Addis Ababa University

Study on the Status of Beekeeping in Qolla–Temben Wereda, Tigray Regional State

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Addis Ababa, Ethiopia

September, 2017

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A Thesis Submitted to the Department of Zoological Sciences in partial fulfillment of the requirements for the degree of Master of Science in Biology

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GRADUATE PROGRAMM

DECLARATION

This is to certify that the thesis prepared by Nigsti Teklu, entitled: **Study on The Status of The Beekeeping in Qolla–Temben Wereda, Tigray Regional State:** and submitted in fulfillment of the requirements for the degree of Master of Science in Biology complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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ABSTRACT

The present study was undertaken in Qolla-Temben Wereda, Central Tigray Zone, Tigray Regional State. The study addressed diverse issues related to beekeeping, including beekeepers perception about bee biology, honeybee flora, as well as honey harvesting and marketing. Data were collected through semi-structured interviews, face to face discussions with the farmers and/or development agents; by making household and/or field observations, as well as through market surveys. The collected data were analyzed and summarized under the following five categories, namely: (1) socioeconomic characteristics of the studied households; (2) Beekeeping activities of the studied communities; (3) farmers perception about bee biology and honeybee flora; (4) honey harvesting; and (5) honey marketing. The present study found out that, of the total beekeepers interviewed 86 were married while 10 and 3 were single and divorced, respectively. It was discovered that 75 of the respondents prefer modern beehives to traditional beehives. On the other hand, 20 of the respondents showed preference to traditional beehives, compared to 3 of the farmers who preferred transitional beehives. The present study showed that the prime time for honey harvesting in Qolla Temben Wereda was October to November, with October as a peak harvesting month for obtaining the largest quantity and quality of honey. The study also found out that, of the total beekeepers 59.2% have reservations on the favorability of the prevailing honey markets. On the other hand, 40.8% beekeepers rate the prevailing market favorability for their honey as positive. They said that the financial and labor inputs of farmers on beekeeping do bring the intended benefits. But this benefit depends up on the season of the year, when it may double, triple or even more. The present study identified lack of knowledge and skilled manpower (56.1% of the respondents), as well as lack of proper equipment (23.5%), and prevalence of pests and predators (20.4%) as major constraints for honey production by small-holder farmers. We conclude that beekeeping brings substantial changes in the farmer's socioeconomic conditions by serving as alternative means of income generation.

KEY WORDS/ PHRASES: Bee forage, bee sting, bee waxes, queen

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DA-Developmental agents

BK-beekeeper

1. INTRODUCTION

1.1 BACK GROUND

Beekeeping has a long standing history. It was practiced in ancient Egyptian, Greek, and Roman civilizations, and parts of the Middle East and Asia have a long history of beekeeping for the purpose of harvesting honey and other bee products. In these ancient civilizations, honey was a staple food during the winter, and it was also used for medicinal purposes (Crane, 2013). Over the past three centuries, the common honeybee has been introduced to all habitable continents. Outside Asia, beekeeping with *Apis mellifera* constitutes an integral part of modern agricultural systems with bees pollinating crops and producing honey and beeswax (Akrathanakul, 1990; Famuyide *et al*., 2014). Several Asian countries have reported on the commercial viability and livelihood of a profitable economic return from beekeeping with *Apis mellifera* L. (Famuyide *et al*., 2014; Richards and Kevan, 2002). This species, however, is facing population decline in several countries (e.g., the United States and Nepal) and is being exposed to multiple diseases because it is an exotic species now living outside its native geographic location. Declining pollinator populations impact not only the sustainability of rural families' livelihoods but also that of plant biodiversity (Potts *et al.*, 2010). Thus, rather than just providing food and additional income, apiculture also plays an important role in maintaining the health of ecosystems. Tropical regions have a diversity of potential pollinator bees in their ecosystems and agro-ecosystems. Beekeeping is a sustainable source of income that does not damage the environment (Oluwole, 1999). Practicing beekeeping requires little land, and the quality of the land is inconsequential, as the beehives are placed on trees. This enterprise serves to empower small-scale farmers who are required to make only modest capital investments (Famuyide *et al*., 2014), and in these communities, a sustainable source of income could alleviate or even eradicate poverty (Terry and Ousseynou, 2004). It also provides job opportunity in the sector. The role it plays in enhancing food security, poverty reduction and food production through pollination of crops has become substantial in the recent years. There is no well-documented evidence that indicates when and where beekeeping practice started in Ethiopia.

According to Ayalew (1978), beekeeping started in the country between 3500–3000 BC. From the rural community's point of view, beekeeping is an inherited tradition and an ideal occupation that contributes for improvement of livelihoods. Owing to its varied

ecological and climatic conditions, Ethiopia is home to some of the most diverse flora and fauna in Africa, making it highly suitable for sustaining a large number of bee colonies (Nuru, 2007). The country has the largest bee population in Africa with over 10 million bee colonies, out of which about 7.5 million are confined in hives and the remaining exist in the forest (Nuru, 2007). This makes the country one of the largest honey producers and the 3rd largest beeswax producers worldwide. Ethiopians honey production accounts for approximately 2.48% of the world production and 21.73% of African honey (EARO Production, 2000; MoARD, 2007).

The country is also one of the four largest beeswax producing countries and this commodity is one of the major exportable products and in 2010/2011, about 620,101 kg of honey was exported (CSA, 2011). It has been reported that annually an average of 420 million Ethiopian Birr was obtained from the sale of honey (Gidey and Kibrom, 2010). The total number of population of honeybee colonies of the country is estimated to be about 10 million, of which about 7.5 million are confined in beehives and the remaining exist as feral colonies in the forest (SNV, 2005).

Contextually, Ethiopia has the potential to produce 500,000 tons of honey and 50,000 tons of beeswax per annum. Meanwhile, there is large and growing demand for honey and other bee bee wax products worldwide since it has nutritional and/or medicinal values (Gizachew, 2011). However, significant proportion of honey produced in the country is used for domestic consumption. Reports indicate that the amount of honey exported is comparatively low, only less than 1% of the total honey produced (SNV, 2005; Beyene and David, 2007; CSA, 2012).

The most well known and utilized harvestable products from honey bees is honey. Honey is the sweets substance produced by honeybees from the nectar of blossoms or from secretions on living plants, which the bees collect, transforms and store in honey combs (CAC, 2001).

1.2 Overview of Beekeeping in Tigray

Extreme environmental degradation has occurred throughout the Region on all land types as evidenced by soil erosion, loss of trees, grasses and general biodiversity. Much of the original woody vegetation and grasses have been removed from cultivated land and from unprotected hillsides, which historically have been used for grazing and wood extraction (Tony, 2010). However in the past two decades the Government gave attention to the

rehabilitation of degraded areas in the Region and this situation created favorable conditions for the development of beekeeping. The success of the honey promotion program, however, is inextricably linked with the success of enclosure areas in rehabilitating vegetation on a large scale. Vast areas of land are now covered with flowering plants such as *Tebeb*, *Gerbia* and *Akacha* which provide bee fodder (Tony, 2010). Moreover, the landless youth have got benefits from these enclosed areas through beekeeping activity. Therefore, transforming enclosure or watershed into apiary is just one example of a possible "win-win situation" for poverty alleviation (Jacobs *et al*., 2006). The same authors recommend the integration of apiculture sector into overall land management strategies and farming systems, so as to ensure abundant nectar and pollen for a good and successful apiculture development. In Tigray Region, apiculture is a good source of income for smallholder farmers, as both honey and bee colonies are in high demand. To increase the yield and improve the quality of honeybee resources in the Region, the Tigray Regional Government has been introducing framed beehives and accessories (Gidey and Mekonen, 2010). However, because this equipment is relatively expensive to buy, most smallholders could not increase their income as expected. Some innovative beekeepers started to use alternative equipment and practices to manage their bee resources and to improve the quality of the products (Hailu *et al*., 2007). In the Region, during the past two decades, promotion of modern beehive management and equipment, queen rearing by farmers, bee forage development and market development have resulted in honey production, thus increasing from 130 quintals to 31,100 quintals and productivity increased from 10 kg/ beehive to 35 kg/beehive (Gizachew, 2011). According to MoARD (2007), the potential for an expanded honey industry is simply enormous, and there are more than 200,000 honeybee colonies in Tigray Region, of which only 53,282 have modern beehives. The majority of the colonies with frame beehives were recently established (MoARD, 2008).

2. OBJECTIVES

2.1 General objective

The general objective of this study was to assess the status of bee farming in Qolla Temben Wereda (Tigray Regional State) for livelihood improvements.

2.2 Specific objectives

- To study extent of beekeepers perception about the value of beekeeping;
- To examine the benefits of beekeeping in improving farmers' livelihoods;
- To assess extent of economic and technological constraints that hinder modern beekeeping,
- To examine farmers perception on the limitations and/or scarcity of honeybee flora for adequate honey production; and, to find out market favorability in promoting beekeeping.

3. LITRERATURE REVIEW

3.1 Beekeeping and importance of pollination

Pollinators, through facilitating plant reproduction, play a crucial role in the maintenance of ecosystem services (Batra, 1985, 1997). Pollination requires pollinating agents which themselves require resources for nesting, feeding and reproduction in the form of vegetation, prey, and certain habitat conditions, as well as the application of pollinator friendly land-use management practices to ensuring their survival.

The Pollinator Over 75% of the major world crops and 80% of all flowering plant species rely on animal pollinators (Nabhan and Buchmann, 1997; Kevan et al., 2002). Of the hundred or so animal-pollinated crops which make up most of the world's food supply, 15% are pollinated by domestic bees, while at least 80% are pollinated by wild bee species and other wildlife (Prescott-Allen and Prescott-Allen, 1990). Diversity among species, including agricultural crops, depends on animal pollination. Thus, pollinators are essential for diet diversity, biodiversity, and the maintenance of natural resources. The principal pollinators are bees. Approximately 73% of the world's cultivated crops, such as cashews, squash, mangoes, cocoa, cranberries and blueberries, are pollinated by some variety of bees, 19% by flies, 6.5% by bats, 5% by wasps, 5% by beetles, 4% by birds, and 4% by butterflies and moths (Freitas et al., 2004). Of the hundred principal crops that make up most of the world's food supply, only 15% are pollinated by domestic bees (mostly honey bees, bumble bees and alfalfa leafcutter bees), while at least 80% are pollinated by wild bees and other wildlife (as there are an estimated 25,000 bee species, the total number of pollinators probably exceeds 40,000 species). About 25,000 different species of bees differ significantly in size and habitat requirements, and diverge accordingly in the plants they visit and pollinate. Though bees form the most important group of pollinators, other animals, such as bats, birds, butterflies, moths, flies and beetles also play key roles in pollination. Both the diversity of wild plants and the variability of food crops depend on this diversity. Pollination is a complicated process with some being generalists and others being species-specific. Likewise, many different pollinators visit some plants, while other plants have species-specific pollinator requirements. Given this complexity, managing pollination as an ecosystem service requires a comprehensive understanding of the pollination process and the application of that knowledge in the design and implementation of intricate management practices. In most

cases, there is limited knowledge about the exact relations between individual plant species and their pollinators.

The Impact of Declining Pollinator Populations on Agriculture

It is recognized that agricultural production, agro-ecosystem diversity and biodiversity are threatened by declining populations of pollinators. Many pollinator population densities are being reduced below levels at which they can sustain pollination services in agro ecosystems, natural ecosystems, and for the maintenance of wild plant reproductive capacity. The major contributors to this decline in pollinator populations are, inter alia, habitat loss and fragmentation, land management practices, agricultural and industrial chemicals, parasites and diseases, and the introduction of alien species. Ecological dangers of pollinator decline include the loss of essential ecosystem services (particularly agro-ecosystem services) and functions that pollinators provide. Ecosystem services in their turn have their own value biophysical, but also economic. For example, for the entire biosphere, the value of ecological services (most of which outside the market) was estimated to be in the range of US$ 16–54 trillion per year, with an average of US$ 33 trillion per year (Costanza *et al.,* 1987). Services that are provided by native pollinators (non-honeybee species) are estimated to be worth US$ 4.1 billion a year to United States agriculture alone (Prescott-Allen and Prescott-Allen, 1990). In the Canadian prairies, the value of pollinators to the alfalfa seed industry has been placed at about CAD six million per year (Kevan and Phillips, 2001). Examples from Asia (e.g. northern Pakistan, parts of China) show linkages between declining natural insect populations and decreasing crop yields as a result, people have begun to manage the crop-associated biodiversity (i.e. pollinators) in order to maintain their crop yields and quality. For example, farmers in Himachal Pradesh (in northwestern India) are using honeybees to pollinate their apples (Partap, 2003). Due to declining pollinator populations and changing cultivation practices, an increasing number of farmers around the world are now paying for pollination services and are importing and raising non-native pollinators to ensure crop production. In many developing countries, however, external pollination services are not available and rural communities have to live with reduced quantity, quality, and diversity of foods. In fruit orchards in Western China, the decline of useful insect populations has led farmers to pollinating by hand, acting as human bees (Partap, 2003). Despite a general recognition of the impact of declining pollinator populations on ecosystem functioning, and despite the examples of the ecological and economic impacts as well as examples of where this is occurring, bottlenecks and constraints hinder the conservation and management of pollinators in sustainable agriculture. An example of a globally recognized bottleneck is the lack of

taxonomic information, which hampers progress that could be made in identifying and analyzing firstly pollinator populations important to agriculture, and their behavior patterns, but also best management practices.

Best management practices are not readily available or known in all areas of the world, and especially not to all peoples. Indeed, a lack of awareness of pollinator issues from the farmer to the extension worker to the policy maker is also a set-back for the promotion of issues related to the conservation and management of pollinators within the context of sustainable agriculture. Recognition of these bottlenecks and constraints as well as a need for action contributed to the international arena's response to the conservation and management of pollinators, in agricultural systems. The importance of pollination in improving food security and livelihoods through enhancing agricultural productivity is well known. An attempt has been made to analyze such issues as the decline in pollinator populations and its impact on agricultural productivity and implications on pollination management, and challenges to integrate pollination as a necessary input in agricultural policies and plans in the light of available information on pollination. This paper also emphasizes the need to conserve pollinator diversity to ensure pollination and at the same time it tries to present an alternative perception to beekeeping and that is "to promote" beekeeping primarily for crop pollination with honey and other bee products as by products". This new approach combines the two benefits well but institutional reorientation in the context of policies, research and extension might be necessary.

3.2. Value of beekeeping in improving farmers livelihoods

In rural communities, where there are limited opportunities to earn incomes, small-scale beekeeping can contribute significantly to a secure livelihood. Beekeeping also provides honey as a source of food and improves the welfare of beekeepers due to its production as new sources of income (Baumga rtner *et al.,* 2001). Traditional beekeeping is complementary to other farming activities, and it creates diverse socioeconomic benefits by reducing the risks associated with depending solely on conventional crops and animal production for one's income (Sunderlin *et al*., 2008). Although residents have mixed perceptions of what constitutes the overuse of resources, tropical rural community members strongly prefer to engage in practices that are sustainable (e.g., beekeeping), and so ensure that natural products will continue to be available in the future (Swierk, & Madigoskyc, 2014; Wunder, Angelsen, & Belcher, 2014).

Beekeeping in Ethiopia is a long-standing cultural agricultural practice. It has been exercised as a sideline activity by many of the rural farming communities for its honey and beeswax production that contributes to income generation. The role it plays in enhancing food security, poverty reduction and food production through pollination of crops has become substantial in the recent years (MoARD, 2007 a pro-poor income). As beekeeping has low start-up cost and requires little land or labor, it is accessible to many rural community and is promoted as e generation activity (MoARD, 2007). Frequent droughts coupled with environmental degradation have threatened the livelihood of this rural community for several decades (MoARD, 2007). However, regardless of other agricultural activities, bees survive in drought threatened areas and supplement the vulnerable communities with nutritious food, honey, and a source of income. Therefore ranges of applications emerging from apiculture development are enormous and it is considered a major tool in combating food insecurity, while protecting the environment. Furthermore, the apiculture sub-sector is emerging as a strategic means of export diversification (GDS, 2009). Apiculture has also a great role in natural resource protection. Beekeeping is environmentally friendly activity and beekeepers are more aware about the importance of conservation of natural resource than any ordinary farmers (Nuru, 2007). Integrating natural resource conservation programs with income generating options like utilizing the forest resources, in the form of honey and beeswax, while maintaining the natural vegetation would be an appropriate approach (Nuru, 2007).

Comparing with other agricultural activities beekeeping has many relative advantages because of the following reasons (Adjare, 1990; Palaniswamy, 2004; Nuru, 2007).

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

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

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

Side line activity.

d. Beekeeping assists to utilize resources like pollen and nectar which otherwise are

Wasted. Man cannot utilize these resources without bees.

e. Beekeeping can be run in areas which are not suitable for cultivation of crops and

Animal husbandry such as hills and escarpments.

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

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

h. Beekeeping is useful in improving the quality and quantity of crop yields and contributes for the maintaining biodiversity through efficient pollination services of honeybees.

3.3. Constraints of beekeeping in Ethiopia

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 prevailing production constraints in the beekeeping sub sector of the country would vary depending on the agro ecology of the areas where the activities is carried out (Ayalew, 1994;).The major constraints that affect beekeeping sub-sector in Ethiopia are: lack of beekeeping knowledge, shortage of skills man power, shortage of bee equipments, pests and predators, pesticide threat, poor infrastructure development, shortage of bee forage and lack of research extension (Kerealem *et al.,* 2009).

3.4. Honeybee flora

The bees and plants are co-evolved during middle cretaceous period (Michener, 1974). The bees are depending on flowering plants as they provide food in the form of pollen and nectar. Similarly, plants are depending on the bees for pollination. The mutual interdependence of the anthrophilous insects and entomophilous angiosperms hastened their coevolution (Suryanarayana, 1986). The relationship between bees and plants stems from cretaceous times, roughly 100 million years ago (Velthius, 1992). The bees (Apoidea) constitute a group of 20000 species representatives at every level from solitary and non-social to community and true social like modern honeybees, Apis (Hargasim, 1974).

The flowering plants of several plant families are blossoming at different time intervals of the year. Pollen and nectar availability to foraging bees fluctuated with time of the year and flowering of different species of plants (Free, 1970). The phase of the blooming period does not commence simultaneously in all the honey-flora participating in the main honey-flow. Depending on the soil type, climatic factors and the habitat of the vegetation, the time of blooming may change for even and the same nectar plant (Rodionov and Shabanshov,

1986). The honey plants participating in the main honey-flow do not confine everywhere; each of them has restricted to quite definite climatic conditions and particular Regions or area. Therefore, the types of honey harvest not similar in all the area and Regions of a country. The flowering dates of some of the important honey plants in Poland has been studied and made a list of plants useful for honeybees (Gromisz, 1993).

Flowers are the main stay of bee's life. The bees are automated micromanipulators by which man can harvest floral sources that would be otherwise unobtainable (Kevan, 1984). Flower duration and main blooming time is essential information for sound management of beekeeping. Beekeeping is an agri-horticultural and forest based industry and as such it is of great importance for farmers. By investing limited expenses beekeeping can be practiced to obtain maximum subsidiary income with other agricultural activities. The practice of beekeeping is not only depend on the better strain of honeybees but also on the abundance and occurrence of pollen and nectar sources within the surrounding area of an apiary (Free, 1970; Akrathanakul, 1987).Areas with existing floral resources are highly suitable for beekeeping in the country (Bradbear, 2008). Forests provide adequate bee-forage in terms of both quality and quantity of nectar and pollen grains. For this reason, bee-keeping also has the potential to increase opportunities for forest conservation (CIFOR, 2008). When promoted among forest adjacent communities, beekeeping provides reliable livelihood options (Mazur and Stakhnov, 2008). The flower species were identified as a bee plant only after visual conformation and collection of food by honey bees (Sivaram, 1995, Naim and Phadke, 1976).

The elimination of good nectar and pollen producing tree species in many areas makes it difficult to maintain bee colonies without food (Kerealem, 2005). It has been emphasized that the key to sustainable use of native plants is to propagate, domesticate and cultivate these using current scientific atechniques (Legesse Negash, 1995; 2002; 2003a, b; 2004; 2010).

Shortage of bee forage is mainly resulted in Ethiopia due to population pressure and its ecological impacts such deforestation and shifting cultivation. Beekeeping contributes to conservation of the natural environment since its environmentally sustainable activity which integrated with agricultural practices. It would be one of the most important for sustainable development of poor countries (Gibbon, 2001). Beekeeping plays a major role in socioeconomic development and natural resources conservation and pollination.

3.5. Honey Marketing Systems

Beekeepers, honey and beeswax collectors, retailers, tej brewers, processors and exporters are identified to be the key actors in the value chain of the honey sub-sector. Three principal channels were identified in the value chain of the sub-sector. These are tej brewery channel, honey processing and exporting channel and beeswax channel. These channels are complex and interconnected that implies absence of organized marketing channel and lack of formal linkages among the actors. Most of the harvested honey goes through tej brewery channel. Beekeepers directly sell their honey to local honey collectors (dealer or cooperatives) at district or zonal levels, which directly deliver the honey to tej brewery houses in their localities and/or transport it to the big honey dealers (verandah) for breweries in Addis Ababa. Some beekeepers who are producing large quantities of honey also directly supply it to tej houses in their areas. Although economically not so significant, tej is informally exported through country visitors and transitory (Beyene and David, 2007).

Honey processors' and exporters' channels also start from beekeepers and goes through the local agents of honey processors and/or honey marketing cooperatives, which supply the honey directly to the processing plants either with partial refining or as it is. The processing plants further refine the honey using advanced processing devices and pack into labeled containers for local markets (super markets, food groceries and big hotels) and very often to export markets.

Unlike the two channels mentioned above, the beeswax channel starts mainly from tej brewery, which collects the wax as a by-product of tej or berz. The tej brewers either sell the crude beeswax or semi-processed to the local beeswax collectors who supply to beeswax refiners in Addis Ababa. The beeswax processors produce the final pure beeswax suitable for export market and local markets. Sometimes beekeepers buy beeswax from the wax collectors and/or Processors to use as a starting input for honey production using intermediate and modern beehives (Beyene and David, 2007).

4. Materials and Methods

4.1. Description of the study area

Tigray Region lies in the northern part of Ethiopia and Qolla-Tembein Wereda is found in the Central Zone of Tigray, 95 km^2 west of Mekele. The Wereda has an area of 1470 km^2.The total population of the Wereda is 147,493 (73,000 male, 74,493 female).

The topography of the Wereda is low-land dominated which consists of plateaus and hilly areas, which are surrounded by deep river, valleys, gorges. The geology of the Wereda consists of sand stone, limestone, and shell, which is sedimentary .The altitude of the Wereda ranges from 1600 to 2300 m a s l. The annual rain fall of the Wereda ranges from 500 to 800mm. Average annual temperature of the Wereda is from 25 to 30 according to the climatic zonation of Ethiopia based on altitude and rain fall condition 58% are "Qolla" 42%)are "Wainadega". The average land holding in the Wereda varies from place to place. In addition to this the physical characteristics of the soil is silt dominated 68% silt 2.5% clay 20% sand 9.5% mekish 3% silt clay. Structure of the soil is prism like structure and content of the soil is low because of erosion and low vegetation cover.

The total number of households is 29199 (male 23887, female 5312) and with total beehives in the Wereda 14461 local hives and 4127 improved hives. When we see the land use of the Wereda Qolla-Temben is total area coverage's13690.2ha cultivable land is 31021 ha, grazing land is 47925.57 ha,-forest land is 25058.23 ha-settlement area 3423.255 ha-miscellaneous land 29502.14 ha.

4.2. Livelihood of the people

The livelihood of the people in the district is very diverse and the main economic activities are mixed farming crop, livestock production and beekeeping. The main types of crops cultivated by the farmers in the area are maize, wheat, teff, barley, sorghum, beans and fruit. The livestock is considered as an important component in the farming system of the Wereda.

4.3. Sample size and sampling techniques

The present study was conducted in Qolla-Temben Central Tigray Zone, Tigray Regional State district area. Samples were taken using household selection. Five *qebeles* with

140 households were selected from twenty seven *qebeles* purposely based on transport accessibility and agro ecological zones.

The study area had two agro ecological Zones. These are Qolla and Wainadega. From those 98 respondents were taken from the two agro ecological Zones. Three from Qolla and two from wainadega. Stratified random sampling procedure was followed to select the sample respondents or peasants and/or development agents. Approximately 20% of the *qebeles* were sampled based on the proportion of the *qebele* in each agro ecological Zone. Sample size for each *qebele* was taken as .G/mlesley 35, Dr/ataklty 28, A/bkalsi 14 Zlakme 7, Lmate 14 respectively.

G/mlesley 50 household=sample size=35

Dr/ataklty = 40 household = sample size =28

A/bkalsi = 20 household, =sample size = 14

Zlakme = 10 household, = sample size =7

Lmate = 20 household, = sample size =14

Yamane's formula was used to calculate the sample size proportional to the total household of each *qebele.*

$n = N/1+N (e^2)$

4. 4. Data sources and methods of Data collection

Data were collected through semi-structured interviews, discussions with the farmers and/or development agents, household and/or field observations and honey market survey. Based on the information obtained from secondary data and informal surveys, a structured questionnaire was developed for the household survey with a list of questions covering a wide range of beekeeping activities. In addition to this both primary and secondary data collection were used to meet the objectives of the study.

The questionnaire contained open ended questions and close-ended questions. This was necessary due to the nature of the issues that were being investigated. One day of training was given for the enumerators who have college diploma and working in the district areas as development agents (DAs) to implement the actual household survey. The collection of information was made at household level. The researcher monitored (supervised) the data collection process closely and had checked the quality and appropriateness of the data. Secondary data were collected from different published and unpublished sources, including from district agricultural offices, transport bureaus, the Internet, NGOs and other unpublished materials.

4.5. Method of data analysis

The collected data were summarized and analyzed using tables and graphs, accompanied with computed percentages. Both qualitative and quantitative approaches were employed for interpreting the data.

5. RESULTS

5.1. Socio-economic characteristics of the studied households

From the sample respondents 3 beekeepers (BK) have 2 members in the family, 10 beekeepers (BK) have 3 members in the family, 11 beekeepers (BK) have 4 members in the family, 13 beekeepers (BK) have 5 members in the family, 9 beekeepers (BK) have 6 members in the family, 20 beekeepers (BK) have 7 members in the family, 15 beekeepers (BK) have 8 members in the family, 11 beekeepers (BK) have 9 members in the family and 6 beekeepers (BK) have 10 members in the family. The average family size contained 6 persons with minimum and maximum of 2 and 10 persons, respectively (figure 1).

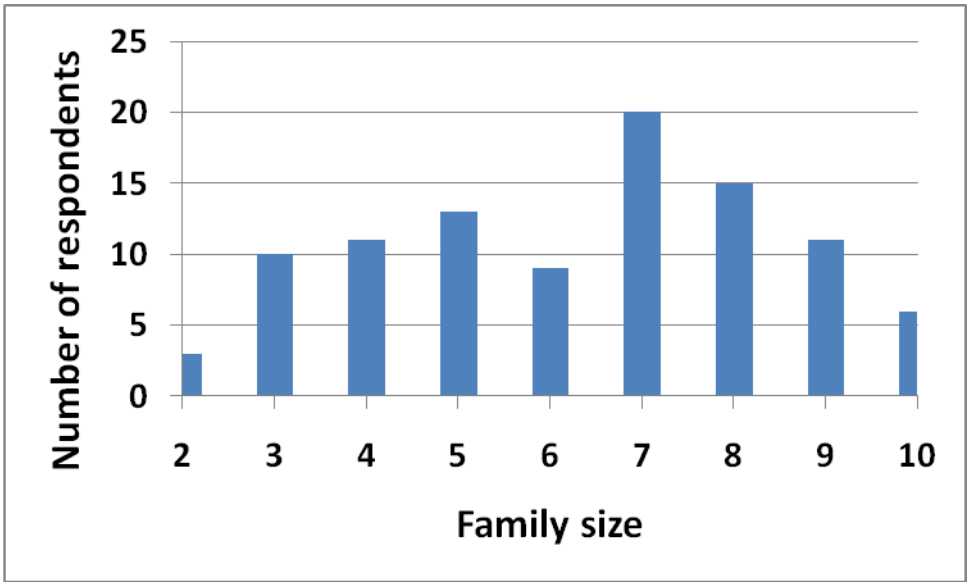

Figure 1 Family size of beekeepers interviewed and/or discussed with in Qola-Temben Werda.

Based on the result found 50 respondents have 1 to 20 years experiences in beekeeping, 33 respondents have 21-30 years of experience and 15 respondents have 31-40 years of experiences.. The range of experience in beekeeping of the sample beekeeper was 1 to 40 years (figure 2).

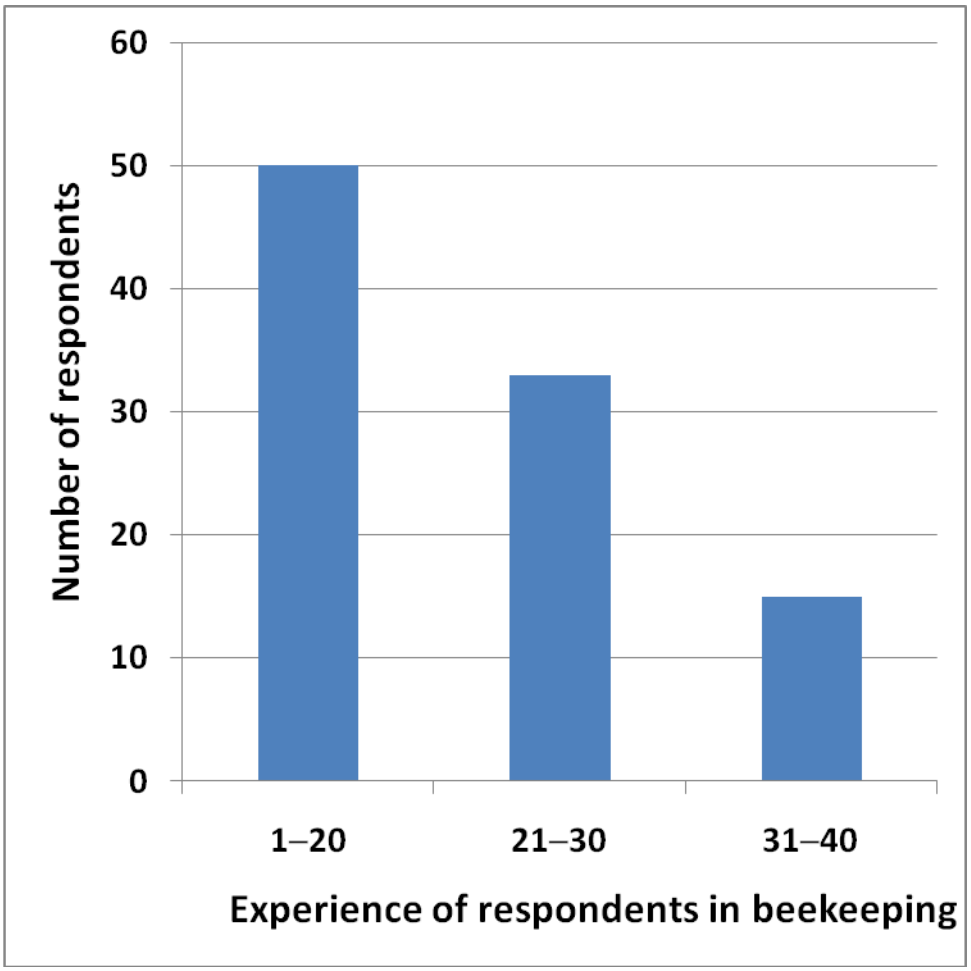

Figure 2 Experience of respondents in beekeeping (year) interviewed and/or discussed with in Qolla-Temben

Figure 3 provides the results of beekeepers age of the respondents interviewed and/or discussed with in Qola-Temben Werda. From the results, 45 respondents have ages ranging from 20 to 40 years, 25 respondents have ages ranging from 41 to 60, and 28 respondents

have ages ranging from 61 to 80 years. The age range of respondents varies from 20 to 80 years (figure3).

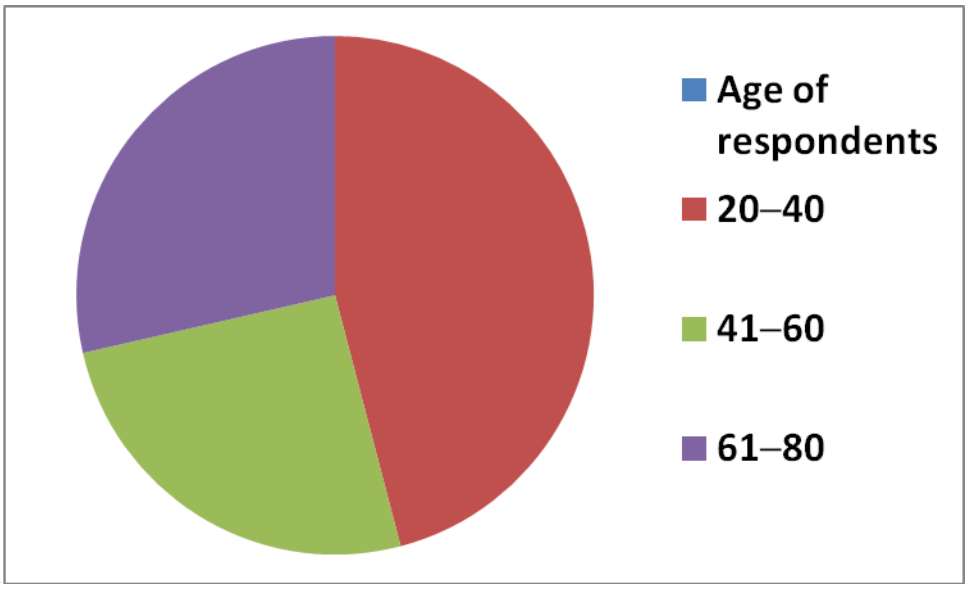

Figure 3 Age of respondents interviewed and/or discussed with in Qolla-Temben Wereda

From the total sample beekeepers 85 were married while 10 and 3 were single and divorced, respectively. Based on the study result beekeeping activities could be performed by every social class of the community regardless of their marital status (figure 4).

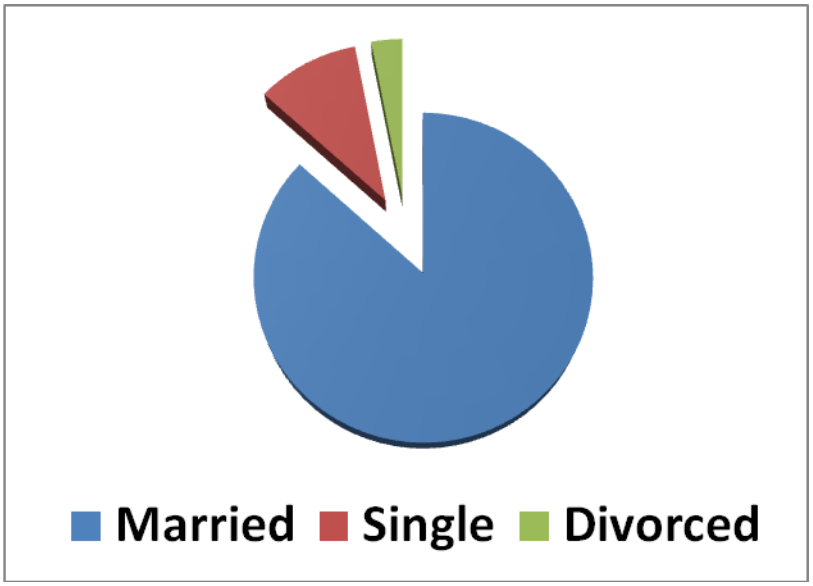

Figure4 Marital status of sample respondents interviewed and/or discussed with in Qolla-Temben Wereda

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Figure 5 provides educational level of beekeepers in Qolla-Temben Wereda.

According to the result found 75 of respondents were illiterate, 15 were literate and 8 were junior.(figure 5).

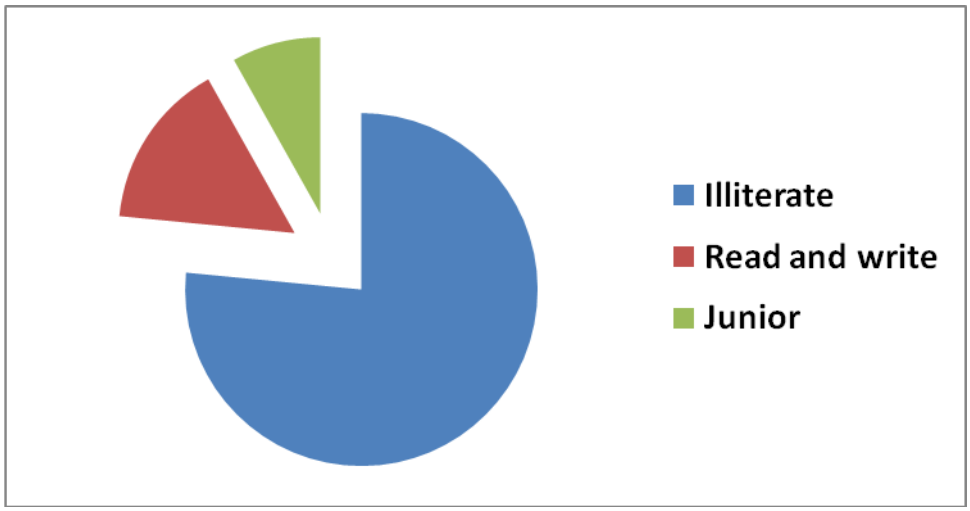

Figure 5 Educational status of respondents interviewed and/or discussed with in Qolla-Temben Wereda

The present result showed that the beekeepers in the study area were using both traditional and modern beehives. Of the beekeepers (51.0%) and (34.7%) use traditional and modern beehive, respectively. and only (14.3%) use both traditional modern beehives. From the total of 98 sample households interviewed about 89.8% were males and 10.2% were female headed household.(Table 1).

Table 1 Beehive ownership and gender of sample respondents with the corresponding percentages.

Beehive ownership and gender	Number of respondents	Percentage
Traditional only	50	51.0
Modern	34	34.7
Both traditional and modern	14	14.3
Male	88	89.9
Female	10	10.2

5.2. Farmers start of beekeeping activities and the resulting assets

According to the present study result 30 of sample respondents were started beekeeping activities before 2000 E.C, 20 farmers started beekeeping in 2001 E.C, 20 farmers were started in 2002 E.C and 28 farmers were started after 2003 E.C. The majority of sample respondents replied that they started beekeeping activities before 2000E.C and after 2003 E.C (figure 6).

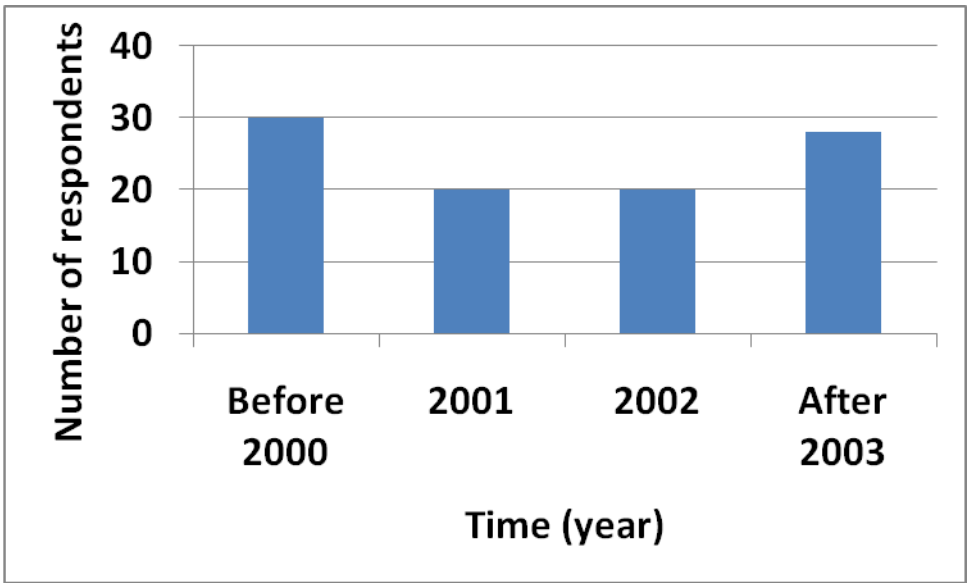

Figure 6 First time acquaintance of beekeeping (EC), with corresponding number of respondents.

Based on table 2 about (40.8%) of respondents got the information from agricultural experts, (30.6%) beekeepers got from model beekeepers, (16.3%) from family and (15.3%) from other sources (table 2).

Table 2 Source of information for usefulness of beekeeping, number of respondents and corresponding percentages.

Information source	Number of respondents	Percentage
Agricultural experts	40	40.8
Model beekeepers	30	30.6
Family	13	13.3
From others	15	15.3

Providing table 3 of the interviewed farmers (38.8%) were owned one beehive at the beginning of beekeeping activities, (18.4%) were owned 2 beehives and (25.5%) were owned 3 beehives and (17.3) were owned more than 3 beehives (table 3).

Table 3 Number of beehives at the beginning, number of respondents and corresponding percentages.

Number of Beehive at the beginning time	Number of respondents	Percentage
1	38	38.8
2	18	18.4
3	25	25.5
More than 3 beehives.	17	17.3

According to figure 7 the result found about 13 of respondents were paid 400birr for one beehive, 15 respondents paid 500 birr 18 farmers paid 600brr and 53 farmers paid above 600birr (figure 7).

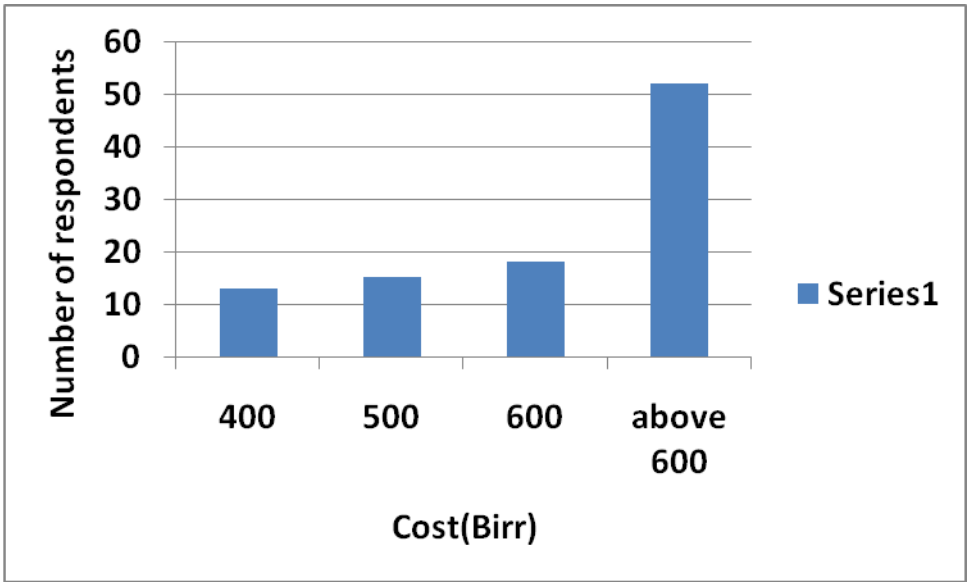

Figure 7 Cost of beehives in (Birr) with corresponding respondents interviewed and/or discussed in Qolla-Temben Wereda

Based on table 4 the beekeepers information it was found out that (56.1%) farmers begin beekeeping activities for the home use. On the other hand (43.9%) farmers begin for

the economic purpose. From the total sample respondents (66.3%) established their bee colonies from market and (33.7%) established from natural (feral). According to the beekeepers responded (71.4%) of beekeepers got the bee colonies from market and (28.6%) got from relatives or friends (table 4).

Table 4 Questions asked and/or discussions made with the respondents concerning purposes of beekeeping, sources for the establishment of the first colonies, sources of beehives, number of respondents and the corresponding percentages.

Questions asked and/or discussions made with the respondents	Purposes/sources	Number of respondents	Percentages
Purpose of beekeeping	Home uses?	55	56.1
	Economic purposes?	43	43.9
Sources for the establishment of the first colonies	Markets?	65	66.3
	Natural (From tree colonies)?	33	33.7
Source of beehives and/colonies	Market?	70	71.0
	Relatives (Friends)?	28	28.6

Based on the beekeepers information the expensiveness of beehives, (38.8%) of sample respondents responded that double, (35.7%) triple and (25.5%) more than (table 5).

Table 5 Current expensiveness of beehives, number of respondents and corresponding percentages.

.Current expensiveness of beehives	Number of respondents	Percentage
Double	38	38.8
Triple	35	35.7
And more than	25	25.5

As shown from table 6 the present study result, (74.5%) of sample respondents were concerned about getting hold of best type of beehives and (25.5) did not about. From these (54.8%) consult with agricultural experts and (45.2%) consult with model beekeepers (figure 6).

Table 6 Extent of concerns of the studied beekeepers about the best type of beehives and beekeeping practices and consultations sought from various experts.

Extent of concerns about the best type of beehives and beekeeping practices	Number of respondents	Percentage
Yes	73	74.5
No	25	25.5
Consultations sought from various experts		
Agricultural experts	40	54.8
Model beekeepers	33	45.2

According to table 7 result (100%) sample respondents were practiced traditional or modern beekeeping method and (51%) beehives were traditional and (34.7%) beehives were modern (table 7)

Table 7 Type of beehive and practicing methods of farmers, number of respondents and corresponding percentages.

Practicing method and type of beehive.	Number of respondents	Percentage
Yes	98	100
No	0	0
Traditional	50	50.1
Transitional	0	0
Modern	34	34.7

Providing figure 8 the present study found that 75 of respondents replied that modern beehive is conducive, 20 respondents replied traditional and 3 transitional beehive. Majority of the respondents prefer modern beehive. Because the modern beehive can move from place to place to find out forage, water and other sources needed for the bees at different season and this can increase the quality and quantity of honey (figure 8).

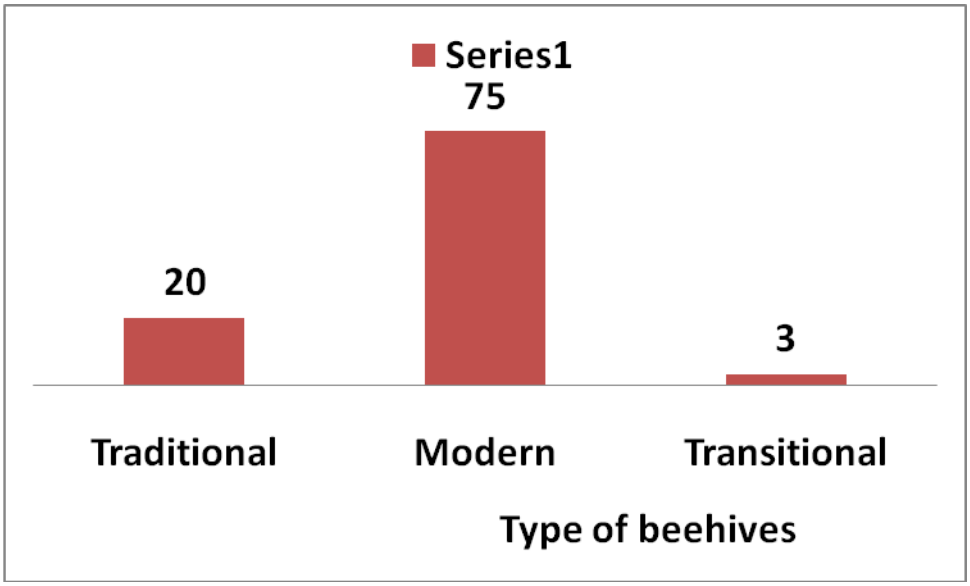

Figure 8 Level of conducivity of beehives of farmers interviewed and/ or discussed in Qolla-Temben Wereda

Figure 9 Conducive beehives in the Qolla-Temben Wereda

According to the beekeepers, most of them can compare the performance of each of the three beehive type in terms of honey quality and quantity and rare respondents cannot compare.

Providing table 8, the constraints of getting the best type beehive were (56.1%) lack of knowledge and man power (20.4%) pests and predators (23.5%) equipment (table 8).

Table 10 Constraints of getting best type of beehive, number of respondents and corresponding percentage.

constraints of getting best type of beehive	Number of respondents	Percentage
Lack of knowledge and skill man power	55	56.1
Pests and predators	20	20.4
Equipment	23	23.5

Based on the respondent result showed most of farmers were said that beehive locations and the climate influence honey bee productivity. On the other hand some farmers said that beehive locations and the climate did not influence. If so, where and how do you

keep your beehive? As respondents replied majority of them locate their beehive on window house or high land to the east direction away from wind.

- The difference between traditional and modern methods of honey harvesting, processing and packaging, which is better? Why?

Above half of respondents replied that the difference between traditional and modern method were: traditional method of harvesting, processing and packaging honey is performed traditionally without using any material assistance. Modern method of harvesting, processing and packaging honey is performed by using materials. During harvesting time the harvester or skill man power protect from being sting by bees through the material. Honey is processed and packed carefully after delivered from the beehive. Based on the result found modern method preferred because of honey quality and quantity.

5.3. Bee biology

Based on beekeepers reflection honey bees are social insects, living together in higher colony. Each member has a specific job to do. A single honeybee cannot grow or survive by itself .the three distinct kinds of honeybees in a colony are Queen, worker and drone.

According to the survey result most respondents responded all bees of a given colony are different and rare responded the same.

- **Different categories of bee colony**

Based on beekeepers in the distinct area replied the different categories of bee colony are Queen, drone and workers bees.

Distinguishing of the different categories of bees

According to beekeepers, the different categories of bees distinguished by; division of labor, shape and size

- **Queen different from the rest of the bees**

As respondents replied above half said Queen is different from the other bees; in shape, forage and labor. The rest of beekeepers did not differentiate the queen from others.

Based on table 9 (42.9%) respondents know the life span of each category and (57.9%) did not know the life span of each category. From the farmers interviewed (44.9%)

of respondents know pollination and (55.1%) did not. As shown from the table 9 (38.8%) of respondents have expertise for queen raring but (61.2%) of respondents do not have expertise for queen raring. All respondents described that bee sting does not have medicinal value and (100%) of respondents replied that all categories of bee colony do not have sting (table 9).

Table 8 Question asked and/or discussed about life span of each category of bees, pollination, medicinal value of bee sting, presence of expertise, number of respondents and corresponding percentages.

Question asked and/ discussed made with the respondents.	Knowledge/Presence	Number of respondents	Percentage
life span of each categories of bees	Yes	42	42.9
	No	56	57.9
Pollination	Yes	44	44.9
	No	54	55.1
Presence of expertise	Yes	38	38.8
	No	60	61.2
Medicinal value of bee sting	Yes	0	0
	No	98	100

- **Importance of honey bees for crop pollination**

  As respondents describes honey bees are important for crop pollination and are vital to facilitate the process of plant reproduction.

- **Colony multiplication**

  Based on respondent's idea colony of honeybee is multiply when the number of workers becomes extremely high another queen is added in one beehive. The new queen continue with the ordinary colony or beehive and the newly one develop by feeding royal jelly and initiates its own colony. This is called splitting method.

Queen rearing

According the idea of respondent's queen raring is replacement of older queen by new one.

Bee sting

As respondents explain bee sting is biting of bee for other living organisms.

As respondents replied that if the bee has stung an intruder the bee become dead.

- **Pests of honey bee and their management**

As respondents replied that there are enemies of honey bee such as parasites, diseases, pest and animal predators and farmers are very aware of these enemies. Indigenous protection methods were practiced to control these pests and animal predators. Exclusively, beekeepers indicated the presence of bee pests and predators, which include ants (both black and red), birds, spiders, mites, wax moth, beetle, bee mice, honey badger, cat worm and lizards. Indigenous protection methods were practiced to control these pests and predators including the application of ash, rope around entrance of hive(hanging the predator's neck), insect repellents (such as dirty engine oil), use of malathine, mechanical killing of the pests, sanitation etc.

5.4 Honeybee flora

- **Bee forage**

  As respondents replied bees forage on flower of parts because the flower contains pollen and nectar which are the main forage of bees.

  Are Plants trees, shrub, herbs or grasses the plant bee forage are trees.

According to respondents showed that there are different important plants preferred by bee and majority of them are tree.

Figure 1 An example of honey bee flora home garden in Qola-Temben Wereda

- **Native or exotic plants**

  Respondents result showed that bee forage plants are native to Ethiopia and their number was decreased from time to time, the number of native plants is very scarcer than before.

Most respondents concern about the scarcity of native plants, some respondents replied that did not concern about the scarcity of native plants.

- **Effort to reverse the loss of native plants**

  Majorities of respondents concerned about the scarcity of native plants and the major efforts showed by farmers were: reforestation of deforested native plants. The beekeepers were growing different indigenous bee forage, such as in Tigrghna (local

language), Shewit Hagay (Parkinsonia aculeate) , Tanbok (Croton macrostachyus), Gemoro (Acacia polyacantha), Aki (Cordia africana), Beles (Opuntia ficus indica) , Banana (Musa acuminata), Liham (Syzgium guineense), Eka (Agave sissanlana), Chugene (Albizia malacophylla), Gaba (Ziziphus spinachristi), Papaye (Carica Papaya), Aranshi (Citrus sinensis), Suf (Carthamus tinctorius), and Lemin (Citrus aurantifolia).

As provided by most beekeepers the availability of bee forage concerns not only for beekeepers but also for the continuity of all life on the earth. On the other hand some did not think about.

- **Abundant available bee forage season**

  As most respondents suggested that the most abundant bee forage season is from September to November some from October to November because flowering plants produce flower from September to November or October to November.
- **Time of forage and distance fly**

  Beekeepers result showed that majority bee forage is on morning and afternoon. Most beekeepers said that distance of bees fly is approximately 2km, 4km, 6km. Bees drink water from water bodies or any supply of water.

5.5. Honey harvesting

The present study result showed that most respondents traditionally harvest honey in the presence fire to release smoke. This smoke protect bee sting and makes bees far away from the honey.

Techniques of honey harvesting and. purifying

Sample respondents presented that different techniques of harvesting honey include, using machine and knife modern and traditional, respectively, purified by using of machine in modern.

Figure 2 Protective materials used during honey harvesting in modern method

Figure 3 Harvesting time Process of packing in modern bee hive

All beekeepers result showed that honey harvested during evening time to escape from the bee war.

As all respondents replied, the type and quality of honey depend on season and all beekeepers responded there is a particular season for harvesting honey. Because beekeepers know and keep that time hopefully to harvest the maximum product.

- **Best quality of honey harvest season**

The major honey harvesting period in Qolla Temben district was October to November. October was a peak harvesting month to obtain the largest quantity and quality of honey.

Based on the reflected, all beekeepers said that there is byproduct on production and these include bee wax.

5.6. Honey marketing

According beekeepers suggested (59.2%) have no prevailing market favorability and (40.8%) have prevailing market favorability for their honey. According respondents result (66.3%) of sale their honey at market and (33.7%) sale their honey at their home and it is not difficult to find market there are so many traders in the locality. Majority of the beekeepers prefer to sale their honey traders and some prefer directly to consumers(table 10).

Table 9 prevailing market favorability, honey sale place, number of respondents and corresponding percentage.

Prevailing market Favorability and honey sale place.	Number respondents	Percentage
Yes	40	40.8
No	58	59.2
Market	65	66.3
Home	33	33.7

- **Preferable time for honey sale**

  Based on result found majority of respondents prefer to sale honey at harvesting time and some prefer out of harvesting time.

- **Intended benefits from beekeeping**

  As respondents replied the financial and labor inputs brings critical intended benefits from beekeeping activities. But this benefit depends up on the season of the year, this may double, triple and above.

- **Economic condition of beekeeping**

  Almost all beekeepers replied that there is profitable change after starting beekeeping activity. Because beekeeping sustainable source of income that do not damage the environment.

- **Comparison of bees and human**

  As the beekeepers result that we cannot compare with bees because bees are unique in terms of intensity and extent of engagement.

  As human taking fruit of labor others is not fair. if this condition happens in human this great conflict cannot resolve by other.

- **Ambition in beekeeping in large scale**

  From the result showed that except rare beekeepers that restrict their source of income, majority of them have ambition to produce in large scale beekeeping is the most profitable mutual with any of the farming activity.

  Most beekeepers need to be done are modern beehive, skill man power and anti enemies of bee, land and credits.

Table 10 Market survey of honey in Qolla Temben Woreda for consecutive six years.

Type of honey (kg)		2004	2005	2006	2007	2008	2009
1	White honey	79.10	82.16	99.62	124	148	199
2	Middle (sergyen) honey	65	66.83	78.44	91	113	146
3	Red honey	38.75	44.16	59	65	70	82

6. DISCUSSIONS

From the result obtained beekeepers have different family size. This could be possible to say beekeeping can do by any family size of a community, because it is less labor intensive. Similar result reported by (Adjare, (1990); Palaniswamy, (2004); and Nuru, (2007) since beekeeping is easy work. It can be done by women, aged men and persons with disabilities. Moreover, since it is less labor intensive, it can be done as part time and Side line activity.

The experience of beekeepers in beekeeping activities ranges from 1 to 40 years. This indicates farmers can stay with the activity for a long period of time. This could be due to increase skill and knowledge in beekeeping activities through adaptation.

Age of large proportion of beekeepers in Qolla-Temben Wereda was ranging from 20 to 80 years. This could reflect beekeeping can practice by different age groups and people at younger and older ages are more engaged in beekeeping. The mean age of the beekeepers in the study area was comparable with that of Tessega, (2009) findings. According to Tessega, beekeeping can be performed by different age groups and in most cases people at younger and older ages are more engaged in beekeeping activities.

Most of the beekeepers in the study area were married. However, some single and divorced beekeepers were included in the activity. This indicates beekeeping activity much better practiced by married person than single and divorced. This could be result of cooperation of husband and wife in treatment of beehive without fear or shy. On the other hand, it could be performed by every social class of the community regardless of their marital status.

Large proportion of respondents were illiterate, on the other hand small proportion of respondents were literate and junior. From the result provided educational level of peoples do not restrict beekeeping activity, because most of the beekeepers involved are illiterate. This could possible to say that beekeeping activity can be performed by any one of the community regardless of their educational level.

Large number of beekeepers in Qolla-Temben Wereda owned traditional beehives. However, some farmers get hold of modern beehives and both. This could be result of relative expensiveness of the equipment and can relate with their source of income. Similar

result reported by (Gidey and Mekonen, 2010) accordingly Tigray Regional Government has been introducing framed beehives and accessories However, because this equipment is relatively expensive to buy, most smallholders could not increase their income as expected.

Majority of beekeepers (89.9%) were males and included some female beekeepers (10.2%) in the activity. This indicates beekeeping activities much better performed by males than females. This could be due to adaptation. However it can perform by both sexes. This could be the nature of the job. Then similar results were reported by (Adjare, 1990) which suggests, since beekeeping is light work, it can be done by women, aged men and persons with disabilities. Moreover, since it is less labor intensive, it can be done as part time and Side line activity.

Beekeepers start the beekeeping activity at different time interval. Most beekeepers in the study area started the activity before 2000 EC and after 2003EC. This could be due to cost of beehive and cost of honey, respectively. This indicates beekeeping activity was present at early time and it is now continuous in a specialized way of beekeeping practice.

Beekeepers collect information from different source about the usefulness of beekeeping from their surroundings. Those include agricultural experts, model beekeepers, family and other sources. Agricultural experts and model beekeepers are the most significant one. These probably may have sufficient knowledge than the others. Most beekeepers in the study area begin with one beehive. This indicates farmers start awareness towards beekeeping activity. On the other hand there are farmers started the activity with more than one beehive. This could be result of having income difference from other farming activity or attitude.

Beekeepers have purposes when they start the beekeeping activity that is honey harvesting. The honey uses either for home or source of income. Above half of the beekeepers in the study area started beekeeping activity for home use, source of food and remain for economic purpose, source of income. This may indicate beekeeping have dual purpose in the society. Similar results were reported by (Baumga rtner *et al.,* 2001). Accordingly, beekeeping also provides honey as a source of food and improves the welfare of beekeepers due to its production as new sources of income.

About (66.3%) of farmers establish their bee colony from market and (33.7%) farmers establish from natural colony (feral).This reflects most beekeepers establish from market. However, natural colony also accounts its own role for beekeepers. This could give chance

for those who have no income to establish the activity. This could be possible to say beekeeping activities can establish either by cost or free.

About (71.4%) of beekeepers got their bee colony from market and (28.6%) got their bee colony free from their relatives or friends. This result showed that majority of beekeepers got their bee colonies from market. However, some respondents can get free from their relative or friend. In this section it possible to say this large sector could start with frees payment and could generate significant income for the community. This may create job opportunities for those lands less youths in rural areas. The present study showed that the cost of bee colony increases from time to time. This indicates the attitude of farmers towards beekeeping increases. This could be result of involvement of more beekeepers in the activity and increment of cost of honey.

Currently the cost of bee colony becomes very expensive. Most beekeepers bought their beehive double, triple and more than triple than before. This could also due to the involvement more farmers in the activity and increment of cost of honey.

Majorities of beekeepers concern about getting the best type of beehives day and night to increase their income from beekeeping activity. This reflects the attention of beekeepers towards the activity developed. This could indeed income generation. Above half (54.8%) of the respondents were consulted with agricultural experts and (45.2%) consulted with model beekeepers. From the beekeepers study result experts and model farmers can play great role in increasing awareness about best type beehive in the community.

Almost all beekeepers practiced either of the beekeeping method. About (51%) of respondents use traditional bee colony and (34.7%) was modern bee colony. Beekeepers most probably adapted with the traditional beehive. This could indeed due to the relative expensiveness of modern beehive. Similar result reported by (Gidey and Mekonen, 2010). Accordingly Tigray Regional Government has been introducing framed beehives and accessories. However, because this equipment is relatively expensive to buy, most smallholders could not increase their income as expected.

From the result most of the farmers reflect modern beehive is the most conducive for honey production. This could be due to the modern beehive can move from place to place to find out bee forage, water and other sources needed the bees at different season and this can increase the quality and quantity of honey. For this reason farmers carry their beehive to

favorable area at drought season. But the traditional beehive cannot move from place to place at different season. This is possible to say that most respondents showed preference on modern beehive and could prefer the productive one.

Large number of beekeepers can compare the performance of each of the three beehive type in terms of honey quality and quantity. This could be possible to select the best and harvest maximum product. On the other hand some beekeepers late in comparison of the three types of beehives. This could show carelessness in the activity.

The major constraints that affect best type of beehive in beekeeping activity in the district area are: lack of beekeeping knowledge, shortage of skills man power, shortage of bee equipments, pests and predators. Identifying the constraints enables farmers to make efforts to get or avoid them from these. This could create awareness to treat the activity as a whole. It is possible to say that Lack knowledge and man power could devastate the total management of beekeeping activity. In addition to this pests and predators may decline the density beehives as a whole this can directly related declining of income of beekeepers and pollination process. Then similar results were reported by Kerealem *et al.*, (2009) the major constraints that affect beekeeping subsector in Ethiopia are: lack of beekeeping knowledge, shortage of skills man power, shortage of bee equipments, pests and predators, pesticide threat, poor infrastructure development, shortage of bee forage and lack of research extension. The present study result showed that majorities of respondents have perception on beekeeping activity about the location of beehive with climate influence for honey production. Although some respondents may not have perception about the location and climate influence honey production, this may be result of lack of awareness in the placement of bee.

Most of beekeepers in the study area differentiate between traditional and modern methods of honey harvesting, processing and packaging and can select the best one. This could develop through adaptation and training by different experts. This may be helpful to the existence of honeybee and quality of honey. This may possible to say that most of farmers' preferred modern method compared to traditional one.

Bees of a given colony are different. About (96.9%) of beekeepers said all bees of a given colony are different. It is possible to say that beekeepers differentiate their bee colony. This could be result of experience in their beekeeping processes.

Beekeepers imply the different categories of bee colony are Queen, drone and workers bees. This may indicates farmers develop knowledge about bee biology. This could be result of experience in beekeeping activity.

According to beekeepers, the different categories of bees distinguished by their; division of labor, shape and size. Almost all respondents suggested that the different types of bees in a colony can distinguish by their size, shape and division of labor. This could be possible to say farmers able to identify the different class of bees from their experience in their beekeeping activities. However, rare beekeepers cannot differentiate well. This can be result of carelessness in the activity.

Above half beekeepers said queen is different from the other bees; shape, forage and labor. The rest of beekeepers did not differentiate the queen from others. This shows all beekeepers could not identify the queen from the others. From this result possible to say that all beekeepers may not have adequate knowledge about queen.

About (42.9%) of farmers have hint about the life span of each category bee of a given colony and (57.9%) did not know the life span of each category. Majority of beekeepers did not know the life span of each category of bees and some of respondents have knowhow about. This indicates the beekeepers may not have enough awareness on the life span of the three categories. However, beekeepers generally could count the age of the colony or beehive.

About (44.9%) of beekeepers know pollination and (55.1%) did not. Although majority of farmers can have hint about pollination. However, the deep knowledge about pollination needs to integrate with them throughout their beekeeping activity. From this it is possible to say most farmers or beekeepers must have awareness about how pollination happens. Because bees and crops are interdependent each other.

Honey bees are very important for crop pollination and crop productivity. Farmers' activity depends on honey bee and other pollinators. Honey bee also important plant reproduction and maintain the ecological welfare. Similar results were reported by (Batra 1985, 1997), accordingly, Pollinators, through facilitating plant reproduction, thus play a crucial role in the maintenance of ecosystem services.

Beekeepers reflect colony of honey bee is multiply when another queen is added in one beehive and when the number of workers becomes extremely high. If such type of condition

is appear beekeepers need to divide the number of worker bees with their new queen in to another bee hive. This makes them highly advantageous for beekeepers because they can increase their number of bee colony and their source of income. As respondents determine new queen is produced from one bee hive when the worker bee feeds the food of the older queen. This could develop through adaptation or training.

According the idea of respondent's queen raring is replacement of older queen by new one. Beekeepers can replace the older queen by new queen if the amount of honey produced from specific bee hive is not satisfactory. Then to improve the quality and amount of honey from their bee hive they prefer to change older queen by new one. But the process may require experts. From the beekeepers (38.8%) of respondents have the needed expertises for queen raring about (61.2%) of respondents do not have expertise for queen raring. Most beekeepers do not have experts for queer raring. But some beekeepers have experts for queen raring. This may be possible to say the expertise present in the agricultural office or development agent could help for some beekeepers, but each household farmer may not get chance. This could be due to shortage of skilled man power in the area. Similar result reported by Kerealem *et al.,* (2009) the major constraints that affect beekeeping subsector in Ethiopia are: lack of beekeeping knowledge, shortage of skills man power.

As respondents explain bee sting is biting of bee for other living organisms. From the respondents request bee sting penetrates toxic substances and this can affect different organisms especially if more bees' sting this may kill. All categories of bee colony do not have sting. From the three categories workers have sting. Farmers have enough awareness about sting and this can possible to say develop through experience of beekeeping. Having this perception helps them to save themselves, beehive, and their livestock's because beekeeping is coevolved with animal livestock and other farming activities. The bee sting has no medicinal value.

Almost all beekeepers suggested that the bee that has stung an intruder become dead. This knowledge helps the beekeepers to protect from bee sting and to control their colony. This directly related density of beehive because the number of bee stung increase the density of the colonies, honey quality and quantity decrease.

Exclusively, beekeepers indicated the presence of bee pests and predators, which include ants (both black and red), birds, spiders, mites, wax moth, beetle, bee mice, honey badger, cat worm and lizards. Indigenous protection methods were practiced to control these pests and

predators including the application of ash, rope around entrance of hive(hanging the predator's neck), insect repellents (such as dirty engine oil), use of malathine, mechanical killing of the pests, sanitation etc. This is possible to say farmers develop awareness on enemies of honey bee and their controlling methods and could manage their bee colony properly.

Based on beekeepers request bees forage on flower parts of plants due to the presence of pollen and nectar. Almost all beekeepers have good understanding about bee forage. This could enable to select the best type of plant by planting in their surroundings. This may be important not only for bees but also for the ecological well fare of the ecosystem.

Are Plants trees, shrub, herbs or grasses

Beekeepers implied that the most plant bee forage are trees the number of these trees shows reduction on the environment due to deforestation and shifting cultivation may lead to bee forage elimination.

Most bee forage plants are native to Ethiopia and their number is decrease from time to time, the number of native plants is very scarcer than before. Native plants may have a flower which contains delicious nectar and make them attractive for feeding. But the exotic one could be poisons for bee and they do not prefer them as source of food. From this study it is possible to say that native plants are scarcer than before due to deforestation and other human activities. Similar result were reported by kerealem which suggests the elimination of good nectar and pollen producing tree species in many areas makes it difficult to maintain bee colonies without feeding (Kerealem, 2005). Shortage of bee forage is mainly resulted in Ethiopia due to population pressure and its ecological impacts such deforestation and shifting cultivation

Majority of beekeepers are more concerned about scarcity of native plants than the others. This is because of their bee forage. From the present study majority of respondents have an interest to preserve native plants of Ethiopia and have feeling why they reduce their number from time to time On the other hand some beekeepers act as others or did not take care for native plants and undertake deforestation and eliminate them for different social and agricultural activity. From this it could be possible to say the most beekeepers could take responsibility to create awareness on the others and together reverse the deforested native plants for adequate forage of bees.

Majorities of farmers concerned about the scarcity of native plants and the major efforts done by farmers were: carried out afforestation of an area, reforestation of deforested native plants to increase bee forage and landless youth become beneficial from beekeeping. From this study beekeepers can be aware of any flowering plants from different harmful chemicals and pests that influence indigenous plants and then similar results were reported by (Tony, 2010), accordingly vast areas of land are now covered in flowering plants such as *Tebeb*, *Gerbia* and *Akacha* which provide bee fodder Moreover, the landless youth have got benefits from these enclosed areas through beekeeping activity.

Among the beekeepers (91.8%) concerned about the availability of bee forage and (8.2%) did not concern about the availability of bee forage. From the present study most of the farmers concern about food availability for their bees and planted different indigenous flowering plants around their home for bee forage to increase the yield of honey. Similar result reported by (Legesse Negash, 1995; 2002; 2003a, b; 2004; 2010), accordingly, it has been emphasized that the key to sustainable use of native plants is to propagate, domesticate and cultivate these using current scientific advances.

As most respondents suggested that the most abundant bee forage season is from September to November and some respondents replied that from October to November. This could be because flowering of different plants fluctuate with time of the year. The same result was reported by (Free, 1970), accordingly, Pollen and nectar availability to foraging bees fluctuated with time of the year and flowering of different species of plants (From this study the most abundant bee forage season could be from September to November because most flowering plants raise flower at that time. This may be depending up on the amount rain fall during summer season.

Beekeepers result showed that majority of bees forage time was on morning time and on afternoon. According to the result majority of bees forage on morning and afternoon this probably could be favorability of the condition and the time could be suitable for carrying of nectar. Based on the result most beekeepers said that the distance bees fly approximately2km, 4km, 6km and some respondents replied that we do not know the distance how long bees can fly. From this farmers could not have enough information about distance bees can fly. When we see about the source of water as respondents replied bees drink water from water bodies or any water supply found at their surroundings.

The present study result showed that most respondents harvest honey in the presence fire to release smoke and cut with knife in traditional method. This smoke protect bee sting and makes bees far away from the honey. After that honey was collected from beehive without a problem. This could be able to harvest honey in a good manner. But in modern method honey was harvested by using of machine and using of protective material. This could be more favored in terms of honey quality and quantity.

Sample respondents presented that there are different techniques for harvesting honey which includes using machine and knife in modern and traditional respectively, in modern technique the process of purification of honey is by using of machine. Using of machine could increase the quality and quantity of honey. But in traditional technique honey was harvested by cutting with knife and there no purification.

All beekeepers result showed that honey was harvested during evening time to escape from the bee war. From the present study indicated beekeepers harvest honey at evening this could be comfortable for beekeepers because at night bees can decrease sting and bees cannot observe their environment as day time.

All beekeepers responded there is a particular season for harvesting honey. Beekeepers have enough knowledge for time of harvesting honey. This may be result of adaptation from beekeeping activity. The type and quality of honey depend on season and some said did not depend on season. From the result we could say that type and quality of honey depend on season. The reason could be harvesting honey after the proper season was passed causes honey to be consumed by them and bee hive becomes empty. At the same time its type and quality may be decrease.

The major honey harvesting period in Qolla Temben district was October to November. October was a peak harvesting month to obtain the largest quantity and quality of honey. Honey was harvested once or twice a year. This is possible to say beekeepers harvest their honey at proper season and could sale on time to lead their life.

All beekeepers said there is byproduct on production honey and these include bee wax. Bee wax is used for starting input for honey production in modern beehive, medicinal value of heart, to repair ulcer bodies, source light. Similar results reported by (Beyene and David, 2007). Sometimes beekeepers buy beeswax from the wax collectors and/or Processors to use as a starting input for honey production using intermediate and modern beehives. From

this result beekeepers may use wax mutually with honey in addition to other farming activities. All beekeepers could have enough adaptation with the bee wax.

Based on respondents result (66.3%) of sale their honey at market and (33.7%) sale their honey at their home and it is not difficult to find market there are so many traders in the locality. From the result showed above most farmers' sale their honey at market. These can move to find out alternative profitable income by comparing the cost of different types honey. However some beekeepers sale their honey at home, those can be result of scarcity of transport accessibility and to decrease intensity of labor regard less of its cost. There is no difficulty in market foundation in the Wereda because there are traders in locality. From this result it is possible to say there is no market difficulty but there is difficulty of prevailing market favorability. Due to this reason some of beekeepers forced to sale their honey to traders at their home.

Based on result found majority of respondents prefer to sale honey at harvesting time and some prefer out of harvesting time. This result showed honey can be sale at different time depend on personal interest. This could be due to nature of honey because it could not expired even for a long period of time. About (59.2%) beekeepers have no prevailing market favorability and (40.8%) have prevailing market favorability for their honey. As majority of beekeepers reflected there is no prevailing market favorability at local area. This could affect significant income of beekeepers. The absence of favorable market in the wereda limits to the large beekeepers income generation. This could be solve by creating channels with consumes in the Regional state.

The financial and labor inputs of beekeepers bring critical intended benefits from beekeeping activities. But this benefit depends up on the season of the year, this could double, triple and above. Beekeepers could generally register a valuable economy from beekeeping activities and improve their livelihood.

Almost all beekeepers bring profitable change after starting beekeeping activity. Because beekeeping is a sustainable source of income that does not damage the environment, from this result it is possible to say that beekeeping is favorable and preferable commercial activity of farmers. Similar results were reported by (Oluwole, 1999) according to (Oluwole, 1999), Beekeeping is a sustainable source of income that does not damage the environment.

As the beekeepers result showed that we cannot compare with bees because bees are unique in terms of intensity and extent of engagement. Bees are busier than human and there is no living thing that can compare with bees, because they produce very interesting unique product from flower. Similar result was reported by (Kevan, 1984). Accordingly, the bees are automated micromanipulators by which man can harvest floral sources that would be otherwise unobtainable. As human taking fruit of labor others is not fair. If this condition happens in human this great conflict cannot resolve by any other. From this it could be possible to say human denied fruit of bees suddenly.

From the result showed that except rare beekeepers, who restrict their source of income, majority of them have ambition to produce in large scale because beekeeping is the most profitable mutual activity with any of the farming activity. This may be adapted with them forever. Most beekeepers need to be done are modern beehive, skill man power and anti enemies of bee, land and credits. From this result it is possible to say that most beekeepers need economical support to produce more honey.

As shown from the honey survey result the cost of honey in the consecutive six years shows increment from year to year. This could be due to high number of consumers and decrease in bee forage results to become more expensive at this time.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. CONCLUSIONS

Beekeeping is practiced as an integral part of other agricultural activities mainly livestock and crop production with commercial type of production system. The present study showed that beekeeping activity was practiced at early period of time. But now it is successfully modified in the way of establishment of bee colony, treatment of bee hive, honey harvesting and honey marketing. The acts of modification are all due to creating awareness by the help of agricultural experts and model beekeepers throughout the community.

It is also concluded that there is an increasing trend of honey production and colony number both from the local and modern beehive. This is definitely the result of the ongoing effort of natural resource conservation which contribute for increasing availability of potential bee forages and the market demand for both honey and bee colony. In addition to this there has been an encouragement by governmental and nongovernmental organizations to plant and to cultivate different bee forages. Thus, the beekeepers grow indigenous bee forages around homesteads, in area closure and in and around their apiary sites. The existence of some special bee forage in the study district results in the production of high quality and quantity honey. Furthermore, beekeepers have good perception about value of beekeeping and honey bee flora. Likewise beekeeping plays a great role in improving farmer's livelihoods and beekeepers appreciate the value of bee in crop pollination and crop productivity.

From the result we can also conclude that there are economic and technological constraints that hinder modern beekeeping. Like equipment, skill man power, enemies of bees. Generally beekeepers concerned about the limitation of honey bee forage and absence of market favorability in promoting bee keeping.

7.2. RECOMMENDATIONS

Possible recommendations that could be given on the basis of the study so that can be considered in the future intervention strategies which are amid at the promotion of honey production and marketing of the study area are:

- Since most of the beekeepers in the district have no favorable market, the district should consider the appropriate prevailing market favorability for the future.
- The current effort of natural resource rehabilitation should strongly consider the plantation of indigenous potential bee forages such as tebeb , girbia and siwakerni based on the appropriate propagation technique.
- Strengthening of existing beekeepers associations and establishment of new once that can play significant role for production need immediate attention.
- The extension system should actively aware the beekeepers towards bee biology, pollination, honey harvesting, honey bee flora, honey handling, storage and bee enemies to compete with international market.

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9. APPENDEXES

Appendix 1. Modern bee hive

Appendix 2. Traditional bee hive

Appendix 3 Modern beehive

Appendix 4 Questionnaire used in the study

Addis Ababa University,

1.General information

1.1 Zone_____1.2Wereda_____ 1.3Tabia_____ I. House hold characteristics 1. Name of house hold head----------2.Sex------3.Number of years in beekeeping practice- 4. Age of the household head---5. Marital status: (1) Married (2) Single (3) Widowed (4) Divorced 6. Family size---- 7. Education level of household head: (1) Illiterate (2) Can read and write (3) Primary education (1-4) (4) Junior (5-8) (5) Secondary education (9-10).

2 Farmers start of beekeeping activities and the resulting assets

1.1 When did you start beekeeping activities? _____(year)

1.2 Who told you about the usefulness of beekeeping?

1.3 How many beehives did you have at the beginning?

1.4 Did you start beekeeping activities for home use or economic purpose? I. Home II. Economic

1.5 How did you manage to establish your first bee colonies?

1.6 Did you buy the bee colonies or get from relatives friends? I. relative or friend II .market

1.7 if you got by purchasing, how much did you pay for each bee colony or beehive? ----------Ebrr.

1.8 How expensive are bee colonies currently compared to former times? Why?

1.9 Were you concerned about getting hold of best type of bee colony? I. Yes II. No if yes, whom did you consult?

1.10. Do you practice traditional or modern beekeeping method? 1. Yes 2.No

1.11 Are your beehives traditional, transitional or modern? 1. Traditional 2 Transitional 3. Modern

1.12Which of the three beehives is conducive for honey production? Why?

1.13 Can you compare the performance of each of the three beehive types in terms of honey quantity and quality? 1Yes 2.No

1.14 What are the constraints of getting the best type of beehive?

1.15 Do beehive locations the climate influence honeybee productivity? 1Yes 2.No

1.1If so, where and how do you keep your beehive?

1.17 Can you explain the difference between traditional and modern method of honey harvesting, processing and packaging? Which is better?

2. Bee biology

2.1. Are all bees of a given colony the same? 1Yes 2.No

2.2. If not, what are the different categories of bee colony?

2.3 How do you distinguish the different categories of bees?

2.4 How different is the queen from the rest of bees?

2.5 Do you know the life span of each category of bees? 1Yes 2.No

2.6 Do you know pollination? 1Yes2. No

2.7 What happens during pollination?

2.8 How important are honey bees for crop pollination?

2.9 How do you multiply your colony?

2.10 What is queen raring?

2.11 Do you have the needed expertise for queen raring? 1Yes 2. No If not, why not?

2.12 What is bee sing?

2.13 Does a bee sting have medicinal value? 1Yes 2.No

2.14 Do all categories of a bee colony have a sting? 1Yes 2.No

2.15 What happens to the bee which stung an intruder?

2.16 Are you aware of any enemies of honeybee such as parasites, disease and animal predator? If so, how do you control these?

3. Honeybee flora

3.1 What do bees forage on? Which plant part?

3.2 Which plants do prefer for their forage?

3.3 Are these plants trees shrubs, herbs or grasses?

3.4 Are the plants native to Ethiopia or exotic?

3.5 Are native plants scarcer now than before? Why?

3.6 Are you concerned about the scarcity of native plants? 1Yes 2.No

3.8 Are you concerned about the availability of bee forage? 1Yes 2.No

3.9 If so, what have you done to increase bee forage?

3.10 Which season of the year is bee forage abundantly available?

3.11 What time of the day do bees forage?

3.12 How far do you think bees fly to obtain their forage?

3.13 Where do bees keep the collected forage as they fly back to their respective beehive?

3.14 Do bees drink water? If so, where do they get their water from?

4. Honey harvesting

4.1 How do you harvest your honey?

4.2 What are the different techniques for harvesting honey?

4.3 Can you explain the difference between traditional and modern methods of honey harvesting? Which is better?

4.4 At what time of the day do you harvest your honey? Why?

4.5 Is there a particular season for harvesting honey? 1Yes 2.No

4.6 Does the type and quality of honey depend on the season of the year? 1Yes 2.No

4.7 If so, why do you think so?

4.8 At which season of the year is the best quality of the honey harvested?

4.9 Are there byproduct of honey production? 1Yes 2.No

4.10 If so, what are the different uses of this byproduct?

5. Honey marketing

5.1 Where do you sale your honey?

5.2 Is it difficult to find market for your honey? 1Yes 2.No

5.3 Are there honey traders in your locality? 1Yes2. No

5.4 Do you prefer to sale your honey to traders or directly to consumers?

5.5 At which time of the year do you prefer to sale your honey?

5.6 Is there prevailing market favorable for your honey?

5.7 Do your financial and labor inputs bring the intended benefits from beekeeping? By how much?

5.8 How much time do spend for keeping your bees?

5.9 Have your economic conditions improved since you started beekeeping?

5.10 Compare the intensity and extent of engagement by you and the bees in producing honey. Who is busier? How?

5.11 if consider you as a honeybee, is it fair that mankind takes away the fruit of its labor? Explain.

5.12 Do you the ambition to produce honey on a large scale?

5.13 What needs to be done for you to produce more honey?