ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

OFFICE OF GRADUATE STUDIES

Assessment of Apiculture practices, Opportunities and Constraints in Gololcha district, Bale Zone, Oromia Regional State, Ethiopia

A Thesis

Submitted to the Department of Applied Biology

School of Applied Natural Science

In Partial Fulfillment of the Requirements for the Degree of Master's of Science in Biology

By

Tamiru Mulugeta Jima

Adama, Ethiopia

September, 2017

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Advisor: Dr.Yeshiemebet Major

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APPROVAL OF BOARD OF EXAMINERS

We, the undersigned, members of the Board of Examiners of the final open defence by **Tamiru Mulugeta Jima** have read and evaluated his thesis entitled **"Assessment of Apiculture practices, Opportunities and Constraints in Gololcha district, Bale Zone, Oromia Regional State, Ethiopia**" and examined the candidate. This is, therefore, to certify that the thesis has been accepted in partial fulfillment of the requirement of the Degree of Master of Science in Biology.

Advisor	Signature	Date
Chairperson	Signature	Date
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DECLARATION

I hereby declare that this M.Sc. Thesis is my original work and has not been presented for a degree in any other university, and all sources of material used for this thesis have been duly acknowledged.

Name: Tamiru Mulugeta Jima

Signature: _____

This M.Sc. Thesis has been submitted for examination with my approval as thesis advisor.

Name: Dr. Yeshiemebet Major

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Date of submission: _____

ADVISOR'S APPROVAL SHEET

To: Applied Biology department

Subject: <u>Thesis Submission</u>

This is to certify that the thesis entitled **"Assessment of Apiculture practices, Opportunities and Constraints in Gololcha district, Bale Zone, Oromia Regional State, Ethiopia**" submitted in fulfillment of the requirements for the degree of Master's of Science in Biology, the Graduate program of program of Applied Biology, and has been carried out by Tamiru Mulugeta, **Id.No** GSU/0412/06, under my supervision. Therefore, I recommend that the student has fulfilled the requirements and hence hereby he can submit the thesis to the department.

Name of major Advisor: Dr. Yeshiemebet Major

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Date: _____

BIOGRAPHICAL SKETCH

The Author, Tamiru Mulugeta Jima, was born from his father Mulugeta Jima and his mother Tsige Feye on June 29, 1984 in Bereket Kebele ,Gololcha District, Bale Zone, Oromia Region, Ethiopia. He attended his elementary and junior school education at Bereket primary school and Jara junior school. He attended grade nine and ten at Jara Senior Secondary School. He also attended grade eleventh and twelve at Ginnir Preparatory School. After completion of his preparatory school in 2004, he joined Dilla University Department of Biology and graduated in July 2007 with Degree of Bachelor of Science in Biology. After graduating, he was employed as a teacher at Jara Secondary and Preparatory School in Gololcha district in 2008. In 2014, he joined School of Applied Natural Science at Adama Science and Technology University as a candidate for Master of Biology. Still, he has been teaching biology at Jara Preparatory School.

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ACRONYMS

CSA	Central Statistical Agency
DA	Development Agent
FAO	Food and Agricultural Organization
FGD	Focus Group Discussion
HBRC	Holeta Bee Research Center
KII	Key Informant Interview
MoARD	Ministry of Agriculture and Rural Development
NGO	Non- Governmental Organization

ABSTRACT

This study was conducted to assess apiculture practices, opportunities and constraints in Gololcha district, Bale Zone, Oromia Regional State, Ethiopia from February to June, 2017. The main objectives of this study were to assess factors affecting honey quality and beeswax production, examine market constraints, identify the opportunities and major beekeeping constraints, and to assess the main problems that contribute to traditional beekeepers to remain in traditional method of apiculture in the study area. Both purposive and random sampling techniques were employed to select kebeles and specific farmer beekeepers, respectively. Accordingly, four Kebele peasant associations such as Borat, LemlemHalila, Kurawada and Kejewa were purposively selected from twenty five Kebeles and 120 sample beekeepers were randomly selected for the formal household survey. Primary data was gathered through formal interview using semi- structured questionnaire. Descriptive statistics and SPSS version 20 software were employed as analytical tools. The study found that about 96.7% of males and 3.3% of females were engaged in apiculture practices. The descriptive analyses indicated that traditional beekeeping was the dominant system and accounted for about 98.33% in the study area. About 97.5% of beekeepers didn't involve in various extension service and packages. The survey result was also found that about 94.17% of farmer beekeepers did not produce beeswax. Honey marketing system is not well developed in the study area due to lack of market information and beekeepers cooperative. The study area has huge potential for beekeeping activity. Among the major opportunities of apiculture in the study area were availability of potential flowering plants, existence and abundance of honey bee colonies, and indigenous beekeepers experience and knowledge. The major challenges that hinder the untapped potential of beekeeping were agro-chemical poisoning, pests and predators, absconding, lack of improved beehive and its accessories, and poor management system and lack of training. The study also identified the main factors that contributed to traditional beekeepers remain in traditional apiculture method in the study area. Integration of apiculture activities with natural resource conservation programs, introducing affordable and appropriate beekeeping technology through training and encouraging of community is recommended.

Key words: Apiculture, Bee, Constraints, Gololcha district, Opportunities

1. INTRODUCTION

1.1 Background of the Study

Apiculture has been practiced in the world for a long period of time (Nicola, 2009). It is also a very long-standing and deep-rooted household activity for rural societies in Ethiopia. It seems as old as the history of the country and it is integral part of the life style of the community (Adebabay *et al.*, 2008).

Ethiopia has favorable and diversified agro-climatic conditions, which creates conducive environmental conditions for the growth of over 7000 species of flowering plants. These flowering plants supported the existence of large number of wild bee colonies in the country (Beyene and David, 2007). The ideal climatic conditions and diversity of floral resources allow the country to sustain around 10 million honeybee colonies (Ayalew, 2001). Out of this 7 million are kept in local beehives by farmers and the remaining exists in the forests as wild colonies. This makes the country to have the highest bee density in Africa (Nuru, 2002).

According to the Ministry of Agricultural and Rural Development (MoARD), the current annual honey production of Ethiopia is estimated to be over 54,000 tones. This makes Ethiopia leading in Africa and ninth in the world in honey production. The country is also one of the third largest beeswax producing countries in the world (MoARD, 2013). Beeswax supports the national economy through foreign exchange earnings. It is also one of the major exportable agricultural products (Nuru, 2002).

Ethiopia earns about 420 million birr annually from the sale of honey. There is large and growing demand for honey and other bee products worldwide since it has nutritional and medicinal values (Gidey and Kibrom, 2010; Masuku, 2013).There is a strong local demand for honey due to its use for the production of traditional beverage '*Tej' (*honey mead). In Ethiopia, much honey has traditionally been fermented to make*'Tej'* and about 85% of the total honey estimated to be brought for market is used for '*Tej'* production and about 15% of the total honey produced is consumed at home (Edessa, 2005). Honey bees provide products such as honey, wax, pollen, royal jelly, propolis, venom, etc. These products can also with minimal processing be transformed into value added products. For examples, wax can be processed into candles and honey can be made into honey beer (FAO, 2012). Traditional beekeeping practice has been

known for long period of time than modern beekeeping method in Ethiopia. There are three different types of hives namely traditional, transitional and framed which are currently being used in different parts of the country (Debissa, 2006). Generally, the quantity and quality of Ethiopian honey is poor and about 95% of beekeepers follow traditional method of beekeeping practice with no improved techniques or technology (Oxfam, 2008).

Honey production is growing socio-economic significance worldwide, particularly in developing countries (Krell, 1996). The quality of honey and other hive products are key factors for both local and international markets. Honey quality consideration is an aspect disregarded by producers and processors especially in developing countries. Proper understanding and standardization of honey and other hive product components are most vulnerable during processing. Ethiopia has immense natural resources for beekeeping activity. However, like any other livestock sector, this sub-sector has been seriously devastated by complicated constraints. The honey production constraints are varied depending on the agro ecology of the areas (Edessa, 2002).

The elimination of good nectar and pollen producing tree species in many areas makes it difficult to maintain bee colonies without feeding. Shortage of bee forage is mainly resulted in Ethiopia due to deforestation and agricultural expansion. In Ethiopia, the major constraints that affect apiculture sub-sector are: lack of improved technology, shortage of bee equipment, pests and predators, pesticide threat, poor infrastructure development, shortage of bee forage and lack of research extension (Kerealem *et al.*, 2009).

Gololcha district is found in the South East of Ethiopia, which was not exception to the above facts. The district is covered with natural vegetations, shrubs and man-made forest, annual and perennial crops. This created favorable conditions to undertake apiculture activity and made the area has high potential for apiculture development. In the study area, there was no study that has been conducted regarding apiculture practices, opportunities and constraints and associated with it. Therefore, this study was conducted to assess apiculture practices, opportunities and constraints in Gololcha district, Bale Zone, Oromia Regional State.

1.2 Statement of the Problem

Ethiopia has enormous untapped potentials for the development of apiculture. There is a great potential in the country for working with communities by introducing minor and easily adaptable

apiculture production system leading to considerable gains in productivity beyond family subsistence (Melaku *et al*., 2008). Dependence on traditional and low technology input, poor pre and post-harvest management, inadequate extension services and poor marketing infrastructure are affecting the promotion and development of honey production and marketing. The supplementary role of beekeeping to household economy has been declining due to low production and poor quality of honey bee products. In Ethiopia, apiculture activities are mainly constrained by lack of beekeeping technology, market access and information transmissions, limited availability of bee forage (due to deforestation), shortage of honeybee colonies, inadequate government support, shortage of trained human power, and lack of access to credit services(Ayalew, 2008; FAO, 2012).

In Ethiopia, there are immense natural resources such as natural vegetation, water, suitable climatic conditions which create favorable conditions to undertake apiculture activities and make the country one of the potential country for apiculture sub-sector; but the country still could not harvest this existing potential to the required amount.

In the study area, there was suitable environment and huge potential to conduct apiculture. However, the majority of the rural households in the study area were inclined to traditional method of apiculture. The majority of the beekeepers did not engage in processing and preparing beeswax in required manner for home consumption and other purposes. The local producers did not provide significant quantity of apiculture products to the near towns and there was no experience of providing beekeeping products to the central market by local farmers and local traders which could play role in the national economy in general and increasing the income of the producers and traders in particular. As a result, I focused to assess apiculture practices, opportunities and constraints in the study area.

1.3 Objectives of the Study

1.3.1 General objective

- To assess the apiculture practices, opportunities and constraints in the study area.

1.3.2 Specific objectives

- To assess factors affecting honey quality and beeswax production.
- To examine market constraints that influence honey production in the study area.

- To identify the opportunities and major beekeeping constraints that available in the study area.
- To assess the main problems that contribute to traditional beekeepers to remain in traditional method of apiculture.

1.4 Research Questions

1. What are the factors influencing honey quality and beeswax production in the study area?
2. What are the major market problems that affect honey production?
3. What are the opportunities and major constraints that hinder apiculture development in the study area?
4. What are the main problems contribute to traditional beekeepers to remain in traditional method of apiculture?

1.5 Significance of the Study

Apiculture has significant contribution in strengthening livelihood of the communities and maintaining of ecosystem through cross pollination of plants. Ethiopia can earn significant foreign currency by exporting honey bee products to different countries which have a role in the national economy of the country. But, the country still didn't utilize its potential of producing beekeeping products for more gains due to various factors. The study area was one of the potential areas for honey production. However, apiculture activities were still at low level in the study area.

Therefore, this study was designed to identify the constraints that contributed to the challenges of low beekeeping activities in the study area. It recommended solutions to enhance the beekeeping activities to increase its role in the livelihood of the local community in particular and for the national economy in general. It can be used to allow governmental and non-governmental organizations which want intervention in apiculture activities in the study area. It can be used as inputs for other researchers who have interest in conducting further study in the stated subsector and study area.

1.6 Scope of the Study

The main focus of this study was to assess apiculture practices, opportunities and constraints in the district. The majority of the districts in Bale Zone have suitable environment to undertake beekeeping activities. However, the study is delimited to Gololcha. This district had twenty five peasant associations (known as Kebele) and two town administrations. From this, four rural kebeles such as Borat, Kurawada, LemlemHalila and Kejewa were selected based on the accessibility and potential for apiculture activities.

2. LITERATURE REVIEW

2.1 Apiculture and sustainable livelihood

Apiculture is one of the important agricultural activities in most rural areas of Ethiopia. It has been exercised as a sideline activity by many of the rural farming communities for its honey and beeswax production that contributes to income generation. It is one of the most important income-generating activities in the rural communities. Many resource poor farmers sell their honey to the local markets and use income to purchase livestock, agricultural inputs, food crops and other household items (Kerealem *et al*., 2009). It helps a family to become less vulnerable and strengthen their ability to look into the future and reduce the chance that they will slip in to poverty when there is farming failure (Nicola, 2009) .It is also play a significant role in enhancing food security, poverty reduction and food production through pollination of crops(MoARD, 2010).

According to FAO (2012), the various forms of beekeeping have been in practice for many years in many rural communities of Ethiopia. Introducing beekeeping as a business and building on pre-existent skills will improve the knowledge and capacity of small-scale farmers. This will enhance local traditions in beekeeping. Apiculture is 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 (United States Agency for International Development, 2012). It has also high social values in the country. The number of honeybee colonies and hives owned serves as a major wealth ranking in some societies (Nuru, 2007).

2.2 Apiculture and sustainable environment

Apiculture sustains agriculture which is the livelihood of the rural community by increasing yields through pollinating annual and perennial crops. It offers a good way for people to create income from natural resources without damaging it. It has significant role in ensuring food security through honey bee pollination services of major cultivated crops (Benjamin and McCallum, 2008). Honey bees are responsible for one third of all foods such as fruits, vegetables and dairy products, including ice cream. They also contribute to the fight against global climate

change. When bees pollinate, plants grow, the planet is cooler for the vegetation and greenhouse gases are reduced. It can help to increase the honey bee population and promote a healthy environment and chemical free food. In a time in which bee colonies are decreasing, keeping bees is more important than ever, if not for bees, a host of crops would fail food shortages would follow(Niki, 2009).

The acquisition of honeybees depends on wild colonies and the nectar sources which depend on natural vegetation. The basic elements of apiculture derive from the richness of the nature that provides two resources (nectar and pollen). Therefore, the closer the relationship between life and apiculture becomes the much higher the consciousness of conservation of forest and natural vegetation. The apiculture development has made it possible to raise awareness of the natural environment and to leads to engage in the conservation activities parallel to the beekeeping. Generally, honey bees have a high degree of adaptation to different environment, which are important parts of farming systems and do not cause land degradation and ecological imbalances. Forests provide an essential environment for bees, protect beehives and provide materials for beehive construction. Trees are also major sources of pollen, nectar and plant tissue (Hartmann 2004; Kato and Kawakita, 2004).

2.3 Honey bee products

Honey

According to Codex (2001), honey is defined as one of the oldest sweetening agents and natural substance that is produced by honey bees from the plant nectar, secretions of living parts of the plants and excretions of plant sucking insects on the living part of plants. Honey bees collect, transform and combine this with specific substances of their own and then store it and leave it in the honeycomb to ripen and mature.

It has value as food, medicine and cash crop for both domestic and export markets. Honey is valued everywhere as sweet food. It is a useful carbohydrate source that contains trace elements and adds nutritional diversity to poor diets. It is used as medicine or tonic in many parts of the world to treat children from different ailments. Modern medicine is increasingly using honey for variety of treatments. It has anti-biotic properties. It is a solution with a high sugar concentration that prevents the growth of microorganisms. It is highly acid and contains enzymes which produce hydrogen per oxide that kills bacteria and it has hygroscopic characteristic good for

drying out wounds. Fresh local honey is always more highly valued than imported honey. Many beekeepers sell their products directly to consumers. Honey is often used as a barter commodity in remote areas and it has long shelf life, if harvested and kept well. Moreover, honey is exportable crop. Most developed countries import honey to meet such demand. This requirement can provide developing countries with useful source of foreign currency exchange from honey exports (Nicola, 2004; Benjamin and McCallum, 2008)

Beeswax

It is the substance that is produced by young worker honey bees and used to build their nest. It is valued according to its purity and color. Light colored wax is more highly valued than dark colored wax (FAO, 2003). For several reasons wax is an excellent commodity for rural communities to use as a cash crop. Beeswax processing is not as such complex, its transport and storage is simple. It doesn't deteriorate and individual beekeepers or cooperatives can store small amounts until they have enough to sell. It has many traditional uses. In some countries in Asia and Africa it is used in creating batik fabrics and casting small metal objects. It is widely used as water proofing agent for wood and leather and strengthening threads. It is used in making candle, ingredient in ointments, medicines, soaps and polishes (Ayalew, 2006). The product has great demand on the world market. There are more than 300 industrial uses for beeswax. Cosmetics and pharmaceutical industries are the major ones accounting to 70 percent of the world trade. Moreover, beeswax is used in manufacturing electronic components, modeling, in polishes for shoes, furniture, floors and in specialized industrial lubricants (Nicola, 2004)

Propolis

It is also known as honey bee glue, which is a resin-like product collected by honey bees from vegetable exudates to maintain and repair the beehives. Honey bees collect resins and gums from bud or injured areas of plants (Thomson, 1990). It has been used as medicine and it has been proved scientifically that propolis kills bacteria. It is used by honeybees to weatherproof the hive and for other sanitation purposes including sealing cracks to prevent the growth of bacteria and fungi. It is also commonly used as an ingredient in toothpaste, soaps and ointments (FAO, 2003).

Royal jelly

It is the food that worker bees give to freshly hatched larvae. It contains much insect growth hormones and is valued as a medicine, tonic or aphrodisiac in various parts of the world (Nicola, 2004).It is also a pasty substance produced in the hypo pharyngeal gland of young worker bees. It is extremely rich in proteins and fatty acids (FAO, 1996).

Venom

It is synthesized by the venom glands of workers and queens, which is stored in the venom reservoir and injected through the sting apparatus during the stinging process. The sting apparatus of bees is in fact a modified egg-laying organ (ovipositor), which is present in many other female insects. It is a bitter hydrolytic blend of proteins with basic pH. It has long been used for treating various human ailments in many cultures, particularly for its alleged anti-inflammatory and anti-arthritic effects. The venom gland is located in a chamber at the end of the abdomen and is completely separate from all other glands and organs of the bee. Bee venom is commercially collected by means of a special apparatus that uses electrical current to force worker bees to sting a rubber mat or synthetic membrane and the venom is collected on a glass plate positioned below the membrane. The device is inserted into each hive and operated for only a few minutes (Schmidt and Buchmann, 1992; Gezahegn, 2001)

Bee Brood

It refers to the immature developmental stages of the honey bee, eggs, larvae and pupae. The larvae, pupae and adult bees can be harvested from the hive for several purposes. Adult bees are collected to be sold as packaged bees. The larval and pupal stages are sold for animal feed and for human consumption. They are removed from uncapped cells by shaking the frame or gently flushing the cells with water. The larvae and pupae can be consumed fresh, dried or frozen as a protein-rich food (Lorna and Darcy, 2010).

2.4 Distribution of Honey Bee species in Ethiopia

In the world, honey bee is the most important and valuable insect. Several species of honeybees exist in the world, but *Apis mellifera* is the famous. It is a wonderful and popular bee type for its honey and beeswax production (Ayalew, 2001). According to the multivariate morphometric analysis of Ethiopian honeybee population, five statistically separable morphometric clusters

occupying different ecological areas: *A.m.monticola*, in northern mountainous high land, *A.m. jemenitica,* in eastern, north eastern and north western arid and semi-arid lowlands, *A.m.bandasii,* in central moist highlands, *A.m. scutellata* in western, southern and southwest humid midlands (tropical forest) and *A.m. woyi-gambella* in south western semi-arid to sub humid low lands (Amsalu *et al.,* 2004).

2.5 Types of Beehives Used

The supply and quality of honey is determined primarily by the beehive type in which it is produced. The beekeeper plays an important role in improving the types of beehives used for better quantity and quality bee products. The quality of the products can scarcely be improved once they have been removed from the hive, but their quality can be diminished during harvesting extraction. Durability can be improved by further processing but this also diminishes the quality in certain ways: the product loses its freshness and its therapeutic value is reduced. The edible products (honey, pollen, bee bread, bee milk and bee brood) all contain biologically active ingredients that can lose some of their effectiveness. Beeswax, propolis and bee venom, on the other hand, retain their original qualities much better after extraction and further processing (Olagunju, 2000; Hasan and Suleyman, 2010)

The traditional beehives were initiated in an attempt to utilize the cheap and plentiful local materials for hive construction. Modern beehives have a box-like enclosure with removable top or frames, which facilitate routing inspection of the established colonies. The increasing awareness about honey consumption and other hive products in the world is for a concerted effort on boosting honey production and its quality (Olagunju, 2000). Moreover, beekeeping is an appropriate and well-adapted farming practice to extensive range of ecosystems of the country. Over 10 million of bee colonies are found in the country, which include both feral and hived ones (Ayalew, 2001).

2.6 Rationale for Conducting Apiculture

There are ten reasons for conducting apiculture (Nicola, 2009). These are:

- Pollination: Bees pollinate flowering plants and cultivated crops which useful for maintaining ecosystem.
- Honey: People everywhere like honey which is valuable food and income source.

- Beeswax and other products: Beekeeping also helps to get products such as beeswax, propels, pollen and royal jelly which have many uses.
- Free resource utilization: Beekeeping is feasible even for people with minimal resources. Bees are obtained from the wild, equipment can be made locally, and bees don't need the beekeeper to feed them.
- Nectar and pollen are not used by other livestock, only bees harvest these resources, so there is no competition with others. Without bees, these valuable resources could not be harvested.
- Different sectors and trades benefit from a strong beekeeping industry: Other local traders benefit by making hives and equipment.
- Beekeeping encourages ecological awareness: Beekeepers have a reason to conserve the environment ensuring that flowers are available and bees are protected.
- Everybody can be a beekeeper: Bees can be kept by people of all ages, do not need daily care and can be done with other works.
- Beekeeping is benign: Beekeeping generates income without destroying environment. It encourages the maintenance of biodiversity.

2.7 Opportunities for Apiculture

The major opportunities for beekeeping in Ethiopia include suitability of agro-ecology (availability of potential flowering plants, ample sources of water for bees), existence and abundance of honeybee colony sources, long tradition of beekeeping by the farming community (beekeepers' experience and practices), marketing situation of honeybee products, presence of research center for beekeeping, establishments of Ethiopian Beekeeping Association, the current government agenda of natural resource management (soil and water conservation), the presence of governmental and non-governmental organizations (Workineh, 2006; Tessega, 2009).

2.8 Constraints of Apiculture

2.8.1 Pests and predators

Ethiopia is one of the sub-tropical countries, which the land is not only favorable to bees, but also for different kinds of honey bee pests and predators that are interacting with the life of honey bees (Desalegn, 2001). Pests and predators cause a serious devastating damage on honey

bee colonies with in short period of time and even overnight. The major bee pests and predators are wax moth, spider, ants, bee-eater birds, honey badger and beetles are the most serious problems to beekeeping development (Kerealem, 2005).

2.8.2 Shortage of bee forage

It is directly related with deforestation of forest coverage from time to time for timber making, construction, fire wood and expansion of agricultural lands. Most beekeepers have been migrated their bee colonies from their area to other area during the dry season for searching bee forage. This will increase the expense of farmers in the form of wage and cause colony loss through pests and predators. The elimination of good nectar and pollen producing tree species in many areas make it difficult to maintain bee colonies without feeding (Kerealem, 2005). Due to deforestation, the honey bee population is in state of continues declining. As a result, it has become a serious challenge to get honey bee colonies to start and expand beekeeping (Nuru, 2007). Beekeeping sector is dependent on healthy flora and a healthy environment. Recent years have seen environmental changes in Ethiopia in terms of erratic rain fall patterns and deforestation. If these problems worsen the beekeeping sector could be affected (Oxfam, 2011).

2.8.3 Problems of agrochemical applications

The district farmers are producing mainly wheat, barley, teff, chick pea and different horticultural crops. They use chemical spray such as pesticide and herbicide for pests and weed controlling without considering damage it cause on bee colonies. The chemical spray used by district farmers is also destroying bee forage like herbs and shrubs which is used as sources of bee forage. Insecticides have a much more dramatic effect on population of bees. Thus, the important contribution made by honey bees to the production of food and human nourishment is declining .On the other hand, herbicides, which are commonly not toxic to bees; destroy many plants that are valuable to bees as source of pollen and nectar. The types of chemicals used include Malathion, Sevin, DDT, 2-4 D and Acetone (Kerealem *et al*., 2009). Poisoning of honeybees by agrochemical has been increased from time to time. Some beekeepers lost totally their colonies due to agrochemicals. Today, there is a growing pesticides grievance on honeybee population and their products decline with considerable economic impacts on beekeepers (Desalegn, 2014).

2.8.4 Poor management system

Most of beekeepers have less knowledge and experience to apply knowledge-based beekeeping management following seasonal variation in nectar flow and honeybee population dynamics in local or traditional beekeeping. In the 'frost period' for instance, most of the inexperienced or unqualified beekeepers harvest without retaining enough honey in the hive for honeybee colony maintenance. Some of beekeepers visit their hive properly and the rest visit to check if the hive was occupied with bees and at least during honey harvesting seasons. Interval hive inspection is not well known by beekeepers. Some Beekeepers cleaned their apiary (around tree) and put ash under the tree to avoid small ant and ant like insect from climbing the tree and get access to hives while the rest did not clean their apiary or under tree. Except few, most of the farmer beekeepers did not have any type of beekeeping equipment and did not bother about their colonies while harvesting. As a result of this, honey bee colonies abscond or migrate after honey harvesting season (Tesfaye and Tesfaye, 2007).

In addition to this, some farmers who have modern beehives did not manage it properly. This might be due to lack of training and knowledge on improved beekeeping practices, lack of supervision or follow up after hives distribution by donor organizations and might be also due to carelessness of the beekeepers. The hives did not have hive stand rather it has been kept on inappropriate stone and woods. Moreover, the hives were totally surrounded by grasses and shrubs. This could affect bees from entering into and coming out from hives. This can waste pollen they collected while they struggle to enter the hives and also kill bee working time. Some of the hives did not have lid, but they covered it with plastic materials. Others were in a position to loge down due to unsuitability of stands. Most of the modern hives were not bounded (fenced) and placed on bare land without shade. If the bees disturbed, they can affect livestock and human being available in the surrounding area (Tesfaye and Tesfaye, 2007).

2.8.5 Problems of harvesting

Traditional beekeepers and honey hunters have developed various ways of harvesting and utilizing honey and other hive products. The traditional hive allows every comb to be used both for laying egg by the queen and for honey and pollen storage by the workers. Extracted honey includes brood and pollen, which is destructive and contaminating. Destroying broods while

harvesting slows regeneration of bee populations and impedes sustainable production (Melaku *et al*., 2008).

2.8.6 Packaging and packing materials

According to FAO (2012), packaging can be a major constraint to bee product marketing. Mostly this is carried out in rural and remote areas using recycled drinking bottles and other packaging materials. However, very often these types of packaging materials are unsuitable for wider distribution of bee products to town, city and export markets. Improved packaging materials like new glass jars with lids for honey are not commonly available in many areas and their cost can be high.

2.8.7 Problems of marketing system

Honey market starts at the smallholder beekeepers level who mainly sells crude honey to collectors in the nearest town/village markets. Therefore, the producers are price takers. The collectors mainly pass the honey to the whole sellers in big cities and towns though significant amount of honey they collect and also sell to local tej brewers, processors and other consumers. The whole sellers are largely situated in cities and big towns and they distribute the honey they get from collectors to retailers, tej brewers, processors and consumers. In some areas, beekeepers form producing and marketing cooperatives to cope with the market challenge they face. The cooperatives collect crude honey from their members and sell the semi-processed honey to processing companies and other intermediaries who buy in bulk and retail. However, in many cases the cooperatives lack proper collection, storage and transportation facilities (Workineh, 2006; Assefa, 2011).

The major constraints of marketing honey and beeswax in the country include low and discouraging price of honey and beeswax in local markets, lower quality of products, lack of market information, absence of organized market channel, transportation problem, lack of appropriate technologies for collecting, processing, packing and storage of honey to keep its natural quality, lack of government support in promoting market development and low involvement of private sector. Similarly, most of the local markets are far away from the beekeepers and are inaccessible. Beekeepers travel on foot for several hours to sell their honey (Gezahegn, 2001; Kerealem *et al*., 2009).

Generally, the major constraints in the apiculture sub-sector are: the unpleasant behavior of bees (aggressiveness, swarming tendency, and absconding behaviors); lack of skilled manpower and training institutions; low level of technology used; high price of improved beekeeping technologies; drought and deforestation of natural vegetation; poor post- harvest management of beehive products and marketing constraints; indiscriminate application of agrochemicals; honeybee disease, pest and predators; poor extension services; absence of coordination between research, extension and farmers; absence of policy in apiculture; shortage of records and up-to-date information and inadequate research institutions to address the problems. But, all these problems may not be a constraint to all parts of the country and may not be equally pressing to every place. So, it requires characterizing the constraints in their respective places to take an appropriate development measure (Ayalew, 2001; Edessa, 2002; Gidey and Kibrom, 2010).

2.9 Apiculture Systems in Ethiopia

Ethiopia is endowed with adequate water resources and various honeybee floras, which create fertile ground for the development of beekeeping. Honey hunting and beekeeping have been practiced in the country for the exploitation of honey. The wild honey bee colonies are found in hollow trees and caves. Honey hunting is still a common practice in Ethiopia (Tessega, 2009). According to (HBRC, 2004), there are four different types of beekeeping practices in Ethiopia namely, traditional forest, traditional backyard, transitional and improved beekeeping.

2.9.1 Traditional apiculture system

It is the oldest and the richest practice, which has been carried out by the people for thousands of years in Ethiopia. This beekeeping practice is extensive and closely tied to swarm management. Beehives are hung up in trees to catch swarms and are then transferred to the ground. Often, such beehives are placed in a kind of bee house that protects the beehives from the heat and rain. Traditional beehives are crafted by creating a tube shaped structure using branches, straw, cow dung and clay. Beehives are typically 30-40 cm across and 1 m long. Sometimes they can be carved from a soft log, such as from a cactus tree (Gallmann and Thomas, 2012).

Several million bee colonies are managed with the same old traditional beekeeping methods in almost all parts of the country (Fichtl and Admasu, 1994). This beekeeping practice different based on the resource in the area for the beekeeping activities. There are two types of traditional beekeeping is found in the country. These are forest and backyard beekeeping.

Forest beekeeping is commonly exercised in forest-covered areas of the country where the population of honeybees are abundant. The advantage of forest beekeeping is the bees do not cause harm to the domestic animals and humans and the bees can get access to abundant forage plants in their vicinity. Its disadvantages are lack of close follow up during honey harvesting period as the beekeeper drops down the hive from the tree, it damages the honeybee colony. It is also dangerous for the beekeeper to climb tall tree in night (HBRC, 2004).

Honey hunting is practiced by many people on an opportunistic base in the forest dominated localities in the region (Solomon, 2007).Traditional back yard beekeeping is undertaken in safeguarded area for honeybees mostly at homestead. The advantages of such practices are: construction is very simple, it does not require improved beekeeping equipment and it does not also require skilled manpower. Its disadvantages are inconvenience to undertake internal inspection and feeding. In some places the size is too small and causes swarming, it has no possibilities of supering and there is no partition to differentiate brood chamber and honey chamber (HBRC, 2004).

2.9.2 Transitional apiculture system

Intermediate apiculture system is one of improved method of beekeeping practices. The hives can be constructed from timber, mud or locally available materials. Each hive carries 27-30 top bars on which honeybees attach their combs. The top bars have 3.2cm and 48.3cm width and length, respectively. Intermediate apiculture practice has different advantages such as, it can be opened easily and quickly, the bees are guided into building parallel combs by following the line of the top bars, the top bars are easily removable and this enables beekeepers to work fast, the top bars are easier to construct than frames, honeycombs can be removed from the hive for harvesting without disturbing combs containing broods, the hive can be suspended with wires or ropes and this gives protection against pests. Transitional beekeeping has its own disadvantages such as top bar hives are relatively more expensive than traditional hives, combs suspended from the top bars are more apt to break off than combs which are building within frames (HBRC, 2004).

2.9.3 Movable-frame beehive apiculture system

According to Nicola (2002), modern apiculture methods aim to obtain the maximum honey crop season after season without harming bees. It uses different types of frame hives. Zandar and

Langstroth hives are the most common that exist in the country. Dadant, Modified Zandar and foam hive are found rarely. These hives differ in number and size of frames. The most commonly used hive type in Ethiopia is Zandar type. Frame beehives have components like brood chamber, super (honey chamber), inner and outer cover. Frame or box beehives have an advantage over the others in that it gives honey yield both in quality and in quantity. The other advantages of improved box hive is its possibilities of swarming control by easily giving additional space (supering) to the bee colony and it allows easy movements from place to place for searching high potential honeybee flower and pollination services. On the other hand, its disadvantages are the equipment are relatively expensive, requires skilled manpower and the equipment needs to maintain precision while constructing (HBRC, 2004).

2.10 Resources Required for Apiculture

Some resources are required to undertake beekeeping activities (Nicola, 2009:2). These resources are:

- Natural resources: Bees, honey bee flora and other natural resources.
- Human resources: The existing skills, knowledge of the producer and skill in packaging and marketing.
- Social resources: Assistances available from families, friends, network member-ship of groups, access to wider society, market information and research findings.
- Physical resources: Tools, equipment, buildings, transport and road.
- Financial resources: Finance required purchasing equipment and other inputs

3. MATERIALS AND METHODS

3.1 Description of the Study Area

3.1.1 Location and population

The study was conducted in Gololcha district (Figure 1), which is located in Bale zone, Oromia regional state in South East part of the country. The total area of the district was 2392 km^2 (239,200 hectare), which ranked the district the Tenth largest among the zonal district. It is bounded by Gasera district in the West, Lega-hidha and Sawena in the East, Ginnir district in the South, Arsi and West Hererge in the North. It was about 550 km away from Addis Ababa and about 120 km from Robe, which is the capital city of Bale. Astronomically, the district lies between 13^0 15'00''-13^0 38'30''N latitude and *$49^0$17'30''-$39^0$47'30''E* longitude. This district contains about twenty five kebele peasant associations and two town administrations known as Jara and Dinsa (Gololcha Rural Land and Environmental Protection Office, 2015).

The total population was about 116,778. From this about 58,972 were males and 57,806 were females. There were high concentrations of population in rural areas than urban areas in the district. The rural population was 107,844 and urban population was 8,934 (CSA, 1999).The population of the study area composed of Oromo ethnic group (major) and other belongs to other ethnic groups. Regarding the livelihood of the population, the majority of the population engaged in agriculture which includes crop production, animal husbandry and pastorals. They produced crops like wheat, barley, maize, teff and coffee. They also produced vegetables, fruits and chat. Moreover, they are engaged in beekeeping activity parallel with the above stated activities for home consumption and income generation (Gololcha Agricultural and Rural Development Office, 2015).

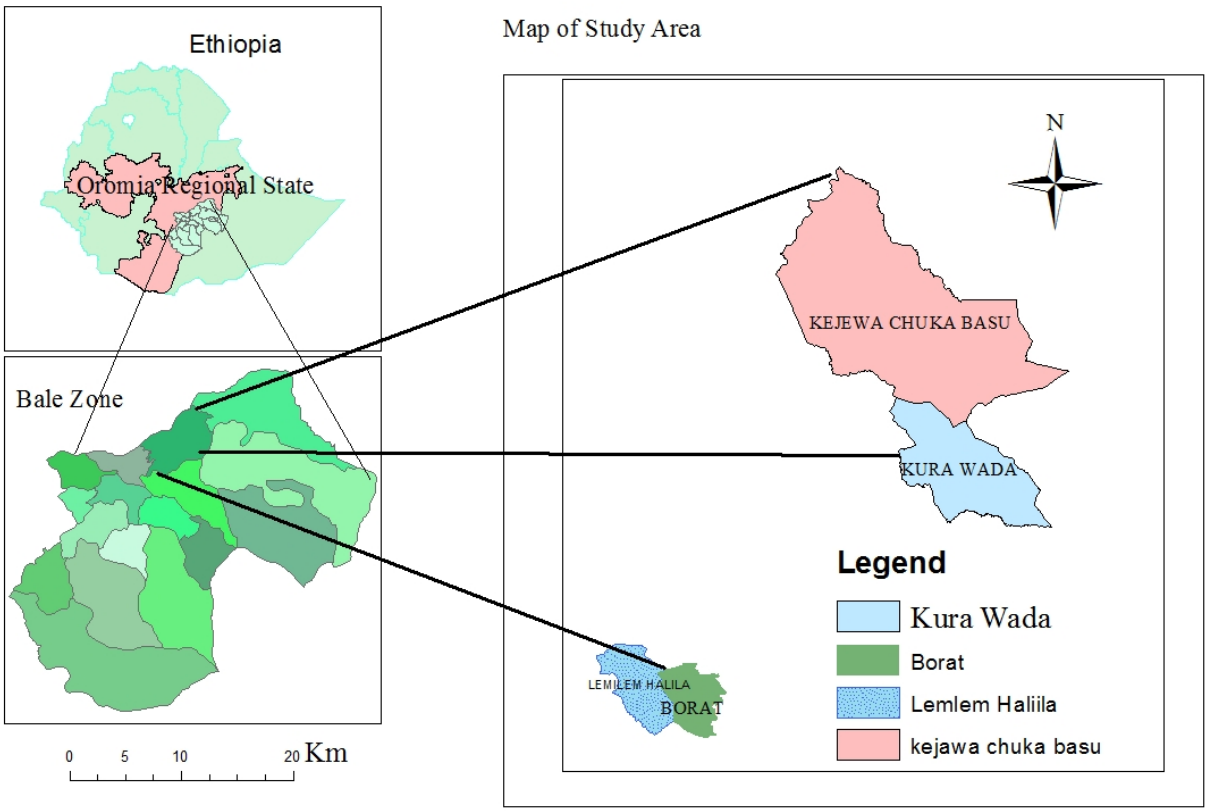

Figure 1: Map of the Gololcha district

Source: Geographical information system by Eshetu Kebebew, 2017

3.1.2 Topography, altitude, climate and vegetation

There were about 4% plain land, 54% rugged terrains, 2.5% valley, 3% mountains and 0 .5% was the composition of different setting structure in the district. The central and southern part of the district had relatively hills and ranged plateaus that elevated up to 2660m above sea level. The most prominent and significant mountains peaks in the district was mount Arab lij (2660m), mount Abinas (2600m), mount Kubayo (2390m) and Mount Dadala (1928m). The altitude of the district was between 1200m to 2660m above sea level. Based on altitude, the district is classified in to three-agro climatic zones. Namely, high land (2301-2660),which covers about 12.82%, semi- high land (1501-2300),which covers about 52.84% and low land (1200-1500),which covers about 34.34% of the area (Gololcha Rural Land and Environmental Protection Office, 2015).Regarding rainfall and temperature, five years data (2011-2015) were taken and calculated

from the National Meteorological Services Agency. The mean annual rainfall of the district was 910mm.The study area had bimodal types of rainfall regime. The first regime was characterized by one rainy season that extends from March to June. But, months with heavy rainfall were May, August and September. This type of rainfall covers all the parts of the district. The second type of rainfall in the district was the one rainy season that extends from August to November (Figure 2).

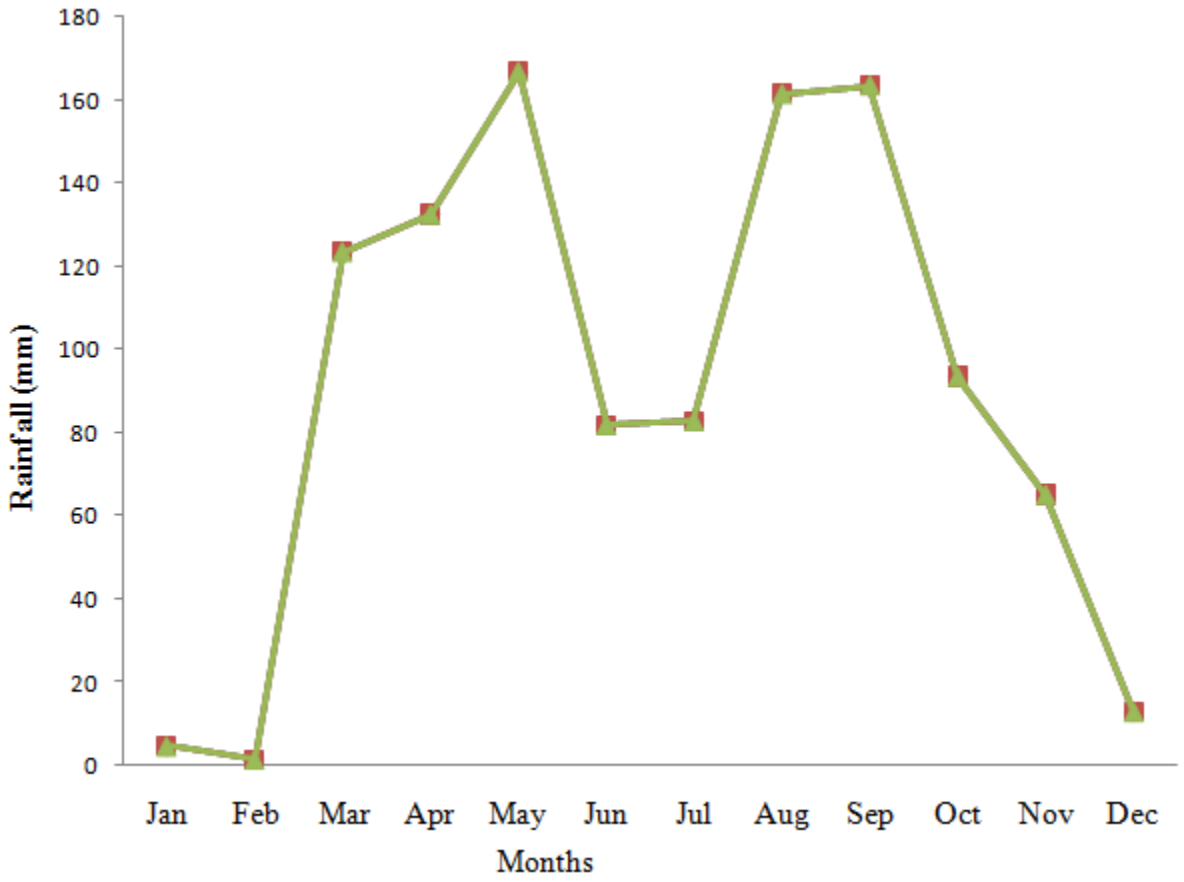

Figure 2: The average monthly rainfall distribution of the study area from 2011-2015

Source: National Meteorological Services Agency, 2017

The average minimum and maximum temperature of the study area was 12.51^0C and 26.03^0C. The months with high temperature were January, February, March and April and months with low temperature were October and December (Figure 3). Gololcha district is characterized by a great diversity of temperature as a result of wide range of altitudinal extent. In the northern part of lowland area along Wabe River, the area experience moderately warm temperature. This thermal zone covers 35% of the total area of the district. Semi- highland temperature areas of the

district are found in all part of the area except in the northern part of the district. These thermal zones cover 49% of the total areas of the district. High land temperature areas of the district are found central part of the district, which covers about 16% of the total areas of the district (Gololcha Agricultural and Rural Development Office, 2015).

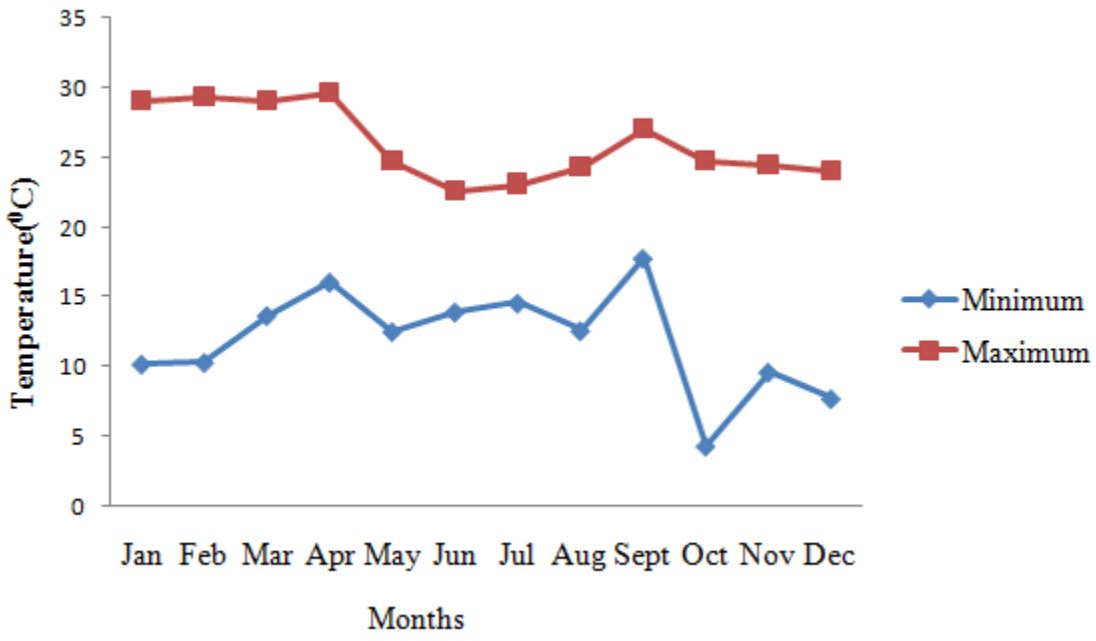

Figure 3: The average monthly temperature distribution of the study area from 2011-2015

Source: National Meteorological Services Agency, 2017

Distribution of vegetation is controlled by natural (climatic, soil and altitude) and human factors. It can develop to its maximum stage depending on the optimum growth condition provided by the former factors and the absence of the interference of the later factors. The distribution of natural forest in district was a direct reflection of altitude and climate. The variation of temperature and rainfall determines the location of natural vegetation that exists in the forest. Natural forest covered about 22% out of total area of zonal covered by forest. The forest that found in eastern part of the district is known as Kubayo, which was established around 1979. Now, a day this forest is decreasing from time to time and cleared out due to the expansion of agricultural land, construction and home consumption of wood for fire. The vegetation of the study area consists of various trees, shrubs and herbaceous species. Some of the common plant species include Bekanisa (*Croton macrostachys*),Wadesa (*Cordia Africana*), lafto (*Acacia*

abyssinica), Bargamo (*Eucalyptus* spp), Gatira (*Juniperus procera*), Ejersa (*Olea europea*), Ebicha (*Vernonia amegdalina*) (Gololcha Forest and Wild life Protection Office, 2015).

3.2 Research Design

The major aim of this study was to assess the apiculture practices, opportunities and constraints in Gololcha district. In this study, a descriptive survey design which involves both qualitative and quantitative approach was employed. Sharma (2000) described that a descriptive survey is helpful to identify present conditions and point to present needs. Besides, it is useful in showing immediate status of a phenomenon. Thus, the researcher selected this method.

3.3 Types and Sources of Data

Both qualitative and quantitative data were gathered for this study using formal survey method. The sources of primary data were farmer beekeepers, district agricultural and rural development experts, development agents, livestock office experts, district administrator and local traders.

3.4 Methods of Data Collection

3.4.1 Household survey

Formal household survey was conducted to collect primary data from sample beekeepers through semi-structured questionnaire, which was designed to gather data such as household socio-demographic characteristics (sex, age, family size, marital status, educational level and beekeepers experience), sources of honey bee colony, colony holding, types of beehive used, apiary site, honey bee colony inspection and harvesting, honey bee behavior, absconding, trends of honey production and honey bee colonies, occurrence of swarming, smoking and fumigant materials, beekeeping practices, honey marketing system, opportunities and constraints of apiculture and the main factors that contributed to traditional beekeepers remain in the traditional method of beekeeping.

The semi-structured questionnaire was prepared and pre-tested before administration. Some re-arrangements and corrections were made in accordance with respondents' perception. Enumerators were acquainted with the questions, trained on methods of data collection and interviewing techniques. The questionnaire was prepared in English language first and translated to Afan Oromo language and administered to the randomly selected household heads by

enumerators recruited and trained for this purpose with close supervision by researcher to collect primary data.

3.4.2 Key informant interview

Key informant interview (KII) was conducted with development agents (DAs), district livestock office experts and district agriculture heads to collect primary data with respect to research questions and related issues.

3.4.3 Field observation

Observation was made to enrich the data on beekeeping practices, bee flora, beehive types, and honeybee pests and predators, honey storage materials, smoking and fumigant materials, honey marketing and utilization and any events pertaining to investigations was observed to strengthen the obtaining information.

3.4.4 Focus group discussion

Focus group discussion (FGD) was conducted with selected beekeepers that live in the selected kebele peasant associations. The beekeepers that were selected for the focus group discussion were those beekeepers that were not included in the household survey. They were selected purposively with the help of development agents based on their beekeeping performance. It had 7-9 knowledgeable individuals who had knowledge about the beekeeping practices, management systems, major bee flora, honey storage, honey utilization and constraints of apiculture.

3.5 Sample Size and Sampling Techniques

The combination of both purposive and probability sampling techniques were employed in this study. There were twenty five kebele peasant associations and two town administrations in study area. Four kebele peasant associations were selected out of twenty five kebele peasant associations purposively with criteria of having relatively large number of participants in beekeeping and potential for beekeeping with the help of district livestock office experts and development agents. The purposively selected kebele peasant associations were Kurawada, Kejewa, Borat and lemlemHalila. The sample size (N) was resolved by using the formula recommended by Arsham (2005) as $N = 0.25/SE^2$, where N is sample size, and SE is the standard error (4.56%) at 0.05 level of significance. Accordingly, 120 households were selected for household survey. The total sample size (120 beekeepers) was divided proportionally for each

purposively selected kebeles according to the number of beekeepers in each purposely selected kebeles. The sampling frame was involved only those households with beekeeping experience. The sample size for the rural kebeles and beekeepers were decided by the researcher to be 4 and 120, respectively. Furthermore, purposive sampling method was used for the selection of key informants interview and focus group discussion from the selected peasant associations. Accordingly, 5 participants were selected for key informant interview from district agriculture office, livestock office experts and development agents, and 7-9 farmer beekeepers were selected for focus group discussion with the help of development agents from each selected peasant associations.

3.6 Methods of Data Analysis

The collected data was organized for analysis. The data that was gathered through household survey was analyzed using descriptive statistics such as percentage, frequencies, mean and standard deviation. Some of the statistical test such as Pearson correlation test and binomial proportion test were also employed. Statistical Package for Social Science (SPSS) version 20 software was used to fasten the analysis of the household survey data. Moreover, the primary data that was collected through key informant interviews and focus group discussions was analyzed using qualitative technique of data analysis.

4. RESULTS AND DISCUSSION

4.1 Socio-Demographic Characteristics of Sample Household Respondents

4.1.1 Household characteristics

From sample respondents, about 96.7% and 3.3% of men and women head households were engaged in apiculture activities in the study area, respectively. But, the female engagement in beekeeping was very low in the study area. This may be attributed to the traditional belief that apiculture is a men's activity and male headed households dominated the activities. Males undertook most of the tasks such as beehive construction, hanging of beehives on large trees and subsequent bee product harvesting. Similarly, Hartmann (2004) reported that traditional apiculture is men's job in Ethiopia and Workineh (2006) also reported that apiculture is male headed households dominated activity in Atsbi Wemberta district of eastern zone of Tigray region. Apiculture has strong potential for poverty reduction by generating income and employment for smallholders including women, landless youth and elder (Gizachew, 2011).

The mean age of household respondents in the study was 44.11 years and ranged from 18 to 80 years (Table 1).This result indicated that apiculture can be performed by all age groups and most of the productive age was actively engaged in apiculture activities. This survey result was similar with the observation reported by Chala (2010) which stated that the most productive age was actively involved in accommodating experiences from elders and finally become independent beekeepers.

The average family size of sample household beekeepers was 5.78 and the minimum and maximum family sizes were 1 and 15 people, respectively in the study area (Table 1). The survey result demonstrated that households with high family size were alleviated problems of food and competition for other resources due to lack of improved technologies that improve productivity and incomes in the study area. The result of this study contradicted earlier result by Workineh (2011) which stated that beekeepers with large family size have interest and potential for promotion of improved technologies. The sample household beekeepers had an average experience of 17.00 years and ranged from 1 to 62 years (Table 1). The level of beekeepers was taken from the number of years that an individual was continuously involved in apiculture activity. People were actively engaged starting from an early age in helping older beekeepers to

carry out basic tasks. Based on this exposure, young people gradually move on to become independent beekeepers as soon as they obtain their own hive. This survey result was similar with Gichora (2003) reported that the engagement in apiculture activity was started from early age. There was significant relationship between the age of beekeepers and beekeepers' experience ($p<0.01$). This meant that when the age of beekeepers increased, then the beekeepers' experience was also increased. The correlation(R) between beekeepers' experience and age of beekeepers showed that there was strong positive and highly significant relationship. Iheanacho (2000) also reported that the higher the numbers of years spend in bee farming by farmer, the more he becomes aware of new production techniques and increasing the level of his productivity.

Table 1: Age, family size and beekeepers experience of the households in the study area

Variables	**Minimum**	**Maximum**	**Mean**	**SD**	**P-value**	**R**
Age of respondents	18	80	44.11	14.33	0.000*	0.892*
Family size	1	15	5.78	3.00	0.034*	-0.192
Beekeepers experience	1	62	17.00	10.63	0.000*	0.0892*

*Correlation is significant at 0.01 and 0.05 level of significance, SD=standard deviation

4.1.2. Marital status and educational level of the respondents

About 95% of the sample household respondents were married in the study area (Table 2). The study result showed that apiculture activities could be performed by every social class of the community regardless of their marital status. The majority of the household respondents in the study area were illiterate and this had negative contribution to the success of apiculture activities (Table 2). Formal education is important for farmer beekeepers to adopt modern input and technologies in beekeeping sector. Thus, farmers need to get basic education for the reasons of adopting new technologies. It is also observed that education had significant effect on adoption of improved apiculture technology, beekeeping experience and number of colony holdings between illiterate and educated beekeepers. According to the current result of this study, the high level of illiteracy was due to the lack of formal training programs in the study area. Similar survey results were reported by Gichora (2003) and Workineh (2006) in Baringo district of Kenya and Ethiopia, respectively.

Table 2: Marital status and educational level of the respondents in the study area

Variables	No of respondents	Percent (%)
Marital status		
Married	114	95
Widowed	4	3.33
Divorced	2	1.67
Educational level		
Illiterate	63	52.5
Can read and write	14	11.67
Primary education	25	20.83
Junior education	11	9.17
High school education	6	5
College	1	0.83

4.2 Major Apiculture Activities

4.2.1 Sources of honey bee Colonies

From beekeepers interviewed to describe their sources of honey bee colonies, about 78.33% of the beekeepers were started apiculture by catching bee swarms (Table 3).The survey result showed that the existences of huge indigenous knowledge of catching swarms mostly was based on the beekeepers experience. The study also indicated that honey bee colony selling was uncommon and there was no single respondent beekeeper that started apiculture by buying bee colonies. Similarly, Chala (2010) and Tessega (2009) reported that the majority of the beekeepers initiated beekeeping through catching swarms in Gomma district of Oromia region and Burie district of Amhara region, respectively.

Table 3: Sources of honey bee colonies in the study area

Sources	No of respondents	Percent (%)
Catching swarms	94	78.33
Gift from parents	9	7.5
Gift and catching swarms	17	14.17
Buying	-	-

4.2.2 Types of beehive used and placement of beehive

From sample beekeepers interviewed, about 98.33% of beekeepers had only traditional beehives (Table 4). This study indicated that the adoption of improved beehives were very low in the study area. Low adoption and disseminations of movable frame beehive were attributed to many factors such as weak extension services, high costs beekeeping equipment, and poor economic background of the beekeepers. Traditional beekeeping practice was the most predominant in the study area. This could be due to lack of knowledge, shortage of experience sharing and low awareness to adopt the transitional and frame hives. This was in line with the findings of study by Amsalu *et al.* (2004) and Workineh (2011) who reported that beekeeping practice in South and Southwestern Ethiopia is predominantly traditional.

Table 4: Distribution and types of beehive used by respondents in the study area

Types of beehive used	**No of respondents(N=120)**				**Overall %age**
	Borat N=16	Lemlem Halila N=18	Kurawada N=39	Kejewa N=47	
Traditional only	14	18	37	49	98.33
Transitional only	-	-	-	-	-
Frame only	1	-	2	-	2.5
Both traditional and Transitional	1	-	-	-	0.83
Transitional and frame beehive	-	-	-	-	-
Traditional, transitional and movable-frame	-	-	-	-	-

Regarding the placement of beehives, about 25 %, of traditional beehives placed around homestead (backyard) by farmer beekeepers (Table 5). This was enabling the beekeepers to manage their bee colonies easily. About 46.67% of beehives were placed in the forest by hanging on trees. This survey result showed that most of the farmer beekeepers kept their beehives by

hanging on trees in the forest in the study area. This findings agree with HBRC (2004) and Solomon (2007) reported that most of the farmer beekeepers were kept their honey bee colonies by hanging on trees in the forest.

Table 5: Placement of beehives by respondents in the study area

Placement	Traditional (%)	Top bar (%)	Movable-frame (%)
Back yard	25	0.83	2.5
Hanging on trees in the forest	46.67		
Hanging on trees near homestead	4.17		
Under the eaves of house	13.33		
Inside house	1.67		
Both hanging on trees and back yard	3.33		
Under the eaves of the house and hanging on trees near homestead	2.5		

4.2.3 Honey harvesting and apiary inspection frequency

Sample household respondents were interviewed to describe the frequency of honey harvesting and bee colonies inspections. About 81.67% of sample beekeepers were harvested their honey twice in a year in the study area (Figure 4). Some of the beekeepers also harvested the honey once in a year. This was due to the lack of knowledge about proper harvesting time and lack of bee forages. The major honey harvesting seasons in the study area were from November to December and June to July. Some of the beekeepers harvested honey from April to May.

Honey harvesting frequency in the study area was based on the availability of pollen and nectar source plants, length of flowering time, rainfall patterns and different management practices of the beekeepers. This survey result was similar with those previously reported by Chala *et al*. (2012) and Malede *et al*. (2015) which stated that honey was harvested once or twice and even three times in a year depending upon seasonal management skills and flowering potential of the area in Gomma District of Jimma Zone and in and around Gondar, respectively. Mathewos *et al*. (2004) and CSA (2008) also reported that the major honey flow season was from November to December in different parts of Ethiopia.

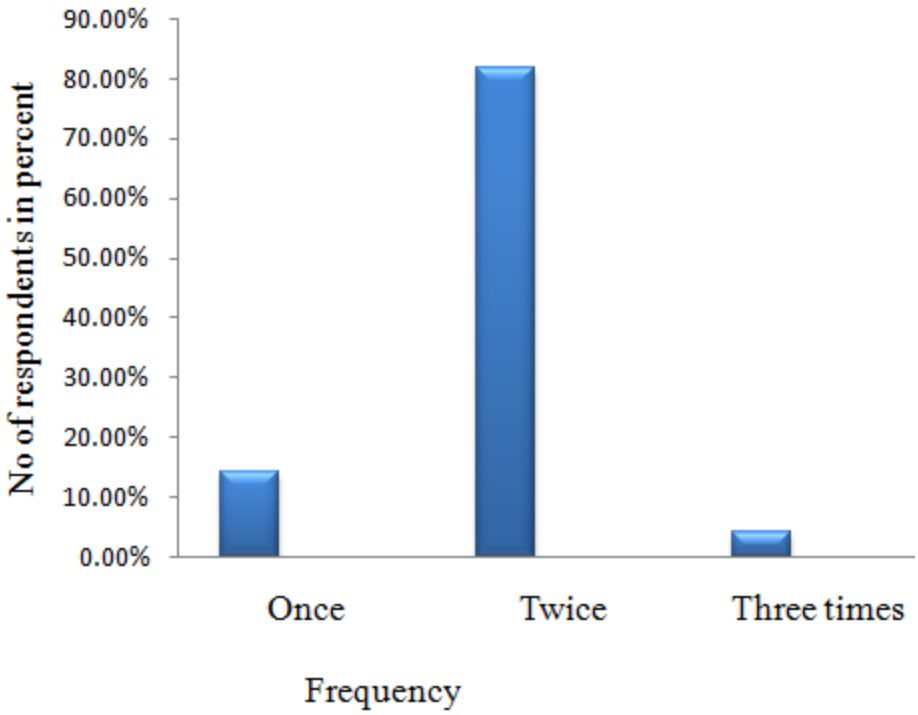

Figure 4: Honey harvesting frequency in the study area

Regarding apiary and bee colonies inspection, about 22.5% of beekeepers externally inspected their apiary and bee colonies monthly at varied frequency to check either the beehive save from pests and predators, respectively (Table 6).However, about 13.33% of the beekeepers didn't externally inspect their bee colonies. This showed that some of beekeepers didn't manage their beehive and bee colonies.

About 90.83% of beekeepers didn't internally inspect their bee colonies. This was because of unsuitability of traditional beehive to inspect bee colonies and frequent opening of this beehive causes the colonies to be disturbed and it might be the reason for absconding. External colony inspection can be done at any season. Caution is required for internal inspection in what season and at what frequency the internal inspection should be conducted. In this regard, training beekeeper farmers is essential. Similarly, different researchers (Tesfaye and Tesfaye, 2007; Chala, 2010) reported that beekeepers in Ethiopia do not commonly practice internal hive inspection due to the difficulty of the traditional beehives for internal inspection such that fixed combs attached to the body of traditional beehive.

Table 6: Apiary inspection frequency by sample beekeepers in the study area

Inspection frequency	**External %**	**Internal %**
Daily	19.17	-
Two to three days	11.67	-
Every week	9.17	-
Two weeks	15.83	-
Monthly	22.5	2.5
Two to three months	8.33	6.67
Not at all	13.33	90.83

4.2.4 Trends of bee colonies and honey production

From the sample respondents, about 55% of beekeepers replied that bee colonies and honey production were decreasing (Figure 5). Shortage of bee forage due to deforestation causes the honeybee colony to abscond to areas where resources are available for their survival. It is directly associated with flowering period of major honeybee forages. According to this survey result, honey production and bee colonies were in a decreasing trend due to existence of honey bee pests and predators, unwise application of chemicals, poor management system and lack of using improved beehives. Similarly, Haftu and Gezahegn (2014) reported that pests and predators, chemical applications and shortage of bee forages and poor management decreased bee colonies and honey production. Bhusal and Thapa (2005) who also reported that insufficient management practice and lack of adequate training resulted in low honey production.

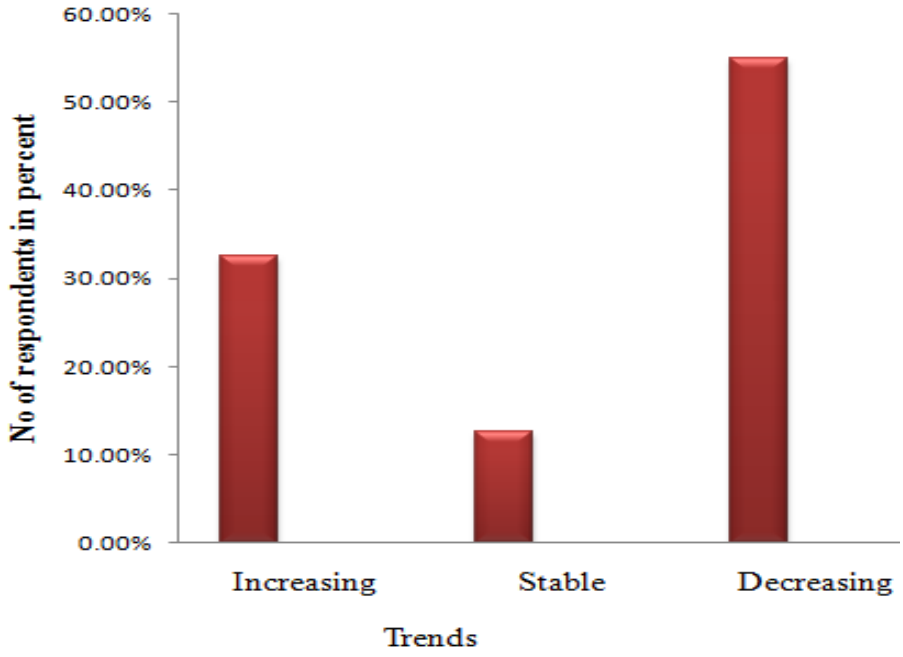

Figure 5: Trends of honey bee colonies and honey production

4.2.5 Honeybee behavior

Sample household beekeepers characterized their honey bees by using traditional and indigenous knowledge. This was mostly based on the stinging behavior and color of honey bees. Accordingly, about 59.17% of beekeepers were categorized their bee colonies as aggressive depending on the stinging behavior (Table 7). Furthermore, beekeepers categorized honey bees as black (52.5%) and red (35%) in color. Beekeepers in the study area characterized those honey bees with black in color as aggressive in stinging behavior and designated as"Faki". Beekeepers believed that this type of honey bee is more productive, active in foraging/hard worker/, tolerant to starvation and highly reproduced. The red color type of honey bees was very aggressive in behavior and also productive, but they were not active like black color bee type in reproduction and bee foraging. This honey bee race is similar with *Apis mellifera scutellata,*and *Apis mellifera bandassii* , which are situated in west, south and south humid midlands and sub moist central high lands of Ethiopia, respectively (Nuru,2002;Amsalu *et al.*, 2004).

Table 7: Honey bee behavior identified in the study area

Behavior	**No of respondents**	**Percent (%)**
Docile	12	10
Aggressive	71	59.17
Very aggressive	37	30.83
Color		
Black	63	52.5
Red	42	35
Mixture of black and red	15	12.5

4.2.6 Smoking and fumigant materials

Beekeepers were interviewed to describe the smoking materials they used to remove honey bees whenever harvesting honeybees products and inspecting their hive. About 50.83% of farmer beekeepers were used cow dung as the smoking materials to remove honey bees, respectively (Table 8). Bark of trees they used as smoking materials include barks of *Juniperus procera* (Gatira), barks of *Ekebergia capensis* (Sombo) and barks of *Cordia Africana* (Wadesa). These beekeepers were also asked either these smoking materials have an effect on honey quality or not .The majority of beekeepers (58.33%) replied that smoking materials have no effect on honey quality and about 41.67% of beekeepers responded that smoking materials contain negative effect on the quality of honey by changing its color, odor and tastes.

According to this study result, using inappropriate method and the types smoking material used by beekeepers during harvesting time could affect the quality of honey by changing the color, tastes and odor. Therefore, selecting appropriate smoking materials is very crucial for the beekeepers to maintain honey quality and manage their honey bee colonies without shocking them. Awraris *et al.* (2012) reported that farmer beekeepers use smoking materials during harvesting of honey like straw, *Vernonia amegdalina* leaves and cow dung to subdue and push away the honey bees in Kaffa, Sheka and Bench-Maji Zones of Ethiopia.

Table 8: Smoking materials used in the study area

Smoking materials	No of respondents	Percent (%)
Straw	11	9.17
Dry grass	8	6.67
Cow dung	61	50.83
Bark of trees	40	33.33
Total	120	100

Beekeepers used fumigant materials to attract swarms to the new hive and kill microorganisms that found in the hive. About 95.83% of beekeepers used the fumigant materials for baited hive to attract swarms and 4.17% didn't use attractant materials for baited hive. These beekeepers had good indigenous knowledge of these attractant materials which includes barks, roots, leaves, stem of selected trees and crude beeswax (Table 9).Farmer beekeepers believed that smoking with attractant materials such as *Olea europaea* and *Ekebergia capensis* could well attract swarms to the new hives and initiate to prepare honey bees to start brood rearing. This result was in agreement with the report of Fichtl and Admassu (1994) that showed as pollen production by *Olea europaea* is valuable for strengthening honey bee colonies and stimulating brood rearing in Ethiopia.

Table 9: Attractant materials identified in the study area

Local name	Scientific name	Plant parts	Method of application
Qunce hindhesa	*Juniperus procera*	Bark	Smoking
Ejersa	*Olea europacea*	Leaf	Smoking
Sombo	*Ekebergia Capensis*	Bark	Smoking
Gaga	Beeswax	Crude	Smoking
Kusaye	*Lippia adoensis*	Leaf	Smoking
Qolati	*Diospyros mespiliforms*	Stem	Smoking
Qunce Bargamo	*Eucalyptus* spp	Bark	Smoking
Birdhesa	*Terminalia brownie*	Bark	Smoking
Qararu	*Pouteria adolfi-friederici*	Stem	Smoking

Walena	*Erthrina brucei*	Bark	Smoking
Wadesa	*Cordia Africana*	Bark	Smoking

4.2.7 Incidence of honey bee colony swarming

From the sample household beekeepers, about 50.83%, of beekeepers replied that there was reproductive swarming in their apiary every season and about 10.83% of beekeepers didn't know about honey bee colony swarming (Figure 6). The frequency of swarming was based on the availability of honey bee forage and season of the swarming occurrences. Some of the beekeepers had indigenous experience in catching swarm to increase their number of colony and replace non-productive colony. Furthermore, some of the beekeepers used different mechanisms to control reproductive swarming, which include use of large volume of beehives, removal of queen cell, harvesting or cutting combs and returning back the issued swarm to mother colony. This survey result was in line with the report by Tessega (2009) who stated that beekeepers had an experience of catching the issued swarm in Burie district of Amhara region.

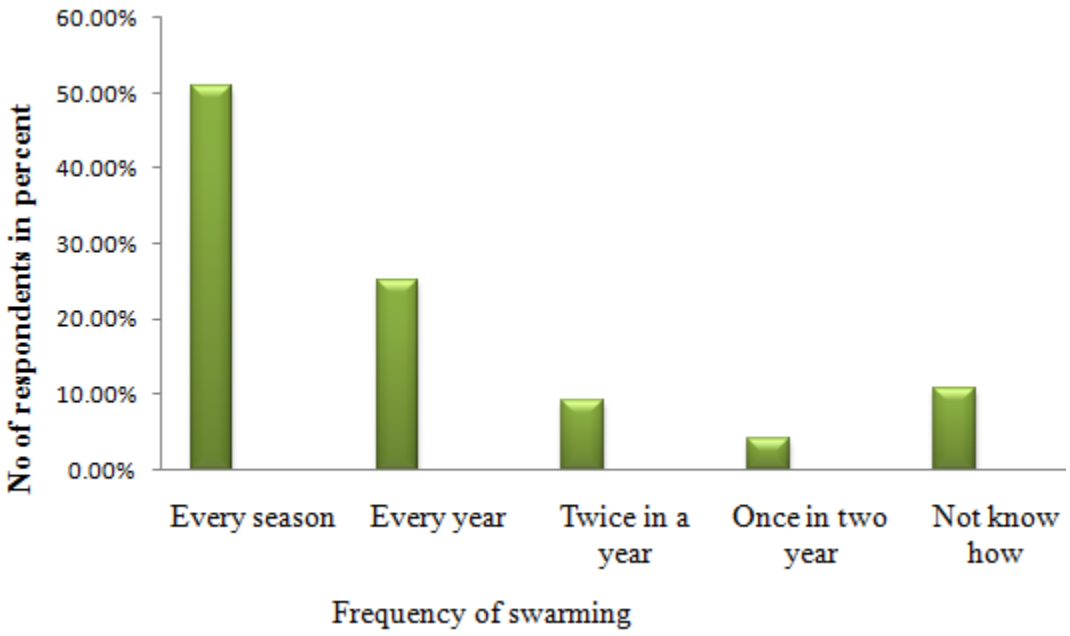

Figure 6: Frequency of swarming occur

4.2.8 Honey bee colony feeding

During the period of food scarcity, honey bees stored honey for their own consumption. However, beekeepers exploited honey without leaving honey in the beehive. In the period of

food scarcity the honey bees faced starvation. To overcome the food shortage, some beekeepers (27.5%) provided supplementary feed, which includes flours, sugar syrup, and honey with water. Honey bees require large quantities of water in the beehive to dilute brood feed and to cool beehive during high temperature. The sources of water found in study area involve rivers, ponds, lake and taps water. These farmer beekeepers also provided water or other solutions by putting grass, plant parts, stone and maize cobs in the container to protect the sinking or damages of honey bees during drinking. But, about 72.5% of beekeepers didn't provide supplementary feed. This survey result indicated that the majority of farmer beekeepers didn't provide supplementary feed for their honey bees to solve the problem of food scarcity. Therefore, supplementary feeding is very important for honey bee colonies. Solomon (2009) reported that supplementary feed was crucial for honey bees during scarcity of food in high lands of southeast Ethiopia.

4.3 Apiculture System in the Study Area

Apiculture is one of an ancient agricultural sub-sector in the Gololcha district that is practiced as sideline with other farm activities. In the study area, there were three types of beekeeping method which involve traditional, top bar and movable-frame based on the types of beehive used by the farmer beekeepers.

4.3.1 Traditional apiculture system

According to this survey result, there were farmers whose livelihoods depend on only traditional beehive apiculture system. About 98.33% of beekeepers followed traditional method of beekeeping in the study area and about 95% of beekeepers followed traditional beekeeping method in the national level (Oxfam, 2008). The overall mean of honey bee colony holdings per household beekeepers in traditional production system in the study area was 9.77. The high bee colony owning was due to the abundant of honey bee flora and conducive environment in the study area (Table 10). The result of this study was comparable with the result of Tessega (2009) who reported that the mean bee colony owning in traditional beehive was 7.75 per households in Burie district of Amhara region.

Table 10: The average honey bee colony holdings per household in the study area

Peasant Associations	Minimum	Maximum	Mean	SD
Borat	1	110	9.88	26.71
LemlemHalila	1	40	5.83	8.70
Kurawada	1	85	11.23	15.40
Kejewa	2	100	12.17	16.53

Traditional beehive was categorized into three categories, which include Log, Basket and Mud (Dogogo) hive types. These beehives had oval shape with the dimension of 90cm up to 100m in length and a diameter of approximately 30 to 40cm. Farmer beekeepers were plastering interior of beehive by mud and cow dung to protect honey bees from cold weather conditions and external parts were covered with grass, barks of tree and tin to protect from rain and sunlight. They also constructed their traditional beehive from different locally available plants such as *Arundo donax*, *Lippia adoensis*, *Solaneco angelatus*, and *Eucalyptus* spp.

The mean honey production obtained from traditional beehive was 8.7kg/hive in the study area. This result was comparable with Malede *et al*. (2015) and also contradicted with Teklu and Dinku (2016) who reported that the average amount of honey harvested from traditional beehive was 10.5 and 13.6kg in and around Gondar and selected districts of Gedeo zone, respectively. The survey result indicated that until now two forms of traditional beekeeping method were used in the study area. These were known as traditional forest beekeeping which is practiced in forest by hanging beehives on large trees (Figure 7) and traditional back yard beekeeping which is practiced around homestead (Figure 8).

Figure 7: Traditional apiculture in the forest

Source: Photo byTamiru Mulugeta, 2017

Figure 8: Traditional apiculture at back yard

Source: Photo by Tamiru Mulugeta, 2017

4.3.2 Transitional apiculture system

It is one of the improved beehive beekeeping methods that practiced in the study area. According to survey result, only one beekeeper (0.83%) had transitional beehive, which was very limited in distribution in the study area due to poor apiculture extension services, lack of research center,

lack of governmental and non-governmental organizations that involved in beekeeping activity to support farmer beekeepers to adopt this improved beehive. There was also lack of training that equip the beekeepers with skill to make Kenya top bar by own from different locally available materials such as Shenbako (*Arundo donax*), Algae (*Cissus Petiolata*) and Bargamo (*Eucalyptus spp*).Intermediate beehives were more expensive than traditional beehives (Figure 9). About 15kg of honey harvested from transitional beehive. Similarly, HBRC (2004) reported that transitional beehives are relatively expensive than traditional beehives in Holeta, Ethiopia

Figure 9: Transitional beehive apiculture

Source: Photo by Tamiru Mulugeta, 2017

4.3.3 Movable- Frame apiculture system

Frame beehive is one of the modern technologies that increase the production of honey and beeswax in quantity and quality. According to the respondents, about 2.5% of beekeepers used movable-frame beehive to produce honey in the study area. The survey result indicated that there was very low distribution of frame beehive in the study area as a result of poor attention given by government and different NGOs to support the beekeepers in different aspects including training, credit and transfer of different modern apiculture technologies. Moreover, farmer beekeepers were not able to make modern beehive due to lack of extension service and cost of excluder in the market.

Modern beehive and accessories were very expensive for the beekeepers to adopt this improved technology. It also required high investment cost and trained man power (Figure 10). Crane (1990) also reported that the frame beehives allow appropriate colony management and use of a higher level of technology with larger honey bee colonies and can give higher yield and quality of honey. About 25kg of honey harvested from modern beehive in the study area. Eugenia (2016) also reported that to improve honey production and increase household livelihoods with modern beekeeping, technical training and equipments have to be provided for local beekeepers to support their transition from traditional beekeeping to more modern techniques of beekeeping.

Figure 10: Modern beehive apiculture

Source: Photo by Tamiru Mulugeta, 2017

4.4 Factors Affecting the Quality of Honey and Beeswax Production

4.4.1 Beekeeping extension service

From the survey result, about 97.5% of beekeepers didn't involve in various extension service and packages and 2.5% of farmer beekeepers participated in extension packages. Extension service is playing a vital role for beekeepers in adopting and transferring of improved technologies to enhance production and productivity. It also develops the knowledge and skill of beekeepers to use improved apiculture technologies and has positive impact on the income of farmer beekeepers. According to this survey result, there were poor extension services that

provide training for the beekeepers to adopt improved technologies which helps to increase the quantity and quality of honey production. Thus, extension service was one of the factors that affect the quantity and quality of honey and beeswax production in the study area. Furthermore, it also observed that some of the beekeepers that contacted and shared their idea with development agents and livestock office experts adopted modern beehive. This study result was similar with the report of Workineh (2006) who stated that the beekeepers obtained direct technical assistance from the development agents and honey bee experts know more the technology.

4.4.2 Honey storage materials

According to this survey result, about 30.83% and 25.83% of the sample beekeepers stored their honey in plastics, and other materials such as tin in which US donated oil, fertilizer bags and recycle bottle plastics (Table 11). Beekeepers did not store their honey in new glass jars due to the lack of them from the local market in the study area. Storing honey in new glass jars is important for maintaining of the quality of honey. This survey result showed that the honey that stored in traditional containers by the beekeepers in the study area could affect the quality of honey. For example, traditional containers absorb moistures and change the flavor of honey.

Nuru (1999) reported that honey quality was reduced when it was stored in traditional storage materials such as hide, clay pots, tin and gourd. During focus group discussions, farmer beekeepers reported that there was no awareness creation and education given by development agents on how to use and store honey. They also stated that there was no provision of standardized equipment used for storing and handling honey bee products by the district agriculture and livestock office. Furthermore, during key informant interview, livestock experts mentioned that beekeepers used improper traditional storage materials that lead the harvested honey to have unnecessary odor or smell, and mix with unnecessary substances. This was because of poor attention given by district agriculture and other concerned bodies to introduce and provide standardized equipment to keep the quality of honey and other products.

Table 11: Honey storage materials in the study area

Storage containers	No of respondents	Percent (%)
Tin-can	23	19.17
Clay pots	9	7.5
Plastics	37	30.83
New glass jars	-	-
Others	31	25.83
Total	120	100

From sample beekeepers interviewed, about 94.17% of farmer beekeepers did not produce beeswax and 5.83% of beekeepers produced beeswax in the study area. Beekeepers also mentioned the main reasons that hindered the production of beeswax in their area. Accordingly, lack of training, lack of experience, lack of awareness, unsuitability of traditional beehive to produce beeswax, consuming and selling of crude honey without beeswax and lack of equipments to produce beeswax from modern beehive (Table 12).The survey result indicated that the majority of farmer beekeepers didn't produce and store beeswax in the study area due to the stated factors. This means that beekeepers didn't obtain benefit from beeswax. Moreover, binomial proportion test was conducted to check whether the identified problems are statistically significant. Accordingly, the identified factors were statistically significant at $p<0.01$ and $p<0.05$. Similarly, Haftu and Gezahegn (2014) reported that the majority of farmer beekeepers didn't produce beeswax in Hadya Zone of Southern nations, Nationalities and people of Ethiopia.

Table 12: Factors affecting beeswax production in the study area

Factors	Response	N	Percent (%)	P-value
Lack of training	Yes	93	77.5	0.000*
	No	27	22.5	
Lack of experience	Yes	75	62.5	0.008*
	No	45	37.5	
Lack of awareness	Yes	48	40	0.035*

	No	72	60	
Unsuitability of traditional beehive to produce beeswax	Yes No	106 14	88.33 11.67	0.000*
Consuming and selling of crude honey without separating beeswax	Yes No	39 81	32.5 67.5	0.000*
Lack of equipments to produce beeswax from modern beehive	Yes No	3 117	2.5 97.5	0.000*

Note that:*showed that the factors are statistically significant at 0.01 and 0.05 level of significance

Furthermore, focus group discussions were conducted with beekeepers to mention the factors that made the farmer beekeepers didn't produce beeswax in the study area. The participants mentioned that beekeepers didn't have experience of separating beeswax from crude honey due to the lack of training and awareness creation by beekeeping extension services, development agents and livestock office experts in the study area. They also stated that the beekeepers did not know about the advantages of beeswax in income generation. Some of beekeepers produced beeswax and they didn't have experience of storing beeswax. They gave it for dogs and thrown it out side. Lack of separating beeswax from honey could affect the quality of honey produced in the study area.

Beekeepers also mentioned that traditional beehive was not suitable for beeswax production due to lack of supering and narrowing of beehive. In addition to this, lack of the accessories of modern beehive was also the challenges to produce beeswax from modern beehives in the study area. During KII, development agents and livestock office experts stated that there was lack of training and awareness creation for beekeepers to produce beeswax as honey for income generation. They also mentioned that there was lack of attention given by district agricultural office and other concerned bodies such as governmental and non-governmental organizations to promote beeswax production by supplying improved beehive and its equipment in the study area.

4.5 Honey Marketing System

4.5.1 Place of selling honey

Beekeepers sold their honey in different places for income generation. About 73.33% of sample household beekeepers sold their honey nearby market (Table 13). This result indicated that the majority of beekeepers sold their honey in nearby market in small quantity. This was due to the lack of honey collectors (traders) who can buy honey in large quantity from beekeepers for the central market. Local beekeepers did not obtain enough income from beekeeping sub-sector in the study area due to the lack of honey collectors, lack of transportation and beekeepers cooperative. These made the farmer beekeepers to produce low quantity of honey in the study area. Similarly, Beyene and David (2007) reported that the majority of honey produced is marketed as table honey for general consumption in Ethiopia.

Table 13: Place of selling honey by respondents in the study area

Places	No of respondents	Percent (%)
At home	20	16.17
Nearby market	88	73.33
Major market place	12	10
Beekeepers cooperative	-	-
Total	120	100

4.5.2 Supply and demand of honey in the study area

From the sample beekeepers interviewed about supply for honey, about 76.67% of beekeepers replied that the supply of honey didn't enough in the study area (Table 14). This indicated that the majority of beekeepers didn't supply adequate quantity and good quality of honey to the local and central markets due to lack of improved beekeeping technologies, lack of extension services, training, and knowledge and beekeeping equipment. The result of this study agrees with FAO (2012) which reported that limited availability of bee forage due to deforestation, lack of extension services, backward technology, and poor pre- and post- management affected the supply of honey bee products. According to survey result, about 43% and 35.33% of beekeepers responded that the demand of honey in the market was high and low; respectively (Table 14).This showed that the demand of honey was high in the study area. However, the observed

rise in demand for honey was without involvement of market institutions such as traders and producers organizations which compete for better payment of beekeeping products.

Table 14: Supply and demand of honey in the study area

Supply and demand	**No of respondents**	**Percent (%)**
Supply		
Excess	4	3.33
Enough	24	20
Not enough	92	76.67
Demand		
High	51	43
Medium	26	21.67
Low	43	35.33

4.5.3 Market information and trends of market price

About 88.33% of beekeepers didn't obtain market information and some of beekeepers (11.67%) obtained market information from regional mass media, extension agents of their surroundings, other farmers and traders. The study showed that the majority of farmer beekeepers did not get honey market information due to the lack of communication between producers and concerned bodies regarding market for apiculture products. Similarly, Gezahegn (2001) and FAO (2012) reported that absence of organized market channel, lack of market information and lack of government support in promoting market development and low involvement of private sector could influence the marketing of honey and beeswax. During focus group discussions, beekeepers mentioned that there was not provision market information about beekeeping products and inputs to the farmer beekeepers regarding price, place of selling and other information from the concerned bodies. This validated the response of the majority of beekeepers there was no market information with respect to beekeeping products in the study area.

During KII, development agents and livestock office experts mentioned that mass Medias provided market information about the price of cash and cereal crops. However, it did not provide market information about beekeeping products due to the absence of established way for providing market information to beekeepers by district, zonal and regional agriculture and rural

development offices. This indicated the absence of attention given for apiculture sub-sector has own impact on the development of beekeeping in the study area. Thus, access to market information is essential for the beekeepers to sell their honey in good price to increase their income generation. From sample respondents, about 37.5% and 48.33% of beekeepers replied that the trends of market price in the study area was increasing and decreasing, respectively (Figure 11). Beekeepers were sold 1kg of honey to 80 Ethiopia birr, which was low in price when compared to national standard. This survey result showed that the market price of the honey was low. This was due to lack of obtaining market information from mass media and extension agents and traders. Moreover, the market price of honey is also governed by quality of honey, color of honey and test of honey. The honey colors produced and marketed in the study area were red, white and black. The variations of these colors were depending on the available of honey bee flora, season of harvesting and duration of storage in home of farmer beekeepers.

The red colored honey is collected at flowering season of vast weeds and grasses whereas the white colored honey collected during crops and tree flowering seasons of pea, bean, *Croton macrostachy* and *Cordia 46fricana.* Beekeepers also said that the lowest price of honey was mainly during honey harvesting season from December to January and June to August. The survey result agrees with the finding of Beyene and David (2007) who reported that beekeepers sell the largest proportion of their honey during harvesting at low price mainly to meet their demand for cash to pay taxes and other social obligation.

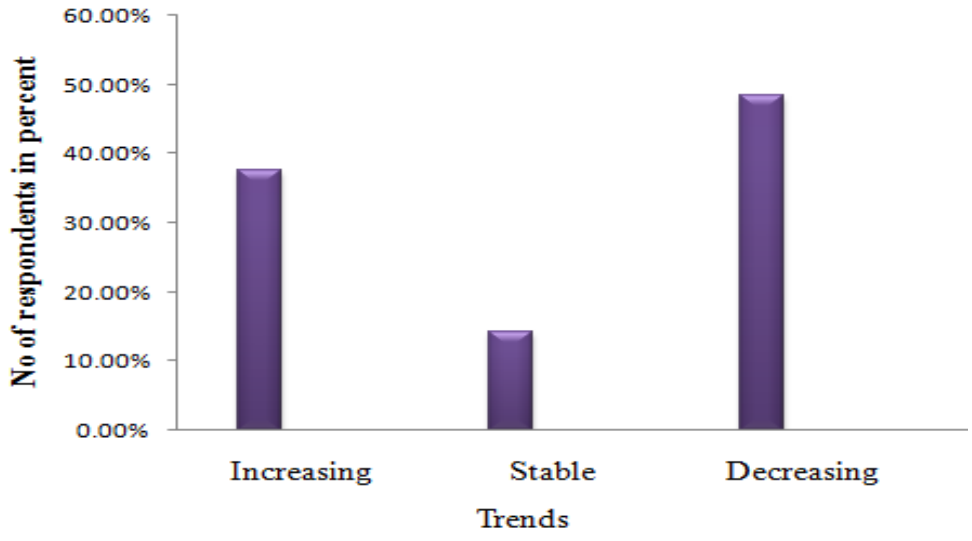

Figure 11: Trends of market price in the study area

4.6 Opportunities of Apiculture Development in the Study Area

Sample household respondents identified the major opportunities of beekeeping that are found in the study area. Beekeepers identified the presence of flowering plants as the first major opportunity for beekeeping in the study area. This area has diversified flowering plants that are favorable for apiculture development. This area had also bimodal type of rainfall which is used for the plants to flower in different season or year round. The honey bee forages of the study area consist of trees, shrubs, herbs, cultivated crops and vegetables which are essential for honeybee colonies as a source of nectar and pollen.

The survey result showed that different bee forage species gave flower at different seasons and serves as a source of pollen, nectar and feeding bees complementally throughout the year (Figure 12).Even if the area had high honey bee forages, beekeepers did not benefit from this sector as they need due to the lack of improved beehive and extension service that encourages the farmer beekeepers to grow indigenous bee forage in addition to natural flora to obtain high quantity and quality of honey in the study area. Some of the important honey bee forages in study area were identified with their local name (Afan Oromo), scientific name and flowering time (Table 15). The scientific name of plants was identified by National Herbarium of Addis Ababa University.

Table 15: Some of the important honey bee forages identified in the study area

Local name	Scientific name	Habit	Flowering time
Bargamo Dima	*Eculyptus camaldulensis*	Tree	January-June
Bakanisa	*Croton macrostachyus*	Tree	April- June
Adami	*Euphorbium abyssinica*	Shrub	January-August
Oda	*Ficus sycomorus*	Tree	December-February
Ejersa	*Olea europea*	Tree	June- July
Hada	*Guizotia scabra*	Herb	September-November
Shoka	*Opunitia cylindrica*	Shrub	March-May
Hagamsa	*Carissa aedulis*	Tree	December- January
Lalu	*Rhoicissus tridentata*	Climber	July-October
Wadesa	*Cordia Africana*	Tree	May- June
Kombolcha	*Maytenussene arbutifolia*	Shrub	May-June

Table 15: Continued

Sombo	*Ekebersia capensis*	Tree	April-May
Wacu	*Acacia seyal*	Tree	August –February
Lafto	*Acacia abyssinica*	Tree	August-February
Walena	*Erthrina absyssinica*	Tree	January-February
Bargamo adi	*Eucalyptus globules*	Tree	January-June
Cekata	*Calpurnia aerea*	Shrub	May-July
Mango	*Mangifera indica*	Shrub	April-June
Nugi	*Guizotia abyssinica*	Oil crop	September-December
Buna	*Coffee Arabica*	Shrub	March-November
Boqolo	*Zea mays*	Crop	May- November
Kamadi	*Triticum aestivum*	Crop	June-December
Atara	*Pisum sativum*	Crop	September-November
Shunkurti dima	*Allium cepa*	Vegetable	June-November
Talba	*Linum usitatimum*	Oil crop	September-December
Baqela	*Vicia faba*	Crop	October-November
Rafu	*Brassica Integrifolia*	Herb	October-November

Figure 12: Honey bee flora in the study area

Source: Photo by Tamiru Mulugeta, 2017

According to the respondents, the second opportunity for apiculture was the huge numbers of honey bee colonies in the study area (Table 16). This was due to the suitability of agro-ecology (diversified flowering plants). The presence of these honey bee colonies were give a great opportunity for the farmer beekeepers to expand and produce more honey in the study area. However, these bee colonies were decreasing from time to time because of deforestation to expand agricultural activities.

Beekeepers also identified indigenous experience and knowledge as a third opportunity in the study area. The indigenous knowledge used by farmer beekeepers were honey harvesting time by smelling, smoking baited beehive by swarm attractant materials like *Ekebergia campensis*, strengthening of bee colonies by providing supplementary feed, cleaning apiary site to protect pests and predators, controlling reproductive swarming by removing brood, catching swarms, identifying honey by smelling, tasting, observing color of honey and inserting stick to beehive to check the presence of honey bees. This study result was agreed with the report of (Beyene, 2015; Teklu and Dinku, 2016) who reported that beekeepers use indigenous knowledge to manage their honey bee colonies in Kewet district of Amhara region and Gedeo zone of Southern Ethiopia, respectively.

Table 16: Opportunities of apiculture identified in the study area

Opportunities	**N**	**Percent (%)**	**Rank**
Presence of flowering plants	47	39.17	1
Availability of honey bee colonies	33	27.5	2
Indigenous beekeepers experience and knowledge	15	12.5	3
Ample source of water	12	10	4
Socio-economic value	8	6.66	5
Market demand of honey	5	4.17	6

4.7 Constraints of Apiculture Identified in the Study Area

Sample household beekeepers identified the most important constraints that influenced the apiculture development sub-sector in the study area (Table 19). According to the beekeepers suggestion, the first major devastating phenomenon that curtails the productivity of honey bee colonies in the study area was the poisoning of agro-chemicals for honey bees, which includes

fungicides such as Tilt, Datura R250 and Albu; herbicides like Round up, 2, 4-D, Glyphos 360, Palus and Atlantis and insecticides includes Danadim 40%EC, Dimeto 40%EC and Malathion 50%EC (Figure 13). Insecticides completely killed honey bee colonies. These days, it is becoming a social problem due to the conflict of interest between the beekeepers and non-beekeepers during its application. This study also indicated that the application of agro-chemicals by farmers didn't match with the flowing time of bee forages to minimize the poisoning effect on honey bees. The lack of providing supplementary feeds during the application of agricultural chemicals also enhanced the declining of honey bee colonies. As a result of this, beekeepers lost significant amount of honey and honey bee colonies in the study area. Similarly, Kerealem *et al*. (2009) and Desalegn (2014) reported that there is a growing pesticides grievance on honey population and their products decline with considerable economic impact on beekeepers in Amhara region.

Figure 13: Agro-chemical applications

Source: Photo by Tamiru Mulugeta, 2017

Honey bee pests and predators were the second major constraints for the apiculture activities in the study area. About 22.5% of beekeepers are currently constrained by honey badger. Sequentially insects and pests were ranked for the damage to the sector. Thus, honey badger (*Mellivora capensis*) ,ants (*Dorylus fulvus*), spiders (*Cheiacanthium punctorium*), bee eating birds, termites, beetles (*Aethina tumida*), waxmoth (*Galleria mellonella*),bee lice (*Braula*

coecal), lizard and snake were ranked ,one to ten in their order of importance and beekeepers were losing significant amount of honey and bee colonies (Table 17). This study indicated that the majority of beekeepers lost their honey bee colonies and honey by pests and predators due to poor management system to minimize the effect of pests and predators. It was also observed that some of the farmer beekeepers used different indigenous mechanism to minimize the effect of these enemies. These mechanisms used by these beekeepers were listed in (Table 18).This result agrees with the study result reported by (Desalegn, 2001; Chala *et al*., 2012; Tesfaye, 2012).

Table 17: Percent and ranked insects and predators in the study area

Insects and predators	**N**	**%**	**Rank**
Honey badger	27	22.5	1
Ants	19	15.83	2
Spiders	16	13.33	3
Bee eating birds	14	11.67	4
Termites	12	10	5
Beetles	10	8.33	6
Wax moth	9	7.5	7
Bee lice	6	5	8
Lizard	4	3.33	9
Snake	3	2.5	10

Table 18: Preventive mechanisms of pests and predators by beekeepers in the study area

Pests and predators	**Preventive mechanisms**
Honey badger	Use spin, killing, fencing and chasing with dogs
Ants	Clean apiary, Place fresh ash
Spiders	Clean apiary, removal of spiders' web and killing
Birds	Putting something around the beehive such as cloth, plastics and killing
Termites	Placing fresh ash around the base of beehive
Beetles	Clean apiary, narrowing the beehive entrance, hand picking and kill, cover opening hive

Wax moth	Clean apiary, remove old comb and strength honey bee colonies, fumigation with cotton cloth and rubbing with recommended plant materials like Vernonia amegdalina.
Bee lice	Clean apiary, fumigate with Ejersa (Olea spp)
Lizard	Clean apiary, use spins around and kills
Snake	Clean apiary, smoking with plant material and kill

Sample beekeepers mentioned absconding as third major problem of apiculture development in the study area. Absconding refers to the sudden departure of the whole colony from a hive. This phenomenon was not desirable since it leads to the loss of bee colonies and income. According to this survey result, about 12.5% of the beekeepers reported that there was absconding of bee colonies (Table 19). The main reasons for absconding of bee colonies were incidence of pests and predators, lack of bee forage due to lack of rain fall and deforestation, poor management of bee hive, bee disease, application of herbicides and swarming.

According to the respondents, honey bees absconding vary from season to season. September to November accounts for reproductively swarmed colonies. This might happen due to lack of close supervision of colonies and incomplete harvesting of honey, which leads the bee colony into congestion and ultimately to creation of swarm to depart the mother colony. It was also occurred due to lack of providing supplementary feeding, lack of leaving honey combs during harvesting, lack of cleaning apiary and queen caging, lack of smoking the beehive with local attractant materials and queen wing clip, lack of transferring bee colonies to other hives and frequent inspection. Similarly, Ayalew (2006) and Kebede(2007) reported that honey bee colonies abscond from their hive at any season of the year for different reasons in Tigray and Adami Tullu Jido Kombolcha district in mid rift valley of Ethiopia, respectively.

Table 19: Constraints of apiculture in the study area

Constraints	**N**	**Percent%**	**Rank**
Agro-Chemical applications	30	25	1
Insect and predators	22	18.33	2
Absconding	15	12.5	3

Table 19: continued

Lack of improved beehive and its accessories	13	10.83	4
Lack beekeeping extension services	10	8.33	5
Market	8	6.67	6
Lack of training	7	5.83	7
Poor management	5	4.17	8
Lack of water	4	3.83	9
Poor infrastructure	3	2.5	10
Lack of bee forage	2	1.17	11
Lack of harvesting time	1	0.83	12

4.8 The Main Factors for the Traditional Beekeepers to Remain in the Traditional Apiculture Method

The sample beekeepers identified the main factors for traditional beekeepers to remain in the traditional beekeeping method in the study area. These factors were the lack of money to buy improved beehive and other equipment due to its expensiveness, lack of training and skill to make improved beehive (90.33%), lack of beekeeping extension service, lack of improved beehive from the local market, lack of relationship with development agents and livestock office experts, lack of governmental and non-governmental organizations and lack of awareness (Table 20). Furthermore, binomial proportion test was conducted to check whether the identified factors were statistically significant. Accordingly, the binomial proportion test showed that the identified factors were statistically significant at $p<0.01$ and $p<0.05$.

Table 20: Distribution of sample beekeepers on the main factors that contributed to traditional beekeepers to remain in the traditional beekeeping method in the study area

Factors	**Response**	**N**	**Percent (%)**	**P-value**
Lack of money to buy improved beehive and its accessories	Yes	73	60.83	0.022*
	No	47	39.17	
Lack of training and skill to make improved beehive	Yes	109	90.33	0.000*
	No	11	9.17	
Lack of beekeeping extension service	Yes	76	63.33	0.004*

	No	44	36.67	
Lack of improved beehive from the local market	Yes	101	84.17	0.000*
	No	19	15.83	
Lack of relationship with development agents and livestock office experts	Yes	46	38.33	0.013*
	No	74	61.67	
Lack of governmental and non-governmental organizations	Yes	81	67.5	0.000*
	No	39	32.5	
Lack of awareness	Yes	37	30.83	0.000*
	No	83	69.17	

*Indicated that the factors are statistically significant at 0.01 and 0.05

In addition to this, FGDs were conducted with farmer beekeepers to obtain additional information on factors that contributed traditional beekeepers to remain in the traditional apiculture method in the study area (Figure 14). As participants stated the price of frame beehive was an expensive to buy from central markets such as Shashamene and Addis Ababa capital city. A modern beehive cost was 1400 Ethiopian birr, which was too expensive for the traditional beekeepers. The expensiveness of modern beehive was one of the challenges for traditional beekeepers to engage in improved apiculture method.

The FGD participants also mentioned that buying only modern beehive was nothing without other accessory equipment such as extractor and honey processor. To buy these materials it requires more than 10,000 Ethiopian birr. It is possible to conclude that if the beekeepers buy modern beehive without having accessory equipment it is the same as having traditional beehive. This means that to use modern beehives, there should be an access to accessories.

In study area, there was lack of support from governmental and non-governmental organizations regarding improved way of apiculture such as financial support and credit facilities. Because of this challenge those beekeepers that have financial capacity to buy modern hive, accessories and interests to start improved beekeeping method remained in traditional beekeeping method. The participants of FGD also reported that there was lack of creating the awareness of the beekeepers on improved beehive by development agents and livestock experts' office. Due to this lack of awareness and skills, farmer beekeepers did not have a chance of making top bar and modern beehive by themselves from available local materials such as timber of *Juniperus procera* and

Cordia Africana. DAs and district agriculture experts' office didn't give attention for improved beekeeping method when they held meeting with farmers on the issues such as use of fertilizers to increase crop yields, coffee production and other issues. This indicated that there was lack of relationship between farmer beekeepers and development agents and district agriculture office experts to develop improved beekeeping method.

In 2001, livestock office and district agriculture office collected money from beekeepers to buy modern beehive. However, the office experts returned the money of beekeepers without buying modern beehive due to the increasing of the price of modern beehive in the central markets. During KII, district agriculture, livestock office experts and DAs also mentioned that there was poor attention given by regional government to adopt improved beekeeping to support farmer beekeepers in particular in the study area to solve the existing problems (Figure 14).

Figure 14: Focus group discussions and Key informant interviews

Source: Photo by Tesfaye Alemu and Shimelis Tolcha, 2017

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Apiculture was practiced in the study area as a side line activity with other agricultural activities mainly crop and livestock production. In the study area, beekeeping was predominantly based on traditional methods, which has greatly contributed to low productivity and inconsistent quality of honey bee products.

The overall honey marketing system was traditional and under developed and farmer beekeepers were not benefited much from the marketing system due to the lack of market information, low market price, lack of transportation and lack of honey collectors such as traders and beekeeping cooperative that transport honey into the central market in the study area. Moreover, in the study area almost the beeswax was not produced due to the lack of training, lack of awareness, lack of experience and unsuitability of traditional beehive in the study area.

The study area had a high opportunity for beekeeping. But, its development was still at infant stage due to poor extension services and lack of improved beehive and its accessories. This study was identified the major beekeeping constraints such as agro-chemical applications, pests and predators, lack of improved beehive and its accessories, absconding, poor extension services, poor management system, etc. in the study area.

This survey result was also identified the main factors for traditional beekeepers to remain in the traditional beekeeping method. These factors were lack of money to buy improved beehive and other equipment due to its expensiveness, lack of training and skill to make improved beehive, lack of beekeeping extension service, lack of improved beehive from the local market, lack of governmental and non-governmental organizations.

5.2 Recommendations

Based on the findings of the study, the following recommendations are forwarded.

To enhance the honey bee production and productivity, adequate training should be given for the beekeepers on apiculture development to transform old traditional beekeeping practices through adopting improved technologies and management practices.

Establishing market networks, developing market information delivery system and organizing beekeepers into groups at local, regional and national level to fix the local market prices and to penetrate the export market should be recommended. Moreover, creating awareness on the value of beeswax and other products and its marketing mechanism should be designed to ensure the right benefit from the activity.

To minimize the problems of absconding and swarming appropriate management practices such as improving pre and post harvests handling of honey bee colonies, regular supervision and monitoring of the bee colonies should be practiced by providing training for farmer beekeepers by the help of extension services.

To reduce the effects of agro-chemicals beekeepers should feed their honey bee colonies during the spray time of agro-chemicals and advice farmers to spray chemicals in 30-40 days before flower of different weeds. Furthermore, to minimize the effects agrochemicals, the district agricultural office and livestock office should be focused on conservation of existing vegetation, planting indigenous honey bee flora and integrating of apiculture with agro-forestry.

Development agents and livestock office experts should create awareness on preventive mechanism of pests and predators for those beekeepers that have less knowledge and awareness to prevent their honey bee colonies.

To maximize the benefits of beekeepers from huge beekeeping resources and honey production in the study area, governmental, non-governmental and other concerned bodies should support farmer beekeepers by establishing improved apiculture demonstration sites, honey bee collection center and organizing honey producers into cooperatives.

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7. APPENDICES

Appendix 1: Questionnaire Used in the Study

Adama Science and Technology University

School of Applied Natural Science

Department of Biology

Post graduate program

This questionnaire is prepared by Tamiru Mulugeta. The main objective of this questionnaire was to collect accurate information and under take on a thesis regarding an assessment of Opportunities and Constraints of Apiculture development. Your genuine and clear response contributes a lot for the successfulness of this study. Hence, you are kindly requested to play your part.

General information

1. Zone _____ 2. Wereda _____ 3.Kebele _____

I. House hold characteristics

1. Name of house hold head _____

2. Sex _____

4. Age _____

5. Marital status: 1/Married 2/ Widowed 3/ Divorced

6. Family size _____ 7/ Beekeepers experience _____

8. Education level of household head:

1/ Illiterate 2/ Can read and write 3/ Primary education (1-6)

4/ Junior education (7-8) 5/High school education (9-12) 6/ College

II. Apiculture /honey production/ Activities

1. What is the source of bee colonies when you start beekeeping?

1/ Catching the swarms 2/ Gift from parents

3/ Gift from parents and catching swarms 4/ Buying

2. What types of bee hive you are using for honey production?

1/ Traditional only 2/ Transitional only

3/ Movable-frame only 4/ Both traditional and transitional

5/ Transitional and movable-frame 6/ Traditional, transitional and movable-frame

3. Where did you place your beehives?

1/ Back yard 2/Hanging on trees in forest

3/Hanging on trees near homestead 4/Under the eaves of house

5/ Inside the house 6/ both hanging on trees and back yard

7/ Under the eaves of the house and hanging on trees near homestead

4. How many times do you harvest honey in a year?

1/Once 2/ Twice 3/ Three times

5. How many times do you visit and inspect your beehives and colonies? (External and internal inspection)?

Inspection frequency	External	Internal
Daily		
Two to three days		
Every week		
Two weeks		
Monthly		
Yearly		
Two to three months		

6. What is the trend of your bee colonies and honey production?

1/ Increasing 2/ Stable 3/ Decreasing

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

_____

_____

_____.

7. What are the characteristic features of your honey bees?

7.1 Behavior: 1/docile 2/ aggressive 3/ very aggressive

7.2 Colors: 1/ Black 2/ Red 3/ Mixture of black and red

7.3 Which one is productive? Behavior: _____ Colors: _____

8. What are the smoking materials you are using?

1/ Straw 2/ dry grass 3/ Cow dung 4/ Barks of trees

9. What are the fumigant materials you are using? List in terms of priority?

N0	Local name	Scientific name	Plant parts	Method of application
1				
2				
3				
4				
5				

10. When does swarming occur more frequently in your bee colonies?

1/ Every season 2/ Every year 3/ Twice in a year

4/ Once in two year 5/ Not know how

11. Do you feed your honeybee colonies?

1/Yes 2/ No

12. Do you participating in beekeeping extension packages?

1/ Yes 2/ No

13. What container do you use for honey storage?

1/ Tin can 2/ Clay pots 3/ Plastics

4/ New Glass jars 5/others (specify)

13.1. For what reason do you store honey?

_____

_____

_____.

14. Do you produce beeswax?

1/Yes 2/ No

14.1 What are the main factors that affect beeswax production in your area? Select yes or no from the given factors?

Factors	Yes	No

Lack of training		
Lack of experience		
Unsuitability of traditional beehive to produce beeswax		
Consuming and selling of crude honey without separating		
Lack of equipments to produce beeswax from modern beehive		

III. Market conditions

15. Do you sale your honey?

1/ Yes 2/ No

16. Where is your major sell place?

1/ In your home 2/ Nearby market place 3/ Major market place 4/ Beekeepers cooperative

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

1/ Excess 2/ Enough 3/ Not enough

17.1. If your response is not enough, what are the reasons?

_____

_____

_____.

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

1/ High 2/ Medium 3/ low

19. Do you get market information?

1/ Yes 2/ No

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

1/ Increasing 2/ Stable 3/ Decreasing

IV. Opportunities for apiculture

21. What are the major opportunities for beekeeping in your area? Rank them in terms of priority?

N0	Opportunities	Rank
1	Presence of flowering plants	
2	Availability of honey bee colonies	
3	Indigenous beekeepers experience and knowledge	

4	Ample source of water	
5	Socio-economic value	
6	Market demand of honey	

22. What are the major honey bee floras in your area? List in terms of priority?

N0	Local/common name of plants	Type (tree,shrub, herb, cultivated crops)	Flowering time (months)
1			
2			
3			
4			
5			

V. Apiculture constraints

23. What are the major constraints of apiculture in the study area? (Rank them)

N0	Constraints of Apiculture	Rank
1	Chemical application	
2	Insect and predators	
3	Absconding	
4	Lack of improved beehive and its accessories	
5	Lack of beekeeping extension service	
6	Market	
7	Lack of training	
8	Poor management	
9	Lack of water	
10	Poor infrastructure	
11	Lack of bee forage	
12	Lack of harvesting time	

24. What are the major pests and predators found in the area that threat your colonies? (Rank them)

N0	Pests and Predators	Rank
1	Honey badger	
2	Ants	
3	Spiders	
4	Bee eating birds	
5	Termites	
6	Beetles	
7	Wax moth	
8	Bee lice	
9	Lizard	
10	Snake	

25. What are the main problems contribute to traditional beekeepers to remain in traditional method of beekeeping? Select yes or no from the given factors?

No	Factors	Yes	No
1	Lack of money to buy improved beehive and its accessories		
2	Lack of training and skill to make improved beehive		
3	Lack of beekeeping extension		
4	Lack of improved beehive from the local market		
5	Lack of relationship with development agents and agriculture office experts		
6	Lack of governmental and non-governmental organizations		
7	Lack of awareness		

26. How many honey bee colonies you owned?

1. Traditional _____ 2/ Transitional _____ 3/ Movable frame _____

27. What is the average productivity of the traditional beehives in the study area in kilogram? __.

28. What are the main problems in honey production and marketing in the study area?

_____

_____

_____.

29. What opportunities do exist in your area to improve the beekeeping activities?

_____

_____

_____.

30. What can be done to increase the efficiency of honey production in your area?

_____

_____

_____.

Thank you for your cooperation!

Compiler: Name_____ Signature _____ Date _____

Duration: Starting day_____ ending day _____

Appendix 2: Interview guideline

1. What are the main problems in honey and beeswax production?
2. How is the contribution of beekeeping to income generation for households?
3. How is the potential of the area for beekeeping?
4. What are the main problems in honey marketing in the study area?
5. What are the main problems contribute to traditional beekeepers to remain in traditional method of beekeeping?
6. Is there any private business or association involved in modern beekeeping in the region?
7. Is there any plan to integrate forest conservation and area rehabilitation with beekeeping? development?

Thank you for your cooperation!

Compiler: Name_____ Signature _____ Date _____

Appendix 3: Focus group discussion check list

1. What are the main factors that affect honey quality and beeswax production in your area?
2. What are the main problems in honey marketing in the study area?
3. What opportunities do exist in your area for beekeeping activities?
4. What are the main problems contribute to traditional beekeepers to remain in traditional method of beekeeping?
6. Do you have relationship with development agents, district agricultural office, and livestock? office experts and governmental and non-governmental organizations in your area?
7. What can be done to increase the efficiency of honey production in your area?

Thank you for your cooperation!

Compiler: Name_____ Signature _____ Date _____

Appendix 4: Questionnaire translated into Afan oromo

Yuniveersiitii Adaamaa saayinsii fi Teeknooloojii

Muummee Baayooloojii

Sagantaa Digirii Lammaffaa

Gaafannoo

Gaafannoo kana kan qopheesse barsiisaa Taammiruu Mulugeetaati. Kaayyoon ijoon gaafannoo kanaa immoo odeeffannoo sirrii ta'e ittin sassaabuu fi waa'ee haala mijaata fi rakkoowwan horsiisa kanniisaa jedhu irratti qorannoo geggeessudha. Deebii sirrii fi ifaa ta'e deebiisuun keessan galma ga'iinsa qorannoo kanaaf gahee guddaa qaba.Kanaafuu,gahee isin irra eegamu akka baataan kabaja guddaadhaan gaafaatamtani jirtu.

Odeeffannoo waliigalaa

1. Godina_____ Aanaa_____ Ganda_____

Haala abbootii warraa

2. Maqaa abbaa warraa_____
3. Saala _____
4. Umrii _____

5. Haala fuudha fi heerumaa: 1/ Kan fuudhe ykn kan heerumte

2/ Kan irra boqate ykn boqatte

3/ Kan hiikee ykn hiikte

6. Baayina maatii _____ 7.Muxannoo Kanniisaa horsiisu hangam qabda _____

8. Sadarkaa barnoota kan abbaa warraa: 1/ kan hin baranne

2/ Kan dubbisu fi barreessuu danda'u

3/ sadarkaa tokkoffaa (1-8)

4/ sadarkaa lammaffaa(9-12)

5/ Koolleejjii

Sochiilee horsiisa kanniisaa

1. Yeroo horsiisa kanniisaa eegaltu, maddi gurmuu kanniisa keetii maalii?

1/ Gurmuu kanniisaa qabuudhaan 2/ Kenna warra kootitiin

3/ Kennaa warra kootii fi gurmuu kanniisaa qabuudhaan 4/ Gurmuu Kanniisaa bituudhaan

2. Kanniisa horsiisuuf, gosoota gaagura kam fayyadamtaa?

1/ Gaagura aadaa qofa 2/ Gaagura ce'umsaa qofa

3/ Gaagura ammayyaa qofa 4/ gaagura aadaa fi ce'umsaa

5/ Gaagura ce'umsaa fi ammayyaa 6/ Gaagura aadaa, ce'umsaa fi ammayyaa

3. Gaagura kee eessa keessa?

1/ Naannoo manatti iddoo eeggame keessa kaa'uudhaan

2/ Bosona keessatti muka irratti fanniisuudhaan

3/ Naannoo manatti muka irratti fanniisuudhaan

4/ Girgiidaa mana jala kaa'uudhaan

5/Mana keessa kaa'uudhaan

6/ Bosona keessatti muka irratti fanniisuu fi naannoo manatti bakka eeggame keessa kaa'uudhaan

7/ Girgiidaa mana jala kaa'uu fi naannoo manatti muka irratti fanniisuudhaan

4. Waggaa tokko keessatti yeroo meeqaaf damma murta ykn baafta?

1/ Al tokko 2/ Al lama 3/ Al sadi

5. Yeroo hangamiif gaagura fi gurmuu kanniisa keetii tohaataa ykn ni ilaaltaa? (ala fi keessa)

Yeroo tohaannoo	Ala	Keessa
Guyyaa guyyaadhaan		
Guyyaa keessatti alama-sadi		
Torbee hunda		
Torbeetti alama		
Ji'a ji'an		
Ji'a lama ykn sadiin		
Wagga waggaan		

6. Haalli gurmuu kanniisaa fi oomisha dammaa maal irra jira?

1/ Dabalaa jira 2/ Dhaabbatadha 3/ Hir'ataa jira

6.1. Yoo hammii lakkoofsa gurmuu kanniisaa fi oomisha dammaa waggaa gara waggaatti ni hir'ata ta'e, sababni isaa maalii?

_____

_____.

7. Amallii kanniisa keetii maalfakkaata?

7.1Amala: 1/ Kan hin aare/hin lole/ 2/ Kan aartu /loltu/ 3/ Kan baay'ee aartu

7.2 Halluu: 1/ Gurraacha 2/ Diimaa 3/ Makaa gurraacha fi diimaa

7.3 kamtuu irra oomishaa damma kena ? Amala_____ Hallu _____

8. Damma baasuuf, wantootni ati itti aarsiitu/ultu/ maalii?

1/ Galabaa 2/ Marga gogge 3/ koboota horii 4/ quncee muka

9. Gurmuun kanniisaa gara gaagura duwwaati akka seenu harkiistoota akkami fa'a faayyadamtaa? Akka beekkamtii isaaniittin tarreessi?

Lakk.	Maqaa naannoo	Maqaa Saayinsaawaa	Caasaa biqiltoota	Mala itti faayyadamtuu
1				
2				
3				
4				
5				

10. Wal hormaanni kanniisaa yeroo kam mul'ata?

1/ waaqti hunda 2/ waggaa hunda 3/ Waggaatti alama

4/ Once in two year 5/ Hin beekuu

11. Gurmuu kanniisa keetiitif nyaata ni kennitaafi?

1/ Eeyyee 2/ Miti

12. Paakeejii eeksteeshinii horsiisa kanniisaa keessatti ni hirmaataa?

1/ Eeyyee 2/ Miti

13. Damma kuusuuf meeshaalee akkami faayyadamta?

1/ Qorqorroo xaasaa 2/ Okkootee 3/ Laastiika

5/ Birciiqqoo 6/ Kanneen biroo

13.1. Sababii maaliitiif damma kuustaa?

_____

_____

_____.

14. Gaagga ni oomishtaa?

1/ Eeyyee 2/ Miti

14.1. Wantootni akka gaagga hin oomishneef sababa ta'an akka naannoo keetitti maal fa'ii? Kan siif kename keessa eeyyee ykn miti jedhi filadhu?

Wantoota	Eeyyee	Miti
Leenjiin dhabuu		
Muxannoo dhabuu		
Gaagurri aadaa gaaggaa oomishuuf mijaata waan hin taaneef.		
Osoo gaagga dammaan adda hin baasiin nyaachuu fi gurgurachuu		
Meeshaaleen gaagura ammayyaarra gaagga oomishaan dhabaamu		

Haala gabaa

15. Damma kee ni gurgurtaa?

1/ Eeyyee 2/ Miti

16. Bakki beekkaman damma itti gurgurtu eessa?

1/ Ganda keessatti 2/ Iddoo gabaa nattii dhihaatutti

3/ Iddoo gabaa beekkamaa 4/ Waldaa horsiistotatti

17. Gabaa keessatti, dhiyeessin dammaa maal fakkaata?

1/ Qubsaadha oli 2/ Qubsaadha 3/ Qubsaa miti

17.1. Deebiin kee qubsaa miti yoo ta'e sababni isaa maalii?

_____

_____

_____.

18. Gabaa keessatti, barbaadamummaan dammaa maalfakkaata?

1/ Guddaadha 2/ Jidduugaleessa 3/ Xiqqaadha

19. Odeeffannoo gabaa dammaa ni argattu?

1/ Eeyyee 2/ Miti

20. Haala gatii gabaayaa dammaa naannoo keetii akkamiin madaalta?

1/ Olkaa'adha 2/ Dhaabbatadha 3/ Gad-aanaadha

Haala mijaata

21. Wantootni gurguddoon naannoo keetitti kanniisaa horsiisuuf mijaata ta'an maal fa'ii? Akka beekkaamti isaaniittin tarreessi?

L.	Haala mijaata	Sadarkaa
1	Biqiltootni daraaraa jiraachuu	
2	Gurmuun kanniisaa jiraachuu	
3	Kanniisaa horsiistootni muxannoo fi beekumsa qabachuu	
4	Maddi bishaanii gaha ta'e jiraachuu	
5	Qabeenyaa gummachuu keessatti gaatii qabachuu	
6	Barbaadamummaan gabaa dammaa jiraachuu	

22. Biqiltootni bebbeekkamoon naannoo keetii faayidaa kanniisatiif oolaan maal fa'ii? Akkaata beekkamtii isaaniitiin tarreessi.

Lakk.	Maqaa biqiltootaa	Gosa biqiltootaa	Ji'a isaan itti daraaraan
1			
2			
3			
4			

5			

Rakkoowwan horsiisa kanniisa

23. Naannoo qa'annoo kana keessatti rakkoowwan ijoon horsiisa kanniisatiif dhiibbaa ta'an maal fa'ii? Sadarkeessi.

Lakk.	Rakkoowwan	Sadarkaa
1	Keemikaalota adda addaa fayyadamu	
2	Rakkoo ilbisotaa fi bineensotaa	
3	Kanniisni gaagura lakkiisee deemuu	
4	Meeshaaleen horsiisa kanniisatiif tajaajilan dhabaamu	
5	Rakkoo gargarsa eexteeshiinii	
6	Rakkoo gabaa	
7	Leenjiin adda addaa waa'ee horsiisa kanniisaa irratti kennamu laafaa ta'u	
8	Eegumsi gurmuu kanniisaa fi gaaguraa godhamu laafaa ta'uu	
9	Rakkoo bishaanii	
10	Rakkoo tajaajila bu'uuraa. fakkeenyaaf karaa	
11	Hir'ina nyaata kanniisaa	
12	Yeroo dammii itti muramu beekuu dhabuu	

24. Ilbisotni fi bineensonni bebbeekkamoon kanniisa miidhaan kan naannoo qo'annoo kana keessatti argaman maal fa'ii? Sadarkeessi.

Lakk.	Ilbisotaa fi bineensota	Sadarkaa
1	Hamaagootaa /Honey badger/	
2	Miixii/Ants/	
3	Shararriitii /Spiders/	
4	Simbirrota kanniisa nyaatu /honey bee eater birds/	
5	Rirma/Termite/	
6	Boombii gaagura nyaatu/small hive beetles/	
7	Ilbisa jiisaa nyaatu /wax moths/	
8	Injiraan kanniisaa/Bee lice/	
9	Lootuu /Lizards/	

10	Bofa /Snake/	

25. Rakkooleen ijoon mala aadaatiin kanniisa horsiisota akka isaan mala aadaa keessaa turan taasise maalii? Kan siif kename keessa eeyyee ykn miti jedhi filadhu?

Lakk.	Rakkoowwan	Eeyyee	Miti
1	Mallaaqni gaagura ammayyaa ittin bitamu dhabaamu		
2	Leenjiin gaagura ammayyaa irratti kennamu laafaa ta'u fi dandeetiin gaagura ammayyaa hojechuu laafaa ta'u		
3	Gargarsi eekteenshiinii dhabaamuu		
4	Gaagurri ammayyaa gabaayaa naannoo irra dhabaamu		
5	Kaka'umsi fi walitti dhufeenyii ogeeyyii qonnaa wajjiin qabdan laafaa ta'u		
6	Gargarsi mootummaa fi dhaabbata dhuunfaa dhabaamu		
7	Hubannoon gaagura ammayyaa irratti qabdan laafaa ta'u		

26. Gurmuu kanniisaa hangam qabdaa?

1/ kan aadaa_____ 2/ Kan ce'umsaa_____ 3/ Kan ammayyaa_____

27. Hammi dammaa gaagurra adda addaa irraa argatu kilograamiidhaan meeqaa ta'a?

1/ kan aadaa_____ 2/ Kan ce'umsaa_____ 3/ Kan ammayyaa_____

28. Rakkooleen gurguddoon naannoo keetiiti oomishaa fi gabaa dammaa keessatti mul'atan maal fa'ii?

_____

29. Oomisha dammaa fooyyeessuuf haalli mijaatan naannoo kee jiru maalii?

_____

30. Oomisha dammaa dabaluuf akka naannoo keetiiti maaltu hojjetamuu danda'uu qabaa?

_____

.

Gargaarsa keessaniif guddaa galatomaa!!

Maqaa waliitti qabaa odeeffannoo kanaa Mallattoo Guyyaa

_____ _____ _____