield per hive differs from agro-ecology to agro-ecologies and from hive type to hive type (Table;10).

Table 10: Honey yield (kg/hive/year) from different type (October, 2019 to June, 2020).

Honey yield from different types of hive	Agro ecologies						Total (N=150)	
Yield traditional hive year	Low land(n=75)		Mid land (n=54)		High land (n=21)			
	Frequency	percent	frequency	percent	frequency	percent	frequency	percent
Less than 1kg	13	17.3	8	14.8	4	19	25	17
1-2kg	16	21.3	24	44.4	13	62	53	35
2.1-4kg	29	38.7	19	35.2	-	-	48	32
4.1-6kg	6	8	3	5.6	1	4.8	10	6.7
Greater than 6kg	11	14.7	-	-	3	14.2	14	9.3
Total	75	100	54	100	21	100	150	100
Honey yield /modern hive /annual								20
Less than 5kg	1	25	-	-	-	-	1	
5.1-10kg	2	50	1	100	-	-	3	60
Greater than 10kg	1	25	-	-	-	-	1	20
Total	4	100	1	100	-	-	5	100

Using traditional hive the highest frequency of the respondents (38.7%) from lowland Agro-ecology yielded 2.1-4kg per hive annually. For similar yield at midland Agro-ecologies the abundance of respondents would be limited to 35.2% and no such yield was registered at highland areas (Table; 10). In relation to honey yield comparatively more than 6kg per hive annually yielded from TBH at lowland areas and no as such amount of honey yield was recorded at midland and lowland areas. The observed honey yield variation based on the bee colony management, bee forage availability and experiences of the respondents on honey production at different AEZs. Similar within agreement the study reported by Worknehe*t al.*,(2006), the yield obtained from traditional hive increase as compared to the survey result in west, south west and north Showa zone which was about 6.2kg. Another similar study developed by (Gezahegn, 2001), under Ethiopian farmers' management condition, the average amount of crude honey produced from traditional hive is estimated to be 5kg/ hive /year (Gezahegn, 2001).Regarding to MBH yield comparison for Agro ecologies more than 10kg per hive annually obtained according

to the respondents opinion from lowland area but this yield was not common at midland and highland areas (Table; 10). This why the problems in addition to honeybee management and understanding of the f the respondents from mid land and highland areas were limited in having of naturally and artificially cultivated bee plant forages. The lowland Agro-ecology relatively skilled with honey beekeeping extension activities because of constructed rural road and near to the woreda and accessed with good diversity of naturally cultivated; trees and shrubs and artificially cultivated bee forage plants.

4.1.11 Honey harvesting season

The survey allowed in order to assessing in formations on the honey harvesting season and number of honey harvesting time per a year in the study area was depended on; the flowering end season in the study area. The major honey flow season was from November to December and the very minor honey flow season, from December to January and April to May respectively. Accordingly the obtained result during survey time 97.2% of the respondents harvesting their honey once per a year from November to December and with very few of the respondents (3%) collected twice per a year from November to December and December to January respectively (Table; 10). Most of the respondents memorized that the early honey harvesting season was involved April to May. But in rare case know a day this honey harvesting season would be applied by very few respondents (0.7%) in the study area (Table; 10). This because in these seasons no diversity of bee flowering plants to provided bee forages and the existed bee flowering plants was destroyed by the local farmers for the function of farming activities, chair coal production and for timber production. The honey harvesting season was also agreed with the finding of Tessaga (2009), and Chala (2010) they reported that honey was harvested once or twice in bedeno and Garamulata district, respectively. Similar results also reported by Mathewos et al.(2004) and CSA, (2008) who indicate that the majority honey flow season was November to December in different part of Ethiopia.

Table11: Honey harvesting time per a year and harvesting season at Haramaya district (October ,2019 to June, 2020)

Number of honey harvesting time per year	Once per year	Twice per year	Three times per year	Total
Honey harvesting season	November - December	November - December December-January	November -December December-january-and April-May	
Frequency	146	3	1	150
Valid percent	97.3	2	0.7	100

4.1.12 Producing and beekeeping honey Common challenges

The respondents have encountered with a number of difficulties and challenges. Accordingly, the major challenges of the beekeepers were presented in (Table; 12).Form responses of the respondents the strongly faced constraints in the study area were affected the honeybee health and bee forage. To this fact, the major constraints represented in the study area includes pest and predator responded by most of the respondents, access to credit and beekeeping extension and agro-chemical application was responded as the main constraints of honey production (Table; 12). Similarly in agreement to this (Adeday G.*et al.*,2012), reported major honey bee constraints are frequent occurrence of drought, lack of bee forage, existence of pests and predators and pesticide poisoning in decreasing order of importance and the major pests and predators are honey badger, ant, wax moth, birds, spiders, and lizards.

Table12: Constraints of honey producing at Haramaya district (October, 2019 to June, 2020).

Constraints	Responses		Percent of cases	Rank
Agro chemical challenges	Frequency	Percent		
	112	17.0	74.7	3
Pests and predator	145	22.1	96.7	1
Deforestation challenge	66	10.1	44	5
Infrastructure	19	2.9	12.7	8
Market access as challenges	35	5.3	23.3	7
Lack of bee keeping materials	47	7.2	31.3	6
Access to credit and beekeeping extension	138	21.0	92.0	2
Gender factor	11	1.7	7.3	9
Long dry season irrigation factors	83	12.7	55.3	4
Total	656	100	437.3	

4.1.13 Pests and predators

The result showed that from the total sample respondents 96.7% of the interviewed respondents responded to the presence of honey bee pests and predators and ranked them as the first honey production challenges. But they do not know the type of bee enemies simply they reported a mass death of honey bee in the hive. Even comparing and identifying the rank among the major pests challenging the honey producing activities ants(*Dorylus fulvus*), spide (***P ardosa atlantica)***, little beeeater bird(*Merops pusillus*) and honey badger (*Mellivora capensis*) were the most pests in the study area in order to decreasing importance (Table; 13).

Table13. Common bee pests and predators at Haramaya district (October, 2019 to June, 2020).

Pests and predators	Reponses		Percent of cases	Rank
	Frequency	Percent		
Mellivoracapensis	5	21.3	39.3	3
Dorylusfulvus	128	46.2	85.3	1
Pardosaatlantica	67	24.2	44.7	2
Meropspusillus	23	8.3	15.3	4
Total	277	100	184.6	

Based on the result of this survey majority of respondents reported that honeybee enemies as major reason for honeybee colony absconding (Table; 12). From this about 85.3% of the respond ents were challenged by *Dorylus fulvus*. This result with regard to the effects of *Dorylus fulvus* o n honey bees agreed with different studies conducted so far (Desalegn and Amsalu, 2001) (Desalegn and Yoseph, 2005).

To overcome the problems the beekeepers have developed their own indigenous knowledge. Some of the methods were dusting ash under the hive stand, plastering the hive stand with plastic materials, painting the stands of hive with burned oil and wiped off the ants from the area of apiary. The next most serious pest which was ranked as second is ***Pardosa atlanticathat was suggested*** by 44.7% of the respondents; which forms network on the hive entrance to catch bees. The respondents protected the spiders by cleaning their hive. The third problem ranked was *Mellivoracapensis* which is recognized by 39.3% of the respondents and protecting it from their apiary catching chasing by dog. Some beekeepers also responded as if they observed brood disease, which results in bad smell of the hive and formation of worms. But the reason is that wax moth is causing that effect on bee's comb through its larvae which the beekeepers get

confused with worms formed due to disease. According to the respondents' response, fumigation of hive with "Ejersa" *(Oleaafricana)* is important for protecting particularly wax mothwhen the bee colony gets weak. The respondents (15.3%) also protect *Meropspusillus* from their hive by putting objects to the bird eaters in the apiary removing branches of trees near apiary , expelling bird from the surroundings. Generally this study result showed that the respondents in the study area used different traditional methods of protecting honey bee enemies. Similar result also reported by Tesfaye (2007) in Adami Tullu Jido Kombolcha district who documented that beekeepers had no special protection method to control disease. However, beekeepers protect their bee colony by simple protection measure by their experiences.

4.1.14 Agro-chemical application

About 74.7% of respondents was suggested that agro-chemical applications for crop protection and public health conceder as the problem to harm beekeeping activity (Table;12). As report of the respondents, the use of agro chemicals to control crop pests, mosquitoes, herbicid e and roundup chemicals and house-holds pest; damaging bees in the study area was ranked as the third constraint of honey production. Agro-chemical application also damaged naturally existed field flowering plants serving as bee forage. This study also showed that the demand of agro-chemical in the study area was increased from time to time which resulting in high negative effect on honey production. However workers never try to encourage farmers to practice hand weeding and apply the chemicals at time when honey bees were not foraging. This is in agreement with the study of Gezahegn (2001), who reported that the promotion of some agricultural inputs such as pesticides as well as the use of deadly chemical for malaria program have substantially reduced honey production.

4.1.15 Lack of beekeeping materials and modern beehive

About 96.7% of respondents practiced traditional system of honey production, with all limitatio ns. About 3.3% of the respondents practiced both traditional and modern beekeeping system (Table; 8). The lack of bee keeping material including modern bee hive was suggested by 31.3% of respondents in the study area(table; 12). This might be attributed to affects the honey yield. Most of the basic tool, that would be needed to work with bees like bee veil, hand gloves, smoker, and overall (beekeepers suit) were reported relatively expensive.

4.1.16 Access to Credit and Beekeeping Extension

The opinion from 92% of respondents were so far in facilitating the beekeepers access to appropr iate technologies by provision of credit services was minimal and access to different services could be essential to improve production and productivity of honey (Table; 12). Credit access is important for beekeepers to buy modern box hive, initial capital for start modern beekeeping management and honey production and hence increase honey production at individual and community level. But in the district, at all there was no credit access for honey producers to purchase modern hive which, was assumed as the constraint for honey producing activities. Majority of the sampled households pointed out that they needed credit for honey production activities, technical support of extension workers and training to invest more honey yield. Therefore, establishing a sustainable provision of a credit system and credit as seed money to the resource poor beekeepers should be given due attention in devising apiculture development programs in the study area.

4.1.17 Lack of market access

As the study showed that, 23.3% of the respondents was readily challenged by the lack of market access (Table;12). This resulting in even the respondents not sold their honey on time of good market because they were lived in remote area and they responded the problem of transports. Therefore the respondents must travel on foot for several hours carrying the honey either on shoulder or on the back of animals to reach to the market place to sell honey. Moreover, lack of technologies for honey harvesting pricing based on honey quality didn't encourage respondents to produce high quality products. Thus the price of honey changes widely based on the production seasons, which is high during the slack season and low during the peak season. This is in agreement with the study by Workneh (2007) who reported that the availability of market for the hive products enhances the adoption of beekeeping technologies. According to Gezahegn (2001), discussed the constraints to marketing of honey and beeswax in the country and these include low and discouraging price of honey and beeswax in local markets, lower quality of products, lack of market information, absence of organized market channel, transportation problem, lack of appropriate technologies for collecting, processing, packing and storage of honey to keep its natural quality, lack of government support in market development, and low

involvement of private sector. About 76.7%of respondents sold their honey at market found in nearby town, (i.e. 62%at" Tej" houses for beverage function and 14.7% of them was marketed for food).

4.1.18 Natural forest deforestation

The effect of deforestation as constraint was responded by (44%) of the respondents in the study area (Table; 12). Large population size in the study area was pressured with high demands for; farmland development, charcoal production, timber production and other goods made through creating deforestation, and ecological degradation to the area. Coupled with above mentioned factors, firing of forest has resulted in a reduction of plants that used for new traditional hive construction, smoking of new traditional hives and coverage of traditional hives in order to protecting the bees from the effect of winds and rain. As a result the respondents suggested that the constructed traditional hives could be used for 1 up to 5 years without maintenances so that hive gets old age and this might be a factor for leaving out the bee colony from such hives. This elimination of good nectar and pollen producing plants and field flowering plants in the study area might be limited the honey flow seasons to seasonally cultivated flowering crop plants and some artificially cultivated indigenous flowering bee plats such as mango (Cordiaafricana), Eucalyptus globules and others because bee plants are a pre- requisite to successful beekeeping as bees depend wholly on plants for their food.

4.1.19 Gender factor

Based on the result of survey few respondents (7.3%) cited the gender impacts on honey production (Table; 12).Traditional beekeeping has basically been an activity for men in the study area. This has been due to the methods used. It should also be underlined that the traditional beekeeping system largely excludes women from participation. Generally it is difficult for a woman to climb a tree it therefore implies only the man can do both sitting and harvesting. Such gender prohibitive methods would be inevitably keeping productivity low. In agreement to this similar study was reported by (Hartman, 2004) the honey production is very traditional which is practiced mainly by hanging traditional hives on tall trees in the dense forest far from human settlement areas and the men jobs in Ethiopia And Solomon (2009), who reported beekeeping is as main activity of male in Bale highlands of South East Ethiopia.

4.1.20 Poor Infrastructure development

The availability of infrastructure limitation was suggested as challenges by12.7% of the respondents in the study area (table; 12). Especially the highland areas had no constructed rural roads that connect the study areas to the main town of the district and the neighboring town. Since the local market far away from the respondents and the transportation means was not accessed. The respondents were travelled on foot for 4-5hr to arrive the marketing place. This poor rural road construction in the area might be makes the respondents hopeless to engage in honey production bee keeping extension and impacted the market of honey. Even poor rural road construction had negative effect on the assessment of information about the mark et of hony to sol with expected price and creates difficulty during data collection. In agreement w ith in Keralem (2009), who reported that bee keeping sub-sector in Ethiopia affected bypoor infrastructure development in Ethiopia (Keralem, 2009).

4.1.21long dry season and irrigation factors

Table 12: showed that 55.3%of the respondents and some of the district DAs were predicted that the impact of limited rain season and none availability of irrigation on honey production. Accordingly the respondents, woreda could be specified with only summer season rain and had no naturally or artificially developed water bodies for irrigation purposes. This because more than one rainy season per year and irrigation activity might be; increased the availability of pollen and nectars as bee forage through cultivating crop plants.

4.1.22 Opportunities of honey production

There are many opportunities for development of beekeeping production and productivity in the study area. The opportunities of honey production was investigated when the key informants in the study area would be inter viewed. These major honey production opportunities suggested by the respondents of the study area categorized as diversity and seasonal availability of bee forage, perception of respondents to accept new technologies for honey production and existence of number of bee colonies were surveyed. For instance similar study was conducted at Wonchi districts; the opportunities relied on for development of bee keeping and productivity of bee hive summarized as seasonal availability of bee forages, availability of eager respondents to accept

new technology, presence of huge number of bee colonies Tourist availability and presence of Wonchi bee keepers association(Taye, B*et al.*,2014).

4.1.23 some diversified seasonal bee forages

The major honey flow season in the study areas was begins from November to December and it could be varied based honey bee flora. More over these trees and shrubs and crop plants provided forages for apiary in the study area. Most of these plants found in uncultivated land, sometimes growing in the farmed land in the form of weeds and some found in their surrounding localities that planted artificially for aesthesis value.

Table14: Major bee flowering plants used at Haramaya district (October, 2019 to June, 2020).

Local name in Afanoromo	Scientific name	Responses		
		Frequency	Percents	Percents of cases
Tufoo	Guizotiascarba	148	13.1	98.7
Bargamo	Eucalyptus globules	67	5.9	44.7
Makkaniisa	Cortonmacrostachys	150	13.2	100
Hagamsa	Carissa edulis	140	12.4	93.3
Eebbicha	Vernoniaanygdanila	106	9.4	70.7
Keelloo	Bidensprestinaria	127	11.2	84.7
Nuugii	Guizotiaabyssinica	34	3	22.7
Boqqollo	Zea maize	100	8.8	66.7
Atara	Viciafaba	43	3.8	28.7
Baqela	Pisum sativa	50	4.4	33.3
Maangoo	Mangiferaindica	37	3.3	24.7
Total		1133	100	755.3

NB. Percentage exceeds 100% because of multiple responses

The major bee forage plants observed through survey and Interviewing the respondents in the study area was presented in (Table 14 and plate5), which are naturally cultivated flowering plant, and locally cultivated crop plants like Zea mays, Viciafaba, Guizotia abyssinica, Mangifera indica. Similar studies reported that *Bidensprisnaria, Guzotia scrabra, Trifoliumspp,* Oil crops, Pulses were documented to be a major source of honey in central highland (Admasu, 1996; Nuru,2002).Moreover, *Guzotiascrabra, Trifoliumrupliannum, Bidensprestinaria* and *Cayluseaabyssinica*, *Eucalyptus globules Vernoniaanygdanila, Cortonmacrostachys*, and

Carissa edulis were the most common weeds in Ethiopian and they were mentioned as important source of nectar of honey.

Plate 5: Some flowering plant at Haramaya district (October, 2019 to June, 2020).

4.1.24 Availability of supplementary bee forage

The bees are purposely produce and stores honey for their own food during dearth period, but their stored honey was consumed by beekeepers, which resulting in honey bees starvation due to lack of feed. In the study area sometimes the respondents were in forced to use some supplementary forage to improve their honey yields using their indigenous experiences they have (Table; 15).

Table15: Some supplementary bee forages at e district (October, 2018 to June, 2019).

Supplementary bee forage	Frequency	Valid percent	Cumulative percent
"shiro" of peas and bean	52	34.7	34.7
Barely powder	17	11.3	46
Honey comb	81	54	100
total	150	100	

About 54% of the respondents were used 1-2, honey comb remained in the hive during honey harvesting period as supplementary bee forage, 11.3% of the respondents had; barely powder as supplementary food for their bees and 34.7% of the respondents supplied their bees with

"shiro" during dearth time to overcome the problem of honeybee starvation (Table; 15). This sup plement-ing of bees with additional forage indicated that how much the respondents have the interest of improving honey yields. The most applicable supplementary bee forages by the respondents in the study area was indicated that the honey comb remained in the hive. Similar study was conducted by Workneh (2007) who reported that the supplementary feed for honey bees include; barley flour, peas and bean flour.

The respondents were not allowed cultivating flowering plants around their apiary sites to get the intended honey yield. Moreover, there was no extension activity which encourages beekeepers to cultivate and conserve indigenous bee forage. The respondents were not cultivated indigenous plant for bee forages but they planted different flowering plants for other purposes like; house building, wood, fence construction, aesthetic value, food value and other income generations but indirectly these plants were served as honeybee pollen and nectar sources. Similar to the study in line with the result of study by Tessega (2009) who reported those beekeepers of Bure district have no indigenous knowledge to planting bee forage, but they plant for their own purpose to income generation, which serving as honeybee pollen and nectar sources for honeybees.

4.1.25 Perception of respondents to accept new technology

The small scale respondents in the study area were so interested to accessing improved technolog ies for their better extension of honey production. Almost all respondents in the study area posses sed TBHs with limited number of respondent's having MBHs. The respondents were sensitive to have; updated training on honey production system, management system and they also have the interest of sharing experiences from their friends and neighboring beekeepers in order boosting the productivity of their bee hive.

4.1.26 Existence of bee colonies

The result showed that existence of bee colonies in the study area considered as the opportunities of honey production. Accordingly large number of TBHs with magnitude of 821(98.6%) and very limited number of MBHs 12 (1.4%) was owned by the respondents in the study area (Table; 16). The minimum honey bee colonies holding per sample HHs in the study area was ten and maximum honey bee colonies holding per sample HHs was hundred twenty eight. These huge numbers of bee colonies in the area would give great opportunities to the respondents as

additional income generation that used to; buy fertilizers for their farming activities, clothing their children and other parent serve. These significances of honey production might be given moral for the respondents to expand and apply scientific methods of honey production in the future.

Table16: Availability of bee colonies at Haramaya districts (October, 2019 to June, 2020).

Type of bee hive	Frequency of hives	Valid percent	Cumulative percent
Traditional bee hive	821	98.6	98.6
Modern bee hive	12	1.4	100
Total	833	100	

4.1.27 Indigenous knowledge

In the study area the respondents have good indigenous knowledge of traditional beekeeping. According to the responses of the sample respondents, the indigenous knowledge used by the interviewed beekeepers were allowed TBHs to have better smell through smoking new hives with dried tree log such as Ejersa *(Oleaafircana),* Sombo *(Ekebergiacapensis),* Kusayee *(Lippiadoensis)*; for attraction of honeybee. The method of smoking the new hive was performed by digging the hole and placing the smoke with fire in the hole and putting the new hive upside down on the opening of the hole. The new hive may be smoked until the inner surface of the hive developed with the colour of brown then; the hives were hanged on trees, placed under the roof or at backyard where the bee swarm can have their forages near. Honey harvesting time by smelling, observation at the beehive entrances for what resources the honeybees are collecting, providing supplementary forages for their bees and insert stick to beehive to check for honey presence, control of honeybee enemies by different means like; cleaning around apiary, dusting around their apiary with ash and painting the stands of hive with burned oil to; improve the quantity of honey yield through protecting bee colonies from the effect of pests and other bee enemies also considered as indigenous knowledge of the respondents. The result of this agrees with previous findings (Gebretsadik*et al.,* 2016) reported as beekeepers have good indigenous knowledge of beekeeping. the indigenous knowledge used by the interviewed beekeepers were smoking baited hive by swarm attractant materials.

CHAPTER FIVE

5. CONCLUSIONAND RECOMMENDATIONS

5.1 Conclusion

Haramaya district of Oromia region plays a significant role as source of additional cash incomes and nutrition for many farmers. However, in spite of its significant economic contribution and its great potential for sustainable development for the district, the attention given to the sector until recently was not satisfactory. Based on the survey result, 98% of respondents of the district engaged in beekeeping were male. There were very limited numbers of females engaged in beekeeping practice in the study area. Based on the result, people in the most productive age are actively engaged in beekeeping activities with having a moderate experience of beekeeping. Th e respondents were acquired beekeeping knowledge through sharing of experience from the experienced beekeepers; this indicated that no work has been done in promoting beekeeping practice in the study area**.**

In the district, two types of beekeeping systems namely: Traditional beekeeping and Modern bee keeping systems have been observed. More than 96.7% of the respondents were engaged in traditional beekeeping; whereas 3.3% practiced the combination of all traditional and modern beekeeping systems. According to this survey, transitional and modern hives resulted in higher honey production per colony at lowland and midland area because of availability of bee forage and bee keeping management experiences differences between agro ecologies. On the other hand, from this survey it can be concluded that the traditional honey production system was economically affordable and appropriate system for the rural areas that makes relatively good use of locally available resources. The study also showed that, all of the respondents reported that, they lack adequate financial resources to invest on improved honey production technologies, storage, processing facilities and packaging.

The district had adequate natural resources and a long tradition of beekeeping. However, mainly because of lack of technological, institutional supports and access to market and value chain development, the district in general and the rural beekeepers in particular have not been

sufficiently benefited from the sub sector. Yet, despite all the constraints and challenges currentl y facing the beekeeping sub-sector, there are still enormous opportunities and potentials to boost the production and quality of honey production in the district. The major constraints to exploit the untapped potential of beekeeping activity in the district were diseases, pests and predators, agrochemical application, shortage of bee forage, reduction of honey colonies, lack of beekeeping materials and beehive, Lack of access to credit, lack of extension support and beekeeping training, marketing problems, high price of beekeeping equipment and lack of knowledge regarding colony management.

5.2 Recommendations

The following possible recommendations were drawn from this study:

- In the study area the respondents have indigenous knowledge regarding to traditional hive construction, smoking hive and managing bee colonies. Identification and documentation of such knowledge can open new doors for researchers to verify and integ rate the indigenous knowledge with main stream science and introduce new practice in th e area at all agro ecologies where by farmers knowledge is not productive and guarantees sustainability.
- The effect of agro chemicals on bee colonies and bee flowering plants in the area should b e managed through; encourage farmers to practice hand weeding instead of using herbicid chemicals and apply the chemicals at time when honey bees were not foraging and awa ering them to manage the effect pestcid through scientifically approved prevention metho ds.
- Exploiting the existing opportunities and potentials of the district more efforts should be put to create awareness of people on beekeeping.

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APPENDICES

Appendix- I

A. Questionnaires used in the study area for the sample respondents.

The main objective of this questionnaire was to obtain the information from the beekeepers that were taken as sample respondents on honey production system in Haramaya distinct.

Name of enumerator_____

Name of household head_____

1. House hold characteristics; Sex_____ Age _____

1.1 Marital status: A. Single B. Widow C. Married D. Divorced

1.2. Have you attended formal education? Yes_____ No_____

1.2.1. If yes, what is the highest grade attended? _____grade

1.2.2. If no; A. Cannot read and write B. read and write

1.3. Religion of household; A. Orthodox B. Muslim C. Protestant D. Catholic E. Wokefata F. Other specify

2. Land utilization

2.1 Do you have land? Yes _____ No_____

2.1.1 If yes how many hectare do you have? _____, hectare.

2.1.2. How do you use your land?

No	Land usage	Hector	Remark
1	Farm land		
2	Forest land		
3	Grazing land		

3. Honey bee colony holding

3.1 Do you have honey bee colony?

3.1.1 If yes how many honey bee colonies do you have? _____ bee colony.

3.1.2 If yes how many years of experiences did you have for honey producing? _____ , Years/year.

3.2 How did you start bee keeping? A. From neighbors'. Parents C. By purchasing Honey bee colony D. Interest E .Through inheritance F .Any other (specify) _____

3.3 Which type of honey bee keeping system do you use? A. Traditional system

B.Transitional system C. Modern system D. All

3.4 Which type of bee hive is better to have more honey yield? A. Traditional system

B. Transitional system C. Modern system D. All

3.5 Do you buy improved box hive whenever you want to buy? Yes ____ No_____

3.5.1 If no, why did you not use improved box hive? A. It is expensive B. No bee forage

C. It is not available D. Lack of land E. It needs skill

F. Any other (specify) _____

4 Bee keeping management

4.1 Do you manage your bee colonies? Yes_____ No_____

4.1.1 If yes how do you identify exact honey harvesting time? A. By internal inspection of the hive B. External inspection

4.1.2 If yes where do place your bee hive? A. in the forest B. under the roof C. at backyard

4.2 Is there any absconding from your box hive? Yes ___ No_____

4.2.1 If yes, what are the reasons for absconding? A. Honey bee pests B. Honeybee predators

C. Any other (specify) _____

4.2.2 If yes, what is the mechanism do you use to stay the honeybee colonies in the new hive?

A. Using queen cage B. Cutting the wing of the queen C. Fixing the queen excluder on the entrance of the hive D. Any other (specify) _____

4.2.3 If yes, how many colonies did you lose this year?____colonies.

4.3 How many honeybee colonies (hives with bees or without bee colonies) do you own? (Fill in table)

Status	Modern hive	Transitional hive	Traditional hive	Total
With honey bee colony				
Without honey bee colony				
Total				

5. Honey bee forage

5.1 Do you have honey bee flowering plants? Yes _____ No_____

5.1.1 If yes how do you have honey bee flower plants? A .by planting honeybee flower plants B. Forest C. Naturally existed filed flower E. Crop plans D. Any other

5.2 Do you use supplementary forage for bees during dearth time? Yes_____ No _____

5.2.1 If yes, what do you feed your honey bees? A. Sugar B. Barely flour (beso) C. *Shiro* of beans and peas D. Honey E. Any other _____

6 Honey harvesting

6.1 Do you harvest honey? Yes _____ No_____

6.1.1 If yes how many times do you harvest honey per year? _____, times.

6.1.2 If yes in which season do you harvest honey? A. November to December B. December to January C. April to MayD.Any other.

6.1.3 If yes which honey harvesting season is the major honey harvesting season?

A. November to December B. December to January C. April to May

6.2 What type of honey do you harvest from the type of bee hive do you have? Use "x" for your honey type by associating with hive type.

Types of honey	Modern hive	Transitional hive	Traditional hive
Pure honey			
Crude honey			
Total			

6.3. Which type of hive is yields more honey? A. Traditional B. Transitional C. Modern hive

6.4. In which type of agro ecology do you live? A. Lowland B. Midland C. Highland

6.5 How many grams of pure honey or crud honey do you harvest per hive annually? Fill in the table below under the type of hive do you have.

Types of honey	Modern hive	Transitional hive	Traditional hive
Pure honey			
Crude honey			
Total			

7 Honey producing challenges

7.1 Is there any challenge that affects bee keeping activities? Yes ____No_____

7.1.1 If yes what are the major factors that affects honey production? Ran k.

No	Constraints	Rank
1	Agrochemical challenge	
2	Disease, pests and predator	
3	Natural forest deforestation	
4	Infrastructure	
5	Market access as challenges	
6	Lack of bee keeping materials	
7	Access to credit and beekeeping extension	
8	Gender factor	
9	Long dry season irrigation factors	

8. Knowledge

8.1 How do you protecting pests from your bee colonies? A. Ash B. Burned oil

C. Any other _____

8.2 Do you smoke the new traditional hives before hanging?

8.3 If yes what kind of materials are used for smoking? Mention them.

9. Opportunities of bee keeping

9.1 Is there any opportunities in the woreda for honey production? yes__ No____

9.1.1 If yes what are the existed opportunities allowed the production of honey in the district?

11. Beekeeping extensions

11.2. Did you ever get beekeeping training? Yes_____ No_____

11.2.1 If yes, on what area did you get training?

A. Colony multiplication B. Bee management C. Hive products D. Marketing

B. Questionnaires used for focus group discussion.

The main objective of this questionnaire was to obtain the relevant information on honey production system and beekeeping by; focus group discussion with potentially honey producers of beekeepers, extension workers (development agents) from Keble administration in t he districts

Name of group_____

Male_____

Female_____

1. Which type of beekeeping systems adopted in the area? A. Traditional beekeeping system B. Transitional beekeeping system C. Modern beekeeping D. all
2. What are the major constrain of honey producing in the distinct? List them.
3. How the beekeepers managing their bee colonies? List them.
4. What are the potentials of honey producing in the districts?
5. What are the major honey plants in the district?

Plate 1. Properly placed traditional and modern bee hive (October, 2019 to June 2020).

Plate 2.Smoking of Traditional Bee hive at Haramaya District (November, 2019).

B. Photo profile during focus group discussions.

Plate3. Focus group discussion (November, 2019)