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ASSESSING FACTERS ASSOCIATED WITH HONEY PRODUCTION IN WOMBERA WEREDA, METAKEL ZONE, BENISHANGUL- GUMUZ REGION, ETHIOPIA

BY

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List of abbreviations/Acronyms

AGPAMD- Agricultural Agribusiness and Agency Development

AGRDO- Agricultural Rural Development Office

AMD- Agribusiness and Market Development

ANOVA - Analysis of variance

CSA - Central Statistical Agency

DDVP - Dimethyl –dichlor-vinyl-phosphate

FGD - Focused group discussion

GDP - Gross domestic products

MOARD - Ministry of Agriculture and rural development

NHB - National honey board

SNV- Netherlands Development Agency

SPSS- Statically package for social sciences. .

TEPP- tetra-ethyl-pyrophosphate

AGP-AMD - Agricultural growth program agribusiness and market development

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ASSESSING FACOTERS ASSOCIATED WITH HONEY PRODUCTION IN WOMBERA WEREDA, METAKEL ZONE, BENISHANGUL- GUMUZ REGION, STATE

Abstract

In Ethiopia, honey production is a traditional occupation widely practiced by farmers as a complementary income generating activity. However, an inefficient agricultural marketing system together with traditional production systems hinders beekeepers to benefit optimally from honey supply. So, this study was conducted out in selected districts of Metakel Zones, Benshangul regional state, Wombera district. The objective of the study was to assess factor associated to honey production in Wombera districts. For this study four Keble were selected purposely focusing on climate variability and their focus on honey production in which 98 respondents were purposively selected by discussing with experts in case of the farmer household who derive their livelihood on honey production. Primary and secondary data were collected from the respondent by using structured questionnaires, survey, interviews and observation. Data was processed and analyzed using computer software packages such as Ms Excel 2007, SPSS. All of the beekeeper in the study area have owned only traditional hives and produce honey for home consumption. The beekeeping practice was dominated by male. despite the long history of honey production in the area honey bee colony and income from honey production was decreasing from time to time due to lack of the beekeeping knowledge, shortage of trained man power, shortage of beekeeping equipments, pests, predators, fires, use of pesticide, lack of properly managed apiary area and feeding, inadequate research work to support developmental programs. Despite all the constraints, there is a great potential to increase the production and quality of honey in the districts .Strong extension and technical intervention, proper pesticide application, establishing beekeepers cooperative and enhancing bee forage plantation through introducing multipurpose trees should been encouraged to increase honey production.

Keywords:-Beekeeping, Modern hive, Wombera, honey production, traditional hive.

Introduction

1.1 Back ground

In Ethiopia, apiculture is a traditional occupation widely practiced by farmers as a resource combined with suitable climatic condition making the country favorable for the beekeeping sector (Nuru *et al*., 2001). Ethiopia has the highest bee colony density in Africa. It is estimated that around one million farmer household keep bees. Currently, traditional beekeeping accounts for more than 95% of honey production and almost all the bees' wax production in the country (CSA, 2010). The remaining 5% includes transitional and modern beekeeping.

The knowledge and skill of honey production and wax extraction of Ethiopian farmers is still very traditional. Of all the countries in the world, no country has such a long tradition of beekeeping than Ethiopia. Despite its long history, beekeeping in Ethiopian is still an undeveloped sector of agriculture. The knowledge and skill of honey and beeswax production of Ethiopian farmers is still very traditional and 95% of beekeepers follow traditional method of beekeeping practice with no improved techniques or technology (Oxfam, 2008).

Ethiopia is a leading honey producer in Africa and one of the ten largest honey producing countries in the world. Ethiopia has a share of around 23.58% and 2.13% of the total Africa and world honey production, respectively (Ayalew, 1990). Due to its wide climatic and edaphic variability, Ethiopia is a home to some of the most diverse flora and fauna in Africa that provide surplus nectar and pollen source to foraging bee colonies (Girma, 1998). This assisted to exist of more than 12 million honey bee colonies in the country (Gezahegn, 2001). Despite the favorable agro ecology for honey production and the number of bee colonies the country is endowed with, the level of honey production and productivity in the country remain low. One of the prominent factors for this low honey production and productivity is traditional hives. Ethiopia has the potential to produce 500,000 tons of honey per year and 50,000 tons of beeswax per annual, but currently production is limited to 43,000 tons of honey and 3,000 tones of beeswax (MOARD, 2008).

Honey is a sweet, viscous food substance produced by bees and some related insect (Crane, 1990). Bees produce honey from the sugary secretion of plants floral nectar through regurgitation, enzymatic activity, and water evaporation, and store it in wax structure called

honeycombs (Crane, 1990). The variety of honey produced by honey bees (the Genus Apis) is the best known due to its worldwide commercial production and human consummation (Crane, 1990). Honey is collected from wild bee colonies', or from hives of domesticated bees.

Honey gets sweetness from the monosaccharide fructose and glucose and has about the same relative sweetness as granulated sugar (National honey board, 2012). It has attractive chemical properties for baking and distinctive flavor when used. Most microorganisms do not grow in honey, so sealed honey does not spoil, even after thousands of years (Geiling, 2013).

Beekeeping is still operating in the old traditional ways implying the need for modernization. Low productivity and poor quality of bees' products are the major economic impediments for rural beekeepers (Nuru, 1999). However, they face another primary economic concern which is mainly due to lack of skill to manage their bees and beekeeping inputs, processing, packaging, and transport their products to market and maximize profit. They produce a low-quality product that they are forced to sell locally to wholesale buyers at price much lower than commercial markets (Amsalu, 2004). The major constraints that hinder beekeeping development in Ethiopia can be stringent rules and conditions set by honey importing countries, very limited domestic market, limited knowledge of honey production, limited access to market information and unreliable transport, poor storage of products, lack of quality monitoring and control plan in place, inadequate laboratory facilitates and poor institutional set-up for assuring quality (Crane, 1990). In line with this, In Benshangul Gumuze region there are enormous constraints that reduce honey production.

1.2 Statement of the problem

Honey production and beekeeping are environmentally friendly practices and relatively easy to engage in. This non- farming business activity had the potential to provide a wide range of economic contributions. In Benshangul Gumuze region most of the ethnic group based on natural resource, from this one is gaining of honey from wild bee nest. In this district for the last many years, honeybee known to live in hollow of trees, inside forest naturally and peoples harvest honey from this area. But, now these situations are no anymore there. Hence, this study was designed to assess the factors that cause this change. On the other hand, still today in these district farmers get income from honey production activities mainly from honey. But, as it was

stated in developmental discussion paper (2013-17) honey production activities have two main economic values such that income generation from honey and it's by products, and from creating non-gender biased employment activities. Opposite to this, in my study area honey production is done in a traditional practice that requires force and experience to hang hive on trees and there are traditional beliefs that most of the time ignore female from this activity. So, my study was designed to create awareness to the districts extension workers and farmers, that it was possible to get income from honey production in different ways by developing traditional beekeeping activities to modern bee keeping and if all member of the community participate equal.

Now days there was great increase in using of agro-chemical on farm land due to lack of man power and loss in soil fertility in this study area. Therefore, this study assesses the effect of agro-chemical on honeybee and its effect on honey production. Even though the honey sector was contributing to export earning; the country's honey export is small. This is mainly because of the low quality of honey from traditional hives. Similarly, farmers in Benshangul Gumuze collect honey from traditional hive with poor quality and low quantity. As statistical agency report from 2010-2011 on the average lists of honey price in different regions of Ethiopia the Benshangul region honey is at very low that was averagely 16.48-21 ETB/kg, this was due to low quality honey harvested in the area. Therefore, this study assesses constraints that exist in the study area.

1.3 Objectives

1.3.1 General objective

To assess factors associated with honey production in Benshangul Gumuze, Metakel Zone, Wombera districts

1.3.2 Specific objectives

- To assess the effect of agrochemical on honey production
- To assess effect of biotic factors on honey production
- To assess types of hives used in honey production
- To identify the influence of environmental change in honey production.

1.4 Research question

- What are the common pesticides that affect honey production and beekeeping?
- What kinds of hives do people use and its effect on the quality of honey production?
- What kind of biotic factors affect honey bee and reduce honey production?
- Does environment change have effect on honey production?

1.5 Significance of the study

This study was significant in that it identifies constraints in honey production and provides specific information and knowledge related to improving honey production practices, indicating the factors that need great attention and identify the aspects that need further research work on honey production. It can be an opportunity to the region and the districts in particular to have an organized document that can serve as guide- line in furthers honey production. It indicates direction and supply information for further research, extension and development efforts, for non -governmental organization whose main concerns may be to invest on. Researcher and extension workers can utilize the results of this study in modifying research and extension activities particularly for improving honey production technologies. Moreover, policy makers can benefit from this study to formulate suitable agro-ecological polices that are important in beekeeping bees. This will support governmental and non- governmental actors working on the issue.

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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 (Michael & 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.

2.1.1 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.

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. Your county extension agent can determine what samples to take from the hive to diagnose 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.

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 propolis (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.

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.

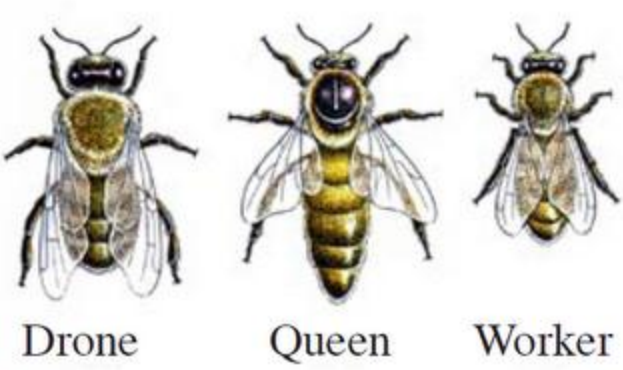

Figure 1: The three distinct kinds of honeybees in a colony.

These insects undergo complete metamorphosis, or change in form, during their development. The four life stages are: egg, larva, pupa and adult.

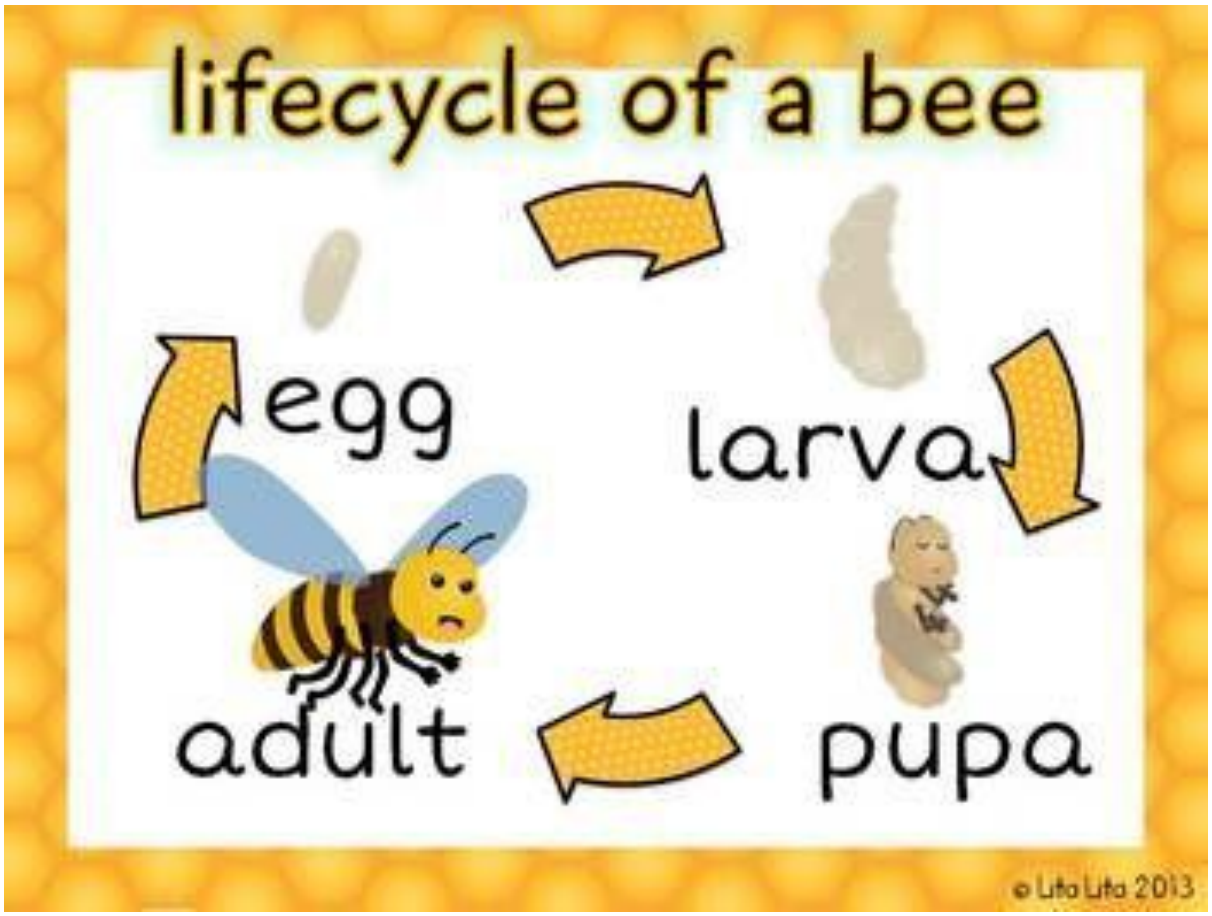

Figure 2: The life cycle of honey bee

2.2 Honey

Honey is the complex substance made when bees ingest nectar, process it and store the substance in to honey combs. All living species of Apies have had their honey gathered indigenous peoples for consumption. *Apis, melifera* and *A. cereana* are the only species that had their honey harvested for commercial purposes. Honey is sometimes also gathered by humans from the nests of various stingless bees. In 1911, a bee culturist estimated a liter (about a quarter) of honey

represented bees flying over estimated 48,000 miles to gather the nectar needed to produce honey.

Honey gets its sweetness from the monosaccharide, fructose and glucose, and has about the same relative sweetness as granulated sugar (National Honey Board, 2012). It has attractive chemical properties for baking and a distinctive flavor when used a sweeter. Most micro-organisms do not grow in honey, so sealed honey does not spoil, even after thousands of years (Geiling and Natasha, 2013).

Honey is collected from wild bee colonies or from domesticated bee hives. The honey is stored in honey combs. Wild bee nests are sometimes located by following a honey guide bird. The bees may first be pacified by using smoke from bee smoker trigger a feeding (attempt to save the resources of the hive from a possible fire)making them less aggressive and the smoke obscures the pheromones the bees use to communicate. The honey comb is removed from that either by crushing or by using a honey extractor. The honey is then usually filtered to remove bees wax and other debris.

The physical properties of honey vary, depending on water content, the type of flora used to produce it (pasturage), temperature and the proportion of the specific sugars it contains. Fresh honey is supersaturated liquid containing more sugar than the water can typically dissolved at ambient temperature. At room temperature honey is a super cooled liquid, in which the glucose will precipitate in to solid granules. This forms semi-solid solution of precipitated glucose crystals in fructose and other ingredients. At the temperature of 20 ^{0}c, density of honey typically ranges between 1.38 and 1.45 kg/l (Root, 2005).

2.2.1 History of honey

Honey use and production has a long and varied history (Hunt & Atwater, 1915).In many cultures association that go beyond its use as a food. It is frequently used as talisman and symbol of sweetness at Arana caves in Spain. Honey collection is an ancient activity (Crane, 1983).Human apparently began hunting for honey at least 8000 years ago, as evidenced by a cave painting in Valencia, Spain (Crane,1983). The painting is a Mesolithic rock painting, showing two honey hunters collecting honey and honey comb from a wild bee nest. The figures are depicted caring baskets or gourds and using a ladder or series of ropes to reach the wild nest.

The greater honey guide birds human guide to wild bee hives and this behavior may have evolved with early hominids (Isack and Reyer, 1989).

The oldest honey remains to have been found were in the country of Georgia. Archaeologists found honey remains on the inner surface of clay vessels unearthed in an ancient tomb, dating back some 4,700-5,500 years (Georgian ancient, 2012). In ancient Georgia, several types of honey were buried with a person for their journey in to the afterlife, including linden, berry and meadow flower varieties.

2.3 Honey production in Ethiopia

Ethiopia is recognized as one of the poorest and most food-insecure countries in the world. It is primarily a net exporter of agricultural products, with 85% of its population employed in agriculture. Ethiopian agriculture contributes more than 45% to the nation's gross domestic product (GDP) and significantly affects the country's export trade (USAID, AGP-AMDe, 2012).

Honey production and beekeeping are environmentally friendly practices and relatively easy to engage in. These non-farming business activities have the potential to provide a wide range of economic contributions. Two main economic values could be derived from engaging in beekeeping including income generation from marketing honey and its by-products (beeswax, royal jelly, pollen, propels, bee colonies, and bee venom) and the creation of non –gender -based employment opportunities. Additional benefits from beekeeping are associated with the purely biological nature of bees' activities, such as plant pollination and conservation of natural flora. Because of its relatively low labor requirements, when properly handled, beekeeping can coexist almost effortlessly with regular farming activities, such as growing crops, horticulture production, and animal husbandry.

Ethiopia is one of the top 10 producers of honey in the world, and it is the largest one in Africa (USAID, AGPAMD, 2012). The total volume of honey production in 2011 was estimated to be 39.89 million kilograms (kg) (CSA, 2012). The country's potential for honey production, the variety of natural honey flavors associated with the country's diverse sources of bee forage, and Ethiopian honey's desirable qualities, such as low moisture content, have been widely recognized. Beekeeping and honey production in Ethiopia form an ancient tradition that has been incorporated into Ethiopian culture and even the country's religious customs. Ethiopia is also the

country with the longest history of marketing honey and beeswax in Africa. Ethiopians use honey in place of sugar to sweeten their foods and to boost their caloric intake. The average household in Ethiopia is composed of six people, and annual honey consumption is estimated to be 10 kg per household. Honey in Ethiopia is generally produced as a cash crop, with yearly sales amounting to 90 to 95 percent of total production. Currently, the majority of honey produced (about 70 percent of the 90 to 95 percent designated for sale) is sold to tej houses. The remaining portion is marketed as table honey for general consumption (Tadesse and Phillips, 2007). The same trend to in this study area tej is cultural drink and most honey produced was solid for tej house next to home consumption.

Ethiopian honey differs not only in color, taste, and quality but also in the quantity produced and the timing of harvesting seasons that vary by region and type of honey. The main harvesting seasons are October through December for Tigray's and Lalibela honey, with an additional harvest period for Tigray's white honey in June and July; November and December for yellow honey; April and May for white honey from the southwest and southeast Highlands; and February, March, May, and June for dark-brown varieties of honey.

In recent years, Ethiopian's honey-production potential and its likely contribution to poverty reduction have been recognized and incorporated into the working agenda of the Government of Ethiopia, especially the Ethiopian Ministry of Agriculture, National Research Centers (Holeta, Andasa), and various non-governmental organizations (NGOs), such as SNV (Netherlands Development Agency), Oxfam GB, and SOS Sahel. These agencies share the belief that the Ethiopian honey value chain is an important part of the country's development strategy. Several other institutional bodies have also emerged to promote the Ethiopian Honey sector—namely, the Ethiopian Honey and Beeswax Producers and Exporters Association (EHBPEA) and th4e Ethiopian Beekeeper's Association (EBA). These institutional actors work together to help establish the successful development of the honey value chain in Ethiopia. The EHBPEA and the EBA cooperate with the government to organize commodity-specific workshops, find solutions to industry problems, facilitate honey policy developments, and organize conferences and international honey expositions (e.g., ApiExpo). The main purpose of these activities is to promote Ethiopian honey and to establish promising market linkages between different actors in the honey value chain.

2.4. Domestic honey consumption and honey export

The total volume of honey production in Ethiopia in 2007–2011 was 163,257.42 tons (Table 1), of which 99.2% was consumed domestically and 0.8% was exported (Table 2). The total volume of Ethiopian honey exports in 2007–2011 was 1,297,717 kg (Table 1), with a total value of US$4,066,528. Although the volume of honey exported increases slightly when the totals for 2007 and 2011 are compared, Ethiopia's honey exports are still very low relative to Ethiopia's total honey production Honey Price Patterns in the Domestic Market, Domestic honey prices in Ethiopia differ substantially by region and type of honey.

Table 1: Honey production and exports versus domestic consummation 2007-2011 Year

Year	Total production in volume in kg	Total export In Volume in kg	Total domestic. consumption in kg
2007-2008	42,180,346	219,889	41,960,457
2008-2000	39,660,647	143412	39517,235
2009-2010	41,524,967	414115	41,110852
2010-2011	39,891,460	520,301	39371159
2007-2011	163,254,420	1,297717	161,959,703

Source: CSA of Ethiopia for volume of domestic production and Ethiopia minster of trade for export in volume

Table 2: Percentage shares of domestic consummation versus export /out of total production (2007-2011).

Ethiopia have	2007-2011	2007-2008	2008-2009	2009-2010	2010-2011
Domestic consummation	99.2%	99.5%	99.6%	99%	98.7%
Exports	0,8%	0,5%	0.4%	1%	1.3%

Source: The CSA for volume of domestic production and the minister of trade for export

2.5 The use of honey

2.5.1 Economic importance of honey

In Ethiopia honey production is present in many parts of the country. Simplicity of the production system, low costs and favorable conditions result in production processes that appear everywhere. Especially, for resource poor farmers with no or little land, this activity is a main source of income. The economic benefit of this sector is the value of bee product obtained; currently honey, bees wax and bee colonies are commercialized.

Honey has been highly prized for its nutritional and medical values as well as its flavor by local communities. In most of the rural areas where there is deficiency of other sugars sources, it is highly demanded for its sweetness and energy-source capacity. Honey selling helps to redistribute money from the urban people with a relatively better standard of living to rural people, currently honey is a cash crop for almost all beekeeper households.

2.5.2 Export

Honey and beeswax are among agricultural products that contribute to the national economy through export earnings. There is an opportunity for Ethiopia to benefit from honey exports as result of its large and diverse flora resource for large-scale honey production. There is also possibility to supply different flavors' of honey throughout the year.

2.5.3 Employment

Apart from, enhancing food security, beekeeping and honey production provides employment especially in areas where there was population pressure on the land (Illgener *et al.,* 1998).This helps households manage economic shock hence reducing vulnerability among these households. Since honey production is a traditionally well-established household activity in almost all parts of Ethiopia, it contributes to rural employment. The employment effect of honey production includes farmer, traders, bee equipment producers, local tej makers and processors. The exact number of people engaged in the honey production is not well documented. However, it is estimated that around one million farm households are involved in honey production (MOARD, 2005/06).

2.5.4. Nutritional and sugar profile

Honey contains antioxidants, minerals, vitamins, proteins and a high calorificial value, which present attractive ingredients that do not occur in artificial sweeteners (Alkire and Foster, 2011). Honey also used for brewing traditional beer in Africa primarily for cultural and religious purposes. Consumption of honey improves food assimilation; reduce infective intestinal problems such as constipation, duodenal ulcers and liver disturbances, which increase proper food utilization (Krell *et al.*, 1996).

In a100 gram serving, honey provides 304 kilocalories with no essential insignificant nutrients content (USDA, National nutrient Database), composed of 17% water and 82% carbohydrates, honey has low content of fat, dietary fiber and protein (Table 3). It is a mixture of sugar and other carbohydrates; honey was mainly fructose and glucose, maltose, sucrose and other complex carbohydrates (NHB, 2012). Its glycemic index ranges from 31 to 78, depending on the variety, (Brand –Milew, 2008). The specific composition, color, aroma and flavor of any batch of honey depend on the flowers foraged by bees that produce the honey (Hent& Atwater, 1915). On 1980, study found that the mixed floral honey from several unit seats regions typically contain.

Table 3: Nutrient content of honey

Nutrient content	Percentage composition
Fructose	33.2
Glucose	31.3
Maltose	7.1
Sucrose	1.3
Other sugars	1.5
Water	17.5
Ash	0.2
Other undetermined	3.2

2.5.5 Medicinal value/ traditional medicine

Honey primarily seen in traditional medical systems as having curative properties; this derives from the fact that honey made from particular medicinal plant (FAO, 2009), on a topical application honey has demonstrated accelerated wound healings in animals. More over common bacteria *Streptococcus, progenies* that because sore throats can be inhibited from growth by the

use of honey (FAO, 2009). In terms of beeswax, claims are made that it has antibiotic properties and can be used for arthritis and nasal inflammation (FAO, 2009).

2.6. Beekeeping resource

Sound utilization of honey bee for economic development cannot take place in absence of information and knowledge of important beekeeping resources. Unfortunately, most beekeepers have little information on important basic bee resource as such food plants and water. According to Heburn and Radloff (1997), detailed studies of honey bee-plant relationship are still patchy. Sustainable beekeeping in Africa can only be achieved through understanding and conservation of the most resourceful plants for the bee's interims of nectar, pollen and resin. Knowledge on bee plants that are important to bees in different localities and seasons is still very scarce; this implies a need for documentation of plant species through biotic survey and analysis of honey.

The major bee plants in Africa are trees that are also used by local communities for charcoal production and timber. With time most of the resource trees species have been reduced to small population that cannot sustain the bee colonies. Thus, most of the problem encountered in such area in regard to poor honey production are related to lack of enough food source and prolonged drought with the continuous in land pressure due to population growth, less and less land is becoming available for bee forage.

2.7 Current deficiencies in the honey sector

So far, Ethiopia has not succeeded in exploiting its natural capacity for honey production, nor has it been able to fully benefiting from its comparative advantage in the honey sector. Several factors have kept Ethiopian honey production from reaching its full market potential.

2.7.1 Backward technology for honey production

Backward technology for honey production, which includes traditional beehives and results in low quantity and poor quality of honey produced. Currently, most of the honey produced in Ethiopia comes from traditional beehives. Statistics show that as of 2011, Ethiopian beekeepers and honey producers possessed about 4,993,815 beehives. Traditional beehives make up 95.57 percent of the total quantity of beehives in Ethiopia, while the percentage of transitional (Kenya top bar) and modern beehives are 1.63 percent (81,596) and 2.8 percent (139,682), respectively

(CSA, 2012). Traditional beehives yield low quantities of honey (around 5 to 7 kg) beehive/year that is also generally low quality, because it contains brood, wax, and other impurities.

2.7.2 Lack of financial resources

Lack of financial resource such as access to loan for beekeeper to obtain modern beehives and other tools necessary to increase honey production, Beekeepers have little access to financial products that would allow them to switch from traditional beehives to improved versions. Moving to transitional and modern beehives requires an initial investment of capital that most beekeepers do not have, so they continue to produce honey using traditional methods.

2.7.3 Supply-related barriers to properly managing modern beehives

The supply of tools necessary to manage modern beehives is not readily available. For instance, some beekeepers possess modern beehives (just boxes), but they lack the tools required for the proper management of these beehives (such as a smoker, queen excluder, or honey extractor).

2.7. 4 others common obstacles in honey production

Additional barriers include the disappearance of bee-foraging areas due to crop intensification and the growing use of agrochemicals; extreme weather conditions in some parts of Ethiopia (droughts); poor transportation infrastructure; weak knowledge of proper storage techniques (at the farm and local honey collectors'/traders' levels); problems with packaging, especially at the processors' level (e.g., difficulty obtaining a reliable supply of glass jars); weak access to profitable export markets due to low productivity; limited knowledge of export-market requirements; and lack of or weak connections with processors. These were key barriers to successfully expand the sector products.

2.8 Stressors in beekeeping and honey production

The pollination of wild flowers and several key crops for food production relay on native and managed bees (Kelin *et al.,* 2007). Managed colonies of honey bees represent an important source of goods and income with a yearly production of 1.6 million tons of honey and 65,000tones of beeswax (FAOSTAT, 2013). However global declines in bee population pose threats to food security and the maintenance of biodiversity. For honeybees, large monitoring programs indicate unprecedented rates of colony losses, in particular in Europe and North

American (Laurent *et al*., 2015). But, similar observation, although less well documented, are being made in other parts of the world.

Stressors affecting bees are multiple in nature and origin, these can be grouped in to four broad classes: Physical, chemical, biological and nutritional. Physical stressors are mostly governed by environmental changes (e.g Climate change, habitat fragmentation and destruction), while chemical stressors mostly include compounds of anthropogenic nature (e.g farming, urban/industries/, mining activities etc.) as well as naturally occurring contaminators (e.g mycotoxins, plant alkaloid, etc.). Biological stressors include bee pest and exotic disease, while nutritional stressors may be expressed as change in bee's nutritional status (e.g protein, lipid, sugars, vitamins and minerals). Both biological and nutritional stressors may be modulated by environmental changes and or anthropogenic activities (e.g an increase in bees pests and exotic disease due to climate change and global trade; nutrition of bee related to resource availability in the land scope and beekeeping management practices).

2.9. Natural enemies and pests

Predation and pest's infestation are major problems in Africa beekeeping industry. The predators include mammals, birds, reptiles, beetles, ants and wasps, flies (Hepburn and Radloff, 1997). Among these predators, the honey badgers, honey guide birds and different species of ants are the most common. However, the recent reports indicate that man is the most significant predators to honey bees in Africa followed by honey badgers (Crane, 1990). This is because most honey gathers use crude method such as, use of fire to harvest and extract the honey from natural colonies thus destroying entire colonies. Further wax production had been identified as the most destructive action of honey bee nests, recent reports show that about 1927 colonies are destroyed per metric ton of wax harvested per annual using traditional methods in the natural habitats in Africa (Hepburn and Radloff, 1997).

2.10 The effect of agrochemicals in honey production

An agrochemical or agrichemical, a contraction of agricultural chemical; was chemical products used in agriculture. In most cases, agrichemicals refer to pesticides including insecticide, herbicides, fungicide and nematicides. It may also include synthetic fertilizers, hormones and other chemicals growth agents and concentrate stores of raw animal manure. Many

agrichemicals are toxic and agrichemical in bulk storage may pose significant environmental and health risk, particularly in the accidental spills. Agrochemicals were introduced to protect crops from pest and enhance crop yields. However indiscriminate uses have side effects on important organisms like honeybees.

Beekeeping is an important input in the agricultural system, but indiscriminate use of pesticides on the crops causes heavy losses to colonies ultimately discouraging beekeeping. Studies revealed that problem of pesticides and herbicides sprays was faced by majority of beekeepers in the mixed crop-livestock production system, resulted in killing of honeybees, which caused great loss (Kebede *et al.*, 2007). Moreover, the use of herbicides in place of hand weeding can also affect honeybees negatively by damaging the forage**.**

2.10.1 Harmful effects of pesticides on honeybees

Pesticides use has became inevitable in modern agriculture with Pesticides consumption increasing several folds during the last four decades, the side effects are also increasing and one of which is the toxicity to honey bees. In some study, Pesticides damage the ability of bee to gather food and were killing them. Since bees are the most important pollinators of crops, the use of pesticides can considerably reduce the yield of cross-pollinated crops. In addition to the above effects contamination of bee's product and loss in production of honey are the other effects caused by pesticide on bees.

Many Pesticides are harmful to bee population. Some Pesticide kills the bees directly. This occurs when bees are on the flowers at the time of application of insecticide and the bees die instantly. Some other types of pesticides allow the bee to return home and then they die. Such types are easy to identify than the first ones. There are certain Pesticides that do not have any effect on the adult bees, but cause damage to young immature bees.

According to research two Pesticide commonly used by farmers today could affects beekeeping. The two Pesticides namely neo-nicotioids and coumaphas target bee brain thus making it a slow learner and make they to forget florid scents.

The neo-nicotinoids are a relatively new class of Pesticides that have an effect on the bee's central nervous system it is the most widely used insecticide, which is used as a cooling in

agricultural seeds and in pot plants. It spreads to the whole plant including pollen nectar that the bees eat. Scientific studies indicate that bees that feed on neo-nicotinod contaminated pollen and nectar forage less and produce fewer offspring. The other insecticides ceumaphos is a compound that is used in honeybee has to kill a parasite called varroamite that commonly attacks honey bees.

Small particles of Pesticides often became suspended in the atmosphere because of wind currents or heated air raising this contamination of the air frequently kills honeybees. Especially when the poison settles on plants and the blossoms are attracting bees. Frequently the farmer applies the Pesticide to a crop not attractive to bees, but the wind blows the poison on to a cultivated crop or to nearby weeds where bees are actively forging for nectar or pollen or broth. The outcome can be catastrophic with many adult field bees dying. If the Pesticide blown in to the entrance of hive many or all house bees and brood may succumb. Pesticide drift that is most damaging to bees usually originated in a field a short distance from the point of contacts with the bees.

In addition to food, bees also drink water to keep their body temperature under control (Schmaranzer, 2000). Pesticide residues in soil eventually move into the water and appear in the stream. Creeks and ponds of agricultural areas beyond which are thus contaminated with a mixture of agrochemical.

2.10.1.1. Effect of insecticide on honey production

Pollinators are very important for the production of any crop as they play very important role in pollination of the flowers and crop. Bees are considered one of the major pollinators of agricultural crop in the way they collect nectar for feeding the colony and making honey. However, when different chemicals are applied to the crop they not only affect the pests of the crop but also harm the beneficial insects as pollinators, predators and parasites at the whole. Therefore the preparation of suitable formulations for an insecticide is a vital part of its development for practical use and generally will determine the particular pest control situation in which it may be employed as well the degree of the danger to foraging pollinators such as honey bees.

Dust can be made by mixing insecticide which is solid (DDT, carbary) with an inert solid for a vehicle which sticks to the foliage. Because of the exterior of bees is largely waxy and hairy the dust adheres quite tenaciously to the bees as well the insecticide may be dissolved in an organic Solvent (xylene, kerosene) and the resulting solution sprayed. The solvent provides penetrating power and the rate of evaporation of the insecticide from aerosolized portion of the spray may offer greater respiratory hazard to bees. An aqueous (water) suspension of the insecticide may be made if it is formulated as a suitable powder. Once the spray contacts the foliage the water evaporate and exposes the insecticide to the environment in much the same way as a dust another formulation bears the name emulsifiable concentrate (EC). A solution of the insecticide in oil containing a detergent substance will form an emulsion (a suspension) of finely. Divided liquid particles again when the water dust from such a spray the insecticide becomes exposed on the surface of the foliage such a spray has less penetrating power and is more evenly disseminated than the watt able powder formulation.

Micro encapsulated insecticides:-of considerably concern is the encapsulated insecticides formulation such as penncap-M, containing methyl parathion. If insecticides dissolved in an organic chemical then treated with another chemical with which it reacts to form a polymer. The insecticide molecule became embedded in polymer matrix and the resulting free-flowing powder (having a particle size of 10 to 50 μ) is sprayed as a water emulsion. After the water has dried the particle behave much like a dusty spray with the exception that contact toxicity is rather minimal because the insecticide is within the particle (capsule). Toxic action is due to primarily release of the insecticide through the capsule wall as a vapor (gas). Beekeepers should be warned that bees will in fact carry the capsule to the hive along with pollen. More over in field tests foliage sprayed with penne cap-m remained toxic for a much longer period than did foliage sprayed with methyl parathion formulated as emulsifiable oil. The organophosphates and carbonates are the most toxic to honey bees.

Chlorinated hydrocarbons:-This includes such important insecticide as DDT, BHC, toxaphen and chlordane. The chemical in this group are slowly reactive chemical, thus persistent in the environment. Biological degradation tends to be slow hence, storage in fat and muscle tissue causes this material to become concentrated and they enter our food chain.

The mode of action of chlorinated hydrocarbon is still a subject of active research. They are classified as neuron active agents which block the transmission of nerve impulse specifically, for example DDT present the normal Sodium potassium exchange in sheath of the nerve because chemicals such as, DDT are not very chemical reactive, it is felt that the mechanism of reaction with the sheath is not chemical, but rather the size and shape of a DDT molecule may fortuitously permit in to protein of sheath.

Oregano phosphorus insecticide: -This today account for about 30% of the registered syntactic insecticide, acaricide in the united state. They process the common characteristics of inhabiting the enzyme cholinesterase, which mediates the transmission of nerve signal. Hence, organophosphate also is neuron active agents. As their name implies this material contain phosphorus and as a group they include parathion- systox, DDVP and malathinon. They are quit reactive chemical and are not regarded as persistent in our environment unless they are micro encapsulated.

2.10.1.2. Effect of herbicide in honey production

Herbicide use has become wide spread, along with an agricultural intensification program and the need for increased food production for food security. Farmers in Ethiopia often cannot cope with heavy weed infestation during the pick period of agricultural activities because of a labor shortage. Most fields are weeded let or left and unwedded, resulting in remarkable reduced production. Hence herbicidal weed management is indispensable, especially where there is a labor shortage. The herbicide 2, 4 - D, round up glyphosate, topic and palace are commonly used, separately or in combination. It is not uncommon to find peasant farmers in rural Ethiopia using or over using this herbicide without fully understanding the under gradable consequence on bees and other crop pollinators, on bee forage and on other non-target organism and on the environment at large. Recent research suggests that even when glyphosate bends to soil particularly, it wills cyclically desorbs or loss its attraction to soil became active again a study by US geological survey found glyphosphate is nearly 70 % of river and stream they tested mid wave.

2.11 An over view of women involvement in honey production

In most of African countries, beekeeping has often been a male dominated activity (Ogaba and Akongo, 2001). However, with intervention from development agencies a change in these practices could occur. Traditionally, in most African Societies the norm had been that men reserved the right of making most of the decision at household level. Therefore women have had less owner ship and control over assets less decision making capacity and fewer educational and economic opportunities than men (Malhotra and Schuler, 2005). Consequently, developmental initiatives affect male and female beneficiary in varying ways due to gender difference and inequalities. In addition, women often encounter obstacles that prevent them from participating in, and benefiting from development projects. Therefore, deliberate consideration of gender dynamics for understanding how developmental initiatives lead to change in gender roles was paramount. Ogaba and Akongo (2001) established that some of the factors that deprived women from participating in beekeeping in Uganda include lack of time at night when honey harvested.

2.12 Effect of land degradation and fragmentation on honey production

Globally, the agriculture land scope has gone through large changes because of land use conversion and intensification (Shepherd *et al.,* 2003). In Ethiopia, the land which the farmers used for livestock feed was converted in to crop lands and settlement due to increase in human population(Eferem *et al.,* 2010).With regard to honeybees, habitat degradation and fragmentation lead to decrease in habitat quality for food and nesting sites. In Ethiopia, the honeybee floral resources have gone through large changes as a result of land use change and deforestation (Abebe *et al.,* and Girma *et al.,* 2008). Still deforestation is high in Ethiopia and it is as a result of harvesting trees and shrubs for fuel wood, use of trees for house construction and selling trees for timber production (Lemenih and Kassa, 2014). Thus, the increase in land use change and deforestation are inducing conditions that are hostile for sustainable beekeeping due to the destruction of natural honeybees' habitats, reducing forage and plant diversity and leading to insufficient nutrition and ultimate starvation of the honeybees. These situations are increasing, especially in the mixed crop-livestock production system.

3. Material and Methods

3.1. Description of the study area

Wombera, the geographical unit of the study area was found in Metakel- administrative zone Benshangul Gumuze regional state which is the north western parts of Ethiopia and found at 649km from Addis Ababa, 851km from Asosa town and 179 km from Metakel. The district was located 10^0 35' 53'N latitude and 35^0 59' 51'E (Figure 3).The district has the elevation range from 580 to 2731masl.The district is about 75% fall in low land which is below 1500m.

The annual minimum temperature of the district in the coldest season range from 12^0c-20^0c depending on altitude and maximum temperature of the district in the dry season range from 20^0c-35^0c depending on altitude (Figure4). So, due to this variation the agro-ecology of Wombera Wereda was divided in to dega (10%), wonia-dega (15%) and kola (75%). Characterized by monomial rain fall pattern, which is the characteristics of western Ethiopia. This district is the wettest from the zone with the annual rain fall ranging from 900mm-1500mm (Appendix 5).

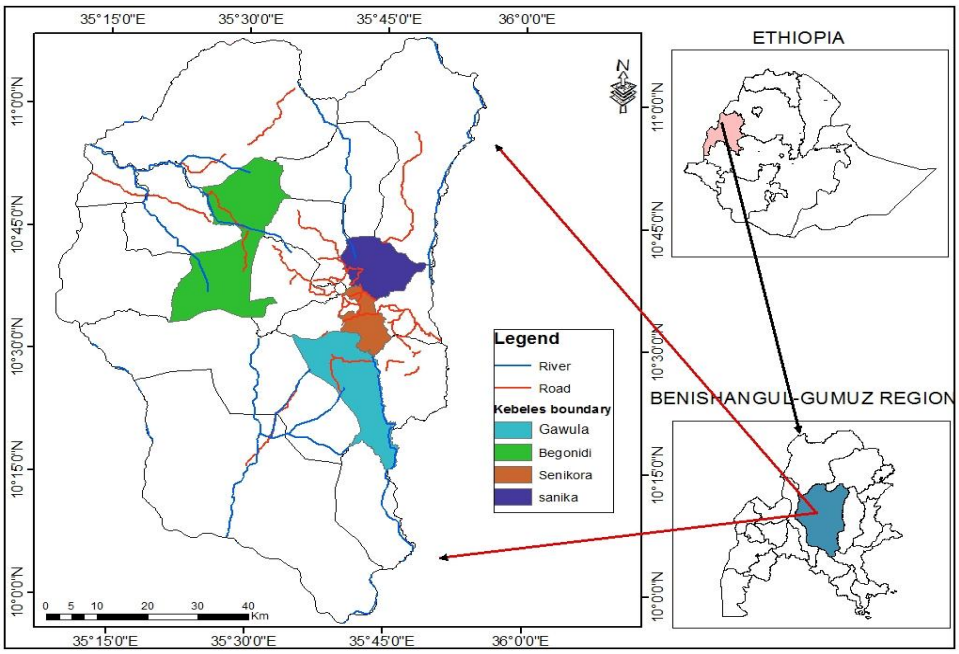

Figure 3: Map of the study area

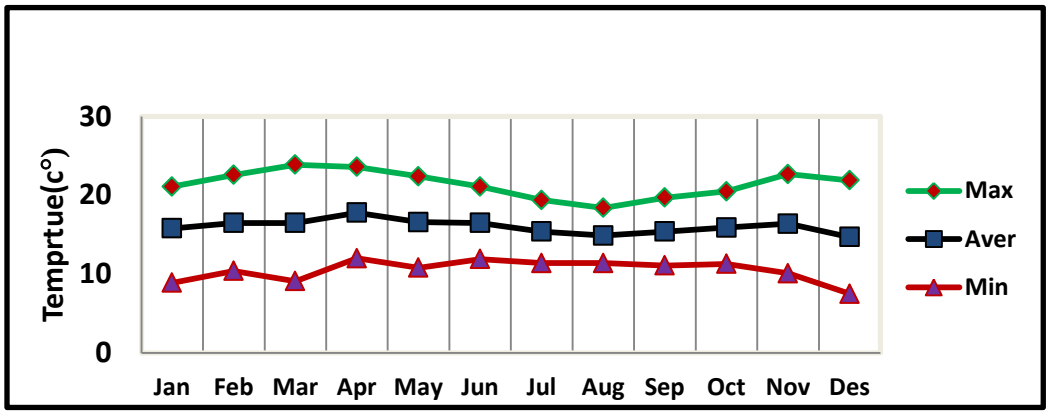

Figure 4: Average temperature distributions from2010-2017 **(Source: (WWMAR, 2017)**

The total population size of this district is about 74,251 of which 36,104 are males and 38,147 are female. Total households in the district were 11,836 of which 10430 are male households and 1,406 are female households. About 75% of these districts were classified as low land with the population of 30% predominately, inhabited by Gumuze-ethnic groups who depend mainly on slash and burning, agriculture and livestock rising. The traditional ways of economic activities in low land of this districts for generating incomes in selling woods and wood products with lower price for neighboring high lands were affect forest resource, that is the source of flora for bees both in wild and domestic honey production. Like to the high land, female, the role of female in the low land (Gumuze women) were range from shifting cultivation to collecting fire wood and preparing charcoal (Figure 5). Even though, most economic activities have direct or indirect influence on the environmental resource, with exception of some area, wise use of natural resources in this area is far away from what is expected and there is no awareness about resource depletion from time to time.

Figure 5: Gumuze women on fuel wood collection

3.2. Research methodologies

3.2.1. Sampling methods and procedures

Wombera district was selected purposely because of fact that the district is well known for honey production and it has a number of constraints in the process of honey production. In order to generate the required sample unit, the determination or sampling frame was essential. In this case the second stage purposive sampling technique has been used to select four Keble from 33 Keble of the district by focusing on climate variability and their focus on honey production.

So, in the third stage 98 house hold beekeepers will be selected by purposive sampling by the help of the districts extension worker. The basic sampling units in this case are the farmers' household who derive their livelihood entirely from apiculture activities in addition to other agricultural activities. The total household heads of the selected four sampled Keble were 2589 (Table 4). Accordingly, 30, 50, 11 and 7 households respondents are sampled from Gawula, Sanki, Senkora and Bagonde sub-districts based on their participation in honey production respectively, and proportionally 96 male households and 2 female households are sampled from the study area (Table 4). Here the sampled respondent statics is male based because in this study area the role of female in honey production is low due to the situation of honey production activity and cultural norms.

Table 4: **The sampling distribution of the household heads in the study area**

District	Kebles	Agro-climate	Total population	Total house hold of the district			Sampled house hold		
Wombera	Sanki	Dega & Kola	3670	Male	Female	Total	Male	Female	Total
				876	274	1150	48	2	50
	Gewula	W/Dega	2035	527	224	751	30	-	30
	Senkora	Dega	1321	289	187	476	11	-	11
	Bagonde	Kola	1228	118	94	212	7	-	7
	Total		7191	1810	779	2589	96	2	98
	Percent			69.91	30.09	100	98	2	100

3.2.2 Data collection and analysis

House hold interview, using standard questionnaire were the major means used to collect both qualitative and quantitative data. The questionnaire survey was conducted by informal survey that involved discussion with key informant farmers, extension workers and district agricultural office interview. These informal surveys were conducted in order to get some general overview on honey production.

3.2.3. Source of data

3.2.3.1 Primary sources

The main data collecting instruments of primary sources is interviewing, standard questionnaire, observation, informal surveys that involved discussions with key informants, including, extension workers, district agricultural officials and camera.

Key informants interview: a total of six key informant interviews with farmers were carried out. The key informants were selected with the help of district live stock developmental agents using criteria such as experience in beekeeping and model farmers in the district. Similarly, interview healed with live stock developmental agent of the districts. Open-ended question were used and interviewed using local language (Appendix 1).

3.2.3.2 Secondary source of data

To obtain secondary data, document analysis and reviewing of different books, thesis papers, dissertations, magazines, and journals will reviewed by the researcher to acquire an in-depth information that more related to the identified problem

3.3. Methods of data analysis

All collected data were coded and organized for analysis using computer software such as Ms Excel 2007, SPSS .The statistical analysis used in the study varied depending on the type of variable and information required. Descriptive statics such as frequency and percentage was used to analyze the quantative data using SPSS version 23 software**.**

4. Results and discussion

4.1. General characteristics of the sample households

4.1.1. Sex and age of households.

From the sampled districts households, 69.91%were male-headed household and 30.09% were female-headed households (Table 5).

Sex of the sampled household: As far as sex of the respondent concerned from the total respondent, 98% were male and 2% were female (Table 5). The survey result indicates that bee keeping activity was dominated by male. In the districts honey production and beekeeping was mostly practiced with traditional method simply involve hanging of hives on big trees.

According to informal discussion and key informant view women were only limited with activities in and nearby houses. Women were not involved in beekeeping as it involves hard work such as climbing of big trees to hang hives. In addition, the main reasons why women were not involved in honey production in the study area was due to cultural norms that ignore women from this activities and mostly the traditional practices of honey production in the district that need force and technique of hanging hive on trees. But, studies showed that beekeeping is one of the important income generating activities in the rural community and it also provides an employment opportunity for many people's (Girma *et a*l., 2008 and Gebey *et al.,* 2010).

With regard to age structure of the respondents, the majority (56.1%) of the respondents were between 18 and 40 years old. About 38.8% of the respondents were between 40-60 years, while5.1% were >60years old (Table 5). This survey results showed that beekeepers in the districts was at the most productive age and has potential to participate actively in beekeeping activities.

4.1.2. Education status

Educational Status of the sampled household: Educational level of farmers was found to be relevant and positively influenced adoption of beekeeping too. This was attributed to increase knowledge access to related information such as the right time for harvesting and improved understanding of the related best management technologies. From household respondents 31.63% were able to read and write, 52.04% cannot read and write, 9.18% attended grade 5-8,

and 7.14% was grade 9-10 (Table 5). The current findings indicated that the large proportion of the beekeepers were illiterate which can be considered as a barrier to modernize beekeeping in the district. Gichora (2003) strictly stressed the need of knowing bee biology and behavior to become effective beekeeper. Further he noted the necessity of intensive training on bee keeping.

Table 5: Demographic characteristics of the respondents

Items	Description	Frequency	Percent
Location of Keble	Urban	-	-
	Rural	98	98
Sex of SHH	Male	96	98
	Female	2	2
Age of respondent	18-40	55	56.1
	40-60	38	38.8
	>60	5	5.1
Educational back ground of respondents	Cannot able to read& write	51	52
	Able to read &write	31	31.6
	5-8	9	9.2
	9-10	7	7.1

4.2. Change in honey bee colony, productivity and use of hives

As far as colony population is concerned, 68.4% of the respondents indicated that honeybee colony population was in decreasing order over the years (Table 6). Moreover, the respondents were asked in open-ended question if they agree or not in honey bee population decline. They agree and also mentioned factors that contributed to the decline. Accordingly, human activities like destruction of forest area for crop cultivation and different factors particularly use of insecticide, predators and traditional honey harvesting practice among others highly contributed to bee honey colonies decline from time to time in the study area. Tessega (2009) from bure district reported that hive products were in a decreasing trend due to shortage of bee forages, drought, pesticides application, lack of water and poor management in that order which is more or less in agreement with the current findings.

As far as the income from honey production was concerned, 79.6% of the respondents replied that income from honey production and wax decrease (Table 6). Accordingly, in open-ended question the respondents realized that due to environmental change, predators, pesticide and traditional practice of honey production there is greatly decrease in income from honey &its

product's. Gebye (2003) report drought, decline in vegetation coverage and subsequent changes in natural environments, pests and predators, and indiscriminate applications of chemicals are causes for the low production of honeybee products, more or less agree with current finding. Also, Nuru (1999) state that beekeeping is still operating in the old traditional ways implying the need for modernization, low productivity and poor quality of bee products are the major economic impediments for rural beekeeper? However, they face another primary economic concern; i.e., lack of skill to manage their bees &bee products, this agree with current finding.

Hive placement and preference of hive type. About 42.9% of the beekeeper in the study area kept the traditional bee hives on trees near home (Figure 6), 7.1%placed their hive at back yard of the house and 50% hang far from house in forest (Table 6). Kerealm (2005) reported that most beekeeper of the Amaro wereda kept their bee colonies by hanging on trees near homestead and in forest area which is in line with the current findings. From the results of field observation in the study area farmers use traditional hives and hang over trees far from home in forest. Also Key informant participants farmers explained that the beekeepers do not use hives near home due to the risk of stinging behavior of honey bee in mixed farming.

In terms of hives use, the majority of beekeepers 91.8% have been using traditional hives only. And only few farmers are using modern hives 4.1% and transitional hive 4.1% (Table 6). This mainly because of the high cost of constructing and purchasing of modern and transitional hive, and due to lack of Knowledge and skill, to use modern and improved hives. Similarly, Mehari (2007) reported that in East Tigray modern beekeeping require more expensive establishment cost, accessories (further cost) and skill training to yield better quality and quantity honey (Mehari,2007)

Figure 6: Traditional hive hanged on trees

Table 6: **Change in honey bee colony and management of honey bee, productivity and use of honey**

Items	Descriptions	Frequency	Percent
Availability of honey bee colony from time to time	Decrease	67	68.4
	Increase	12	12.2
	Constant	19	19.4
Income from honey production from time to time	Increase	7	7.1
	Decrease	78	79.6
	Constant	13	13.3
Types of hive used in your Keble	Modern	4	4.1
	Traditional	90	91.8
	Constant	4	4.1
Hive placement	Back yard of house	7	7.1
	On trees near home	42	42.9
	Far from house in forest	49	50

4.3. Management of honey bee colony

With regard to colony management practices, during harvesting of honey, 67.3% of the respondents replied that there was no nest prepared and 32.7% of the respondent agree that the can prepare nest or hang new hive after harvesting (Table 7).

In open-ended Question they explain that most of the harvesting mechanism is traditional and farmers harvest honey by using fire at night time and they draw out the bees on the ground and collect their hive in small shelter they prepare until hive hanging period arrived. So it was during this time that mostly honey bees are attacked by predators.

Inspections frequency: In order to know the colonies were progressing, beekeepers open the hives and inspect each comb. This will let the beekeepers know whether the honey is being caped regularly, whether the colony was getting ready to swarm or the hive have been attacked by pests. Accordingly, 14.3% of the respondents inspect their colonized hive daily, 37.8% inspect once in a month, 1% inspects only during harvesting and 45.95% of the respondent inspect accidental (Table 7). From this result we can see that in this districts management of colonized hive and protection of apiary area was low. The result of expert and key informant interview farmer in the study area replied that beekeeper does not inspect internally and they check either hive has bees or not seasonally (Appendix 1). However, the internal hive inspection was limited to colonies placed at back yard and under eaves of house. This result agrees with different pervious research (Kerealem, 2005) reported that farmers in Ethiopia do not commonly practice internal hive inspection due to difficulty of traditional hive for internal inspection.

Table 7: Managements of honey bee colony

items	Description	Frequency	Percent
Do you prepare nest for honey bees after harvesting honey.	Yes	32	32.7
	No	66	67.3
Inspection frequency of colonized hive was.	Daily	-	-
	Once a month	14	14.3
	Accidental	37	37.8
	Only during harvesting	45	47.9

4.4. Change in consumption of honey and market of beekeeping equipment and honey production

Majority of the beekeeper (90.08%) in the study district produces honey for home consumption than for export (Table 8). So this result contradicts with the statement that, Honey and bees wax is among agricultural product that contributes to the national economy through export earnings. There was an opportunity for benefit from honey export as result of its large and diverse flora resource for large-scale honey production. Even though the honey sector is contributing to export, the countries honey export was small compared to the estimated production per a year. The result of this study identified beekeeping practice is very traditional in Wombera districts with very low production, producing only for home consumption. Thus, economically the respondents depend mainly on non-beekeeping economic activity. This also indicate that since, the product is insufficient there was no market chain for honey and honey products in the districts. This was contradicted with Tessega (2009) in bure districts of Amhara region the main purposes of beekeeping were for source of income and home consumption. Accordingly, 65.3% of the respondent answered that the market acceptance of honey to facilitate beekeeper is low, 32.7% said the market acceptance is medium and 2% of the respondents said high (Table 8). Most of the rural beekeeper cannot afford to invest the modern beekeeping in puts, processing packaging and transport their product to market to maximize profit. They produce a low quality product that they are forced to sell locally to whole sale buyers at prices much lower than domestic commercial markets (Amsalu *et al.*, 2004)

Table 8: Change in consumption of honey and marketing of beekeeping equipment and honey production.

Items	Descriptions	Frequency	Percent
Honey harvested in your Keble Was mostly used for.	For export	9	9.18
	For home consumption	89	90.82
Market acceptance of honey to facilitate the activity of beekeeper is.	High	2	2
	Medium	32	32.7
	Low	64	65.3

4.5. Honey beekeeping information center

Well trained staff plays a significant role informing actors in the honey channel. There are shortage of skilled person for beekeeping management, post-harvest handling, bee product

marketing at all level (federal, regional &district levels) and processing, and quality control in the country (Gezahegne, 2001). Thus, increase the knowledge gap of the beekeepers in rural area. Accordingly, 69.4% of the respondents in the study area said there is no training at FTC, 27.6% said there is training at FTC once in a year, and 3.1% said there is training once in a month about honey production (Table 9). The same to this 86.7% of the respondents also answered that there was no enough awareness about honey production in the study area and 13.3% of the respondents replied that there is enough awareness creation in the environment (Table 9). Results of this survey indicate that there was information gap about honey production in the district. Similarly, For instance for a study in Ethiopia, Bekele (2015) reported access to extension services such as market information and beekeeping training as the most crucial factor influencing production of honey and other bee products, agree with the current finding. His findings showed that farmers that were frequently contacted by the extension agents produced higher quantities of bee products with better quality than those that did not. In addition, farmers that had received beekeeping training were more likely to use improved beekeeping equipment and produce more honey than their counter parts. Sound utilization of honey bee for economic development cannot take place in absence of information and knowledge of important beekeeping resources. Unfortunately, most beekeepers have little information on important basic bee resource as such food plants and water. According to Heburn and Radloff (1997), detailed studies of honey bee plant relationship are still patchy. The low yield of honey and beekeeping products resulted from insufficient management practices and lack of adequate beekeeping training (Bhusal and Thap, 2005; Masuku, 2013).

Support of the stalk holder: The beekeeping extension services and financial support have been mainly funded and provided by the government through the district office of agriculture. However, 74.49% of the respondents said support of extension worker is low, 13.27% said it medium and 12.24% said high (Table 9). Also results from Extension Worker interview show that due to lack of financial support and costiveness of modern available beekeeping material there was no support given to beekeepers. So in comparative to other agricultural field farmer do not get support in honey production.

About 94.9% of the respondent use material for honey production by themselves from local available material by using indigenous Knowledge and 5.1% get support from governments

(Table 9). So, lack of support was the barrier to produce qualified and quantified honey production. Studies showed that many beekeepers expressed the high cost of equipment/tools as main problem for adoption of movable-frame hive system (Abebe *et al.,* and Girma *et al.,* 2008). Similarity in the study area the cost of modern hive and traditional hive is 1314 and 991 Ethiopian birr respectively, in relative to this the traditional hive is sold by 30 Ethiopians birr, so most of Farmer at low economy level prefer this one(from WWAOFFICE).

Table 9: Honey beekeeping information center

Item	Description	Frequency	Percent
How many times do you trained about beekeeping.	Once in a month	3	3.1
	Twice a month	-	-
	Once in a year	27	27.6
	No training is given	68	69.4
Do you expect training & awareness given to honey production is enough	Yes	13	13.3
	No	85	86.7
Support of extension worker/experts in honey production is.	High	12	12.24
	Medium	13	13.27
	Low	73	74.49
From where do you get material support for honey production	From government	5	5.1
	From NGOs	-	-
	Own/indigenous knowledge	93	94.9
	From experts	-	-

4.6. Descriptive forces on honey production.

Driving forces in case mean any influencing factors that directly or indirectly bring change in the beekeeping. So this part of the study aimed to investigate the beekeeping dynamics and its driving forces of change in the mixed farming system. As far as the effect of land use change on honey production was concerned 78.6%, of the respondents agreed that the land use change have effect on honey production (Table 10). So, the traditional ways of economic activities in low land of this district for generating incomes in sailing woods and wood product with lower price of neighboring high lands were affect forest resource, which is the source of flora for honeybees in both wild and domestic honey production (Figure 4). With regard to honey bees, habitat degradation and fragmentation lead to decrease in habitat quality for food and nesting sites. In Ethiopia the honey bee flora resource have gone though large changes as a result of land use

change and deforestation (Abebe *et al.,* and Girma *et al.,* 2008), more or less agree with current finding.

In this study the survey result show that, 78.6% of the respondents revealed that the effect of deforestation on beekeeping is high, 2% said low and19.4% of the respondents said medium (Table10). Similarly, Lemenih and Kassa (2004) reported still deforestation is high in Ethiopia and it is as a result of harvesting trees and shrubs for fuel wood, use of trees for house construction and selling trees for timber production. Thus, the increase in land use change and deforestation are inducing conditions that are hostile for sustainable beekeeping due to the destruction of natural honey bees' habitat, reducing forage and plant diversity leading to insufficient nutrition and ultimate starvation of the honey bees.

As far as variability of the climate was concerned, 85.7% of the respondents answered that climatic variability has effect on honey production (Table 10). With regard to honey bees, unfavorable weather conditions can influence both directly and indirectly (Alamu *et a*l., 2014). It directly influences the honey bees foraging and flight activities; indirectly it influence honey bees through its effects on their resource base, disease, pests and predator occurrence. Similarly, according to Kulindwa (2010) whether condition not only influence the availability of forage plants but they also affect the average daily brood products, length of worker life and individual productivity of worker that were identified as the three primarily factors that interact together to influence the amount of honey produced.

As far as gender was concerned all most all 100% of the respondents answered that male are involved in honey production (Table 10). The survey result indicates that beekeeping activity in the study area was dominated by male. From the observation of the researcher and interview of experts in the districts beekeeping activity is mostly practiced by traditional method of honey production by using local bee hives. The traditional hives were hanged on big trees in which some of trees are as long as 50 meters and above. So, female cannot climb up big tree to hang and as a result female are not encouraged to participate in this activity. Thus beekeeping is traditionally dominated by male in the study area. Similarly, Getu & Birhan (2004) also reported males engaged in beekeeping activity than females. This because, the fact that traditional cultural norms in Ethiopia consider beekeeping as men's job only. This finding contradicted with the results of Amsalu *et al.,* (2004) and Gezahegn (2001) that pin point that honey production was

one of the income-generating activities for resource of poor farmers including women, youth and the unemployed sectors of the community. Since traditional practice do not make all society to take part in.

Table 10: Physical stressors in honey production

Items	Descriptions	Frequency	percent
The effect of land use on honey production	High	77	78.6
	Medium	15	15.3
	Low	6	6.1
The effect of deforestation on honey production	High	77	78.6
	Low	6	6.1
	Medium	15	15.3
Does climate change have effect on honey production	Yes	84	85.7
	No	14	14.3
Which sex group Mostly involved in honey production activity in you Keble	Male	98	100
	Female	-	-

4.7. Change in honey bee flora resources

As the type and source of food determines the success of beekeeping, the respondents were asked to indicate the source of feed for their bees. Accordingly all of the respondents replied that in this study area bee gets food by foraging (Table 11). This contradicted with the idea of (Alaux *et al.*, 2010) that stated the role of nutrient is so critical that the beekeeper often must provide supplement as sugar syrup or pollen supplement to prevent nutritional deficiency and colony failure. So the colony strength as well as honey bee product mostly depend on the availability and type of bee flora next to level of colony management practice (Bista and Shivakoti, 2010). Most of the respondents, 80% replied that during hanging hive beekeeper do not consider flora source and 18.4% replied that they consider flower when the hung hive, Thus, current finding do not agree to the idea that apiary sites should be nearby the good bee forage plants to obtain good honey bee products and colony strength (Jacobs, 2006).

As far as the availability of flora plant was concerned 80.6% of the respondents realized that flora plant decrease and 17.3% express it remains constant and 2% said increase (Table 11). Though bee forage quality and availability are vital in honey production, these seem to continuously reduce over years due to changes in agricultural practices (Benton, 2006). These changes include the increased use of fertilizers that has reduced rotation of legumes in cropping

systems and extensive use of herbicides that reduces weeds within the crops and at crop edges. Similarly, increased use of pesticides, reduced extensive grazing and harvesting of alfalfa before blooming to maximize protein content significantly reduce bee forage available for pollen and nectar collection by bees (Williams and Tang, 2008).

Sound utilization of honey bee for economic development cannot take place in absence of information and knowledge of important beekeeping resources. Unfortunately, most beekeepers have little information on important basic bee resource as such food plants and water. According to Heburn and Radloff (1997), detailed studies of honey bee plant relationship are still patchy.

Also 77.65% of the respondents perceived that the availability of honey bee flora resource decreased. They perceived that the reasons for the reduction of honey bee flora resource are attributed by settlements, cutting trees for fuel wood, fencing and building (Table 11). Also from analyses interview of the extension worker they explained that the reduction in honey flora resource are due to land clearing for cultivation, human settlements particularly due to renascence dame around low lands and cutting trees for fuel wood, fencing building and use of herbicide on crop and pasture lands. They stated that the use of herbicides i.e. 2, 4-D and glyphostate contributed to the reduction in honey bee flora resource through damaging the weeds which are found in the head grow and inside crop land, crop after math and pastured lands

Table 11: Change in honey bee floral resource

Items	Descriptions	Frequency	Percent
The source of food for honey production is.	Foraging	98	100
	Supplementary	-	-
	Feeding other	-	-
Do you consider flora source when hang hive	Yes	18	18.4
	No	80	81.6
What will decrease honey flora in your environment	Settlement	-	-
	Fuel wood	15	15.3
	Fencing & building	7	7.1
	All	76	77.6
The availability plant in your Keble from time to time	Increase	2	2
	Decrease	79	80.6
	Constant	17	17.3

4.8. Change in honey bee health

pesticide has became inevitable in modern agriculture with pesticide consumption increasing several folds during the last four decades, the side effects are also increasing and one of which is the toxicity to honey bees. Regarding pesticide use to control honey bee from predators like ants, 90.8% of the respondents agree that there is the use of pesticide and 9.2% do not agree on the use of pesticide to control predators (Table 12). Most of the respondents,74.5% replied that they do not understand the effect of pesticide used to control honeybee from the effect of predators on the honey production, 25.5% know its effect (Table 12). So from the observation of the researcher different pesticide beekeeper use and fire they use to control ants and predators also affect the honey bees.

With regard to agrochemical effect in honey production56.13% of respondents replied that pesticide (Like insecticide, Herbicide and fungicide) affect honey bee health, 20.40% of the respondents replied that herbicide affect honey bee health, 10.20 replied insecticide and 13.27 replied that fungicide affect honeybee health (Table 12). Studies showed that the indiscriminate application of agrochemical has increased from time to time, especially in the- dominate farming system (Kebede *et al*., 2007; Girma *et al*., 2008).

Similarly, livestock development agent explained the impacts of agrochemical use as:

"Now a day the honey bees did not return to the hives due to pesticide and other chemical poisoning, especially in the month from August-January. In wombera, different types of agro-chemical were in use, including a mix of endosulfan, diazinon and malathinon spray to control wheat and pasture lands: and a mix of glyphosate and 2, 4-D to destroy any plant materials available in crop land before ploughing the crop land (farmer name as gemilacherash) meaning, destroy any plant materials available in crop land (Apendix 4)." (Live stock development agent in Wombera, March 2018).

Majority of the respondent 93.9% replied that the trained of using herbicide was high, 3.1% replied medium and 3.1% said low (Table 12). From the observation of the researcher in the study area there is great use of herbicide on farm land and use of fungicide in wheat crop to control effects of weeds and fungus respectively (Figure 7). Study revealed that problem of

pesticide and herbicide spray was faced by majority of beekeeping in the mixed crop - livestock production system, resulted in killing of honey bees, which caused great loss (Kebede *et al*., 2007). More over the use of herbicide in place of hand weeding can also affect honey bees negatively by damaging the forage.

Figure 6: Herbicide spraying on farm land in the study area**.**

Honeybees are exposed to a broad range of various environmental stressors, which can be having an impact to apiculture. According to the respond of beekeepers, 58.2%, 24.5%and 17.3% replied that the effect of honey badger was high, low and medium respectively (Table 12)**.** Accordingly, from the field observation of the researcher one of the most series problem that make most of the farmer not involved in honey production was the effect of ants and honey badger, Because their hive was hanged far from house where there are trees with available branches to hold many hives (Figure 6) and in this situation it is very difficult to inspect daily.

Also 51.02% of the respondents replied that the effect of the spider on honeybee was high, 29.59% replied the effect of spider was low and 19.39% replied medium (Table 12).

Table 12: Change in honeybee heath and predators

Items	Description	Frequency	Percent
Do you use pesticide to control honey bee from predators.	Yes	89	90.8
	No	9	9.2
What affect honeybee health in your environment?	Insecticide	10	1o.20
	Herbicide	20	2o.40
	Fungicide	13	13.27
	All	55	56.13
The trained of using herbicide on farm land in your Keble is	High	92	93.9
	Medium	3	3.1
	Low	3	3.1
What is the effect of honey badger on honey production?	High	57	58.2
	Medium	17	17.3
	Low	24	24.5
The effect of spider on honey production is.	High	50	51.02
	Medium	29	29.59
	Low	19	19.39

4.9. Analyzed interview of extension workers

In the study area most of the farmers are involved in mixed farming including beekeeping. In these agricultural activities only male are involved in beekeeping activities, because the traditional practices of hanging hives on trees need experience, technique and in culture females do not climb trees. Also as stated by extension worker in this study area one of the basic problem for the reduction of honeybee colony and honey production is unmanageable traditional activities like using fire to feed on wild nest and burning the bees and nest of bee to harvest honey (Figure 8). Lack of skill full beekeeping experts, including the livestock development agents, districts and zone beekeeping experts is a problem for beekeeping and honey production. As stated by experts in this study area there was finical problem to support beekeepers, Due to this the technical advices that have been delivered to beekeepers is not satisfactory.

Figure 7: Tree burned by human during harvesting of wild honey

In this study area now a days there is much use of agrochemical like herbicide and fungicide to control the effect of herbs on farm land and fungi disease of wheat. Also the hive used in this study area is mostly traditional and the quantity and quality of honey produced is very low. Some of the modern hives that exist at FTC center are not functional due to effect of predators particular ants and lack of skill to manage the colonized hive. The other main factor that is associated with reduction of honey production is human activities and climate change, i.e. human removed forest far farm land. Thus, reduce the flora source for bee foraging. Also climate change, change of rain seasons make the bees feed the prepared honey.

5. Conclusion and recommendation.

5.1. Conclusion

Despite the importance of beekeeping for farmers in the study area, the finding of this study shows that the honey bee colony and honey production decreased. These changes were due to various factors such as, lack of flora resources, agrochemical exposure, honey bee pests and predator and environmental changes. The trends show that the beekeeping system is highly at risk.

Majority of the beekeepers, in the study districts produce honey for home consumption than for market. The most widely used type of beekeeping in the study area is traditional due to the high cost of the improved hives and their accessories. From the study, it was understood that the colony population is decreasing from time to time due to destruction of forest areas for crop cultivation and different constraints particularly insecticide, predators and bee diseases.

From the results of the study in the districts only males are involved in honey production due to difficultness of the traditional practices and low attitude of the society towards honey production, so awareness creation and assistance is needed to empower women in beekeeping activities. The findings also show that the beekeeping was not in harmony with crop production, because the agro chemicals in use to control crop pests including weeds have been affecting the honey bees health. The expansion of the crop land has been damaging the herbs, shrubs that are important honey bee floral resources.

Most of the hive used in the study area are traditional and hanged on trees near home or far from house in forest in a condition difficult to manage. Due to this the inspection frequency of colonized hive is mostly accidental or rare. Honey produced in the area is harvested in traditional way and its quality was low with weak market acceptance. The support of developmental agents in giving training, finical support and initiation of farmers in the beekeeping was low.

In this traditional practice the feeding of bees was total by foraging and no trained of giving supplementary food and water by beekeepers. Also farmers refer to suitability of trees branches to hang hives rather than considering flora source and water requirements for honeybees.

5.2. Recommendation

- In the study area the government and non-government should be contributed the male and female beekeepers proportionally in different beekeeping trainings

- Introducing modern beehives that can make households produce more for market than home consumptions
- Awareness creation and assistance is needed to empower women in the beekeeping activity
- Training on safe use of pesticides
- Training farmers by developing project to change traditional practices and facilitate modern harvesting to produce qualified honey that increase market acceptance of honey.
- Develop the habit of selling wax and if possible bees colonies.
- Developing environmental protection to conserve different vegetation that is the flora source of bees and continuous inspection of apiary area to manage and protect bee's from predators.

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Appendices

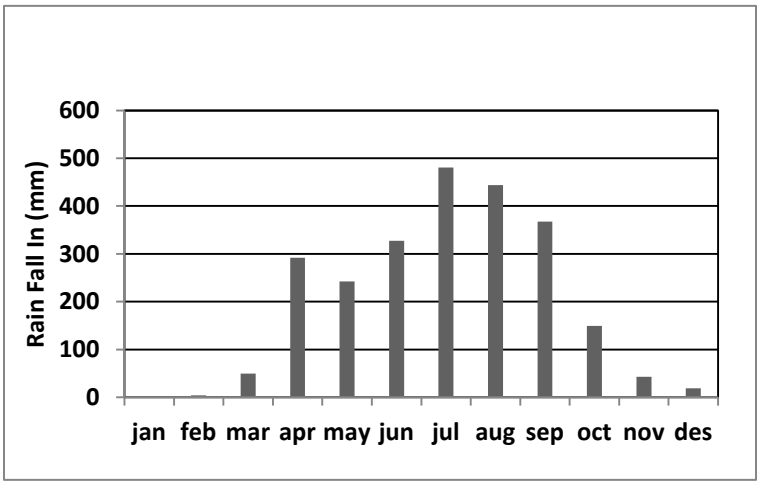
Appendix 1: Interview with extension expert

Apendix-2: Traditional hive**.**

Appendix 3a: Observation of bees disturbance on flowers during herbicide spraying on farm land

Appendix 3b: Observation of bees disturbance on flowers during herbicide spraying on farm land

Appendix4: Farmer spraying herbicide on farm land



Appendix 5: Wombera districts monthly average rain full distributions

Appendix 6-questionier

Addis Ababa University

College of natural science

Department of zoological science

Questionnaire to be filled by farmers/beekeeper

Dear respondents.

The purpose of this study is to assess factors that associated with honey production in Wombera districts. Therefore, your responses are very important for success of the study. Be sure that your response will not be used for other purpose rather than honey production.

Please note the following points before you start filling the question.

1. You are not required to write your name on the questionnaire.
2. Read all the instruction before attempting to answer the questions.
3. Please provide appropriate response by circling on the letter that holds your answer. Write your opinion briefly for short answer question on the space provided.
4. Your response will be kept confidential

Back- ground information

Indicate your response by circling on letters.

Name of Keble_____

1. Location of Keble. A. Urban B. Rural
2. Sex A. Male B. Female
3. Age

18-40	40-60	60 and above

4. The level of your education is A. Able to write and read B. cannot able to write and read C. 5-8 D. 9-10

Change in honey bee colony, productivity and use of hives

5. The honey bee colonies availability in your environment from time to time:
   A. Decrease B. Increases C. No change
6. If your answer is decrease, What is your reason:

   _____

   _____

---

7. What is your income from honey from ancient to now? A. Increase B. Decrease
   C. Constant
8. If your answer, In the above question number, 7 is decrease what would be its cause?

_____

_____

9. What type of hive do you use? A. Modern B. Traditional C. Transitional

10. Agro-climatic zone of hive placement in your surrounding is? A. Back yard of the house
B. Trees near home C. Inside a simple shelter D. under the eaves of the house

Management of honey bee colony

11. During harvesting honey do you prepare available nest for honey bee? A. Yes B. No

12. If your answer is no, what is the chance of
honeybee_____

_____

13. Inspection frequency of your colonized hives? A. Daily B. once a month
C. Only during harvesting D. 1-3 times

Change in consumption of honey and marketing of beekeeping equipment and honey bee production.

14. Honey harvested in your Keble is mostly used for? A. Export B. Home consumption

15. What is the market acceptance of your honey to facilitate beekeeper activities?
A. High B. Medium C. Low

Beekeeping information center

16. How many times do you train beekeeping at FTC? A. Once a month B. twice a month
C. once in a year D. No

17. Do you expect that training or creating awareness about honey production is enough?
A. Yes B. No

18. What is the support of extension workers in honey production? A. High B. Low C. medium

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

Physical stressors in honey production

20. The effective of land use change on honey production is? A. High B. Medium C. Low

21. The effect of deforestation on beekeeping is? A. High B. Low C. Medium

22. Does the variability of climate reduce honey production in your environment? A. Yes B. no

23. Which group of sex group are involved in honey production? A. Male B. Female

Change in honey bee floral resources

24. What is the food for bees in your environment? A. Foraging B. Supplementary C. feeding others

25. Do you consider floral source when you hung hive? A. Yes B. No

26. What will be decrease honey flora? A. Settlement B. Fuel wood C. fencing and building

27. What is the availability of floral plant in your environment from time to time? A. Increase B. Decrease C. Constant

28. your answer in the above question is decrease, What will cause it_____
_____
_____
_____

Change in honey bee health

29. Do you use pesticide to control honey bee from predators like ants? A. Yes B. No

30. In question 28 above if your answer is yes, do you understand its effect on bees?
A. Yes B. No

31. What affect honey bee health in your environment?

A. Pesticide B. Herbicide C. Fungicide D. all

32. The trained of using herbicide farmland in your Keble is? A. High B. Medium C. low

33. Is there honey badger (*Mellivora , capensis* in your environment. A. Yes B. No

34. What is the effect of honey badger on honey production in your environment?
A. High B. Medium C. Low

35. What is the effect of spider on honey production? A. High B. Medium C. Low

Appendix 7-Focus group discussion

Interview Guide for key informant and extension

Part Back ground information.

1. Name of Keble_____
2. Sex A. Male B. Female
3. Age

18-40	40-60	Above 60

4. Working experience

1-4	5-8	9-12	13-16	>16

Basic question on honey production

1. Does your Keble have involved in honey production?
2. Which members of the society involved in honey production.
3. Do you visit farmer during harvesting honey production?
4. Do you trend beekeeper about honey production?
5. Do you create awareness for beekeeper to trend and pesticide use in your Keble? If YES? Do you trend them about its effect?
6. What types of hive do farmer /beekeeper use in your Keble? Traditional or modern?
7. Which hive type is more important in honey production?
8. Is there climate/weather change in your Keble? What is its effect on honey production?
9. What are the problems that affect honey production in your Keble?
10. What was the effect of predators on honey production? And which of them would be more serious problem in honey production?
11. What do you suggest as solution to over the problem?

Thank you