



Beekeeping Practice, Opportunities, Marketing and Challenges in Ethiopia: Review



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Abstract

This paper was aimed to compile the beekeeping practice, marketing system, existence of opportunities and constraints in Ethiopia. Ethiopia has huge apicultural resources that made it the leading honey and beeswax producer in Africa. The beekeeping practices available in Ethiopia are traditional forest, traditional backyard, transitional and improved beekeeping. Ethiopia has been revealed that the opportunities for beekeeping are the availability of natural forest with adequate apiculture flora and water resource, existence of a number of bee colonies, availability of farmers having indigenous knowledge and socio-economic value of honey and demand for honeybee products. In Ethiopian, only about 10% of the honey produced in the country is consumed by the beekeeping households. The remaining 90% is sold for income generation and of this amount, it is estimated that 80% is used for tej brewing. The bee products marketing in Ethiopia is still informal and lacks structure. The domestic honey market starts at the smallholder beekeepers level, who majorly sells crude honey to collectors in the nearest town/village markets, and they sold it by the purchasers cut price. Ethiopia Exports honey to Sudan, Norway, UK, Saudi Arabia, Kuwait, Yemen, USA and other European countries; and also beeswax export to USA, Japan, Greece, Great Britain and Netherland. Even though, the export price of honey and beeswax was increasing, the honey price in the domestic market is mostly advanced than the international honey price which makes honey export less profitable in Ethiopia, due to increasing the demand of tej in country, as a result of this reason many of these honey exporters have dropped out of the international honey trade. However, lack of improved technology, application of chemicals, honey bee disease, market accessibility, prevalence of pests and predators, high cost and limited availability of modern beekeeping equipment's and absconding and migration of bee colonies are the major constraints to beekeeping sector development in Ethiopia. Beekeepers have deep indigenous knowledge; this contributes to the development of beekeeping practice, to improve the quality and quantity of honey and to other hive products. In conclusion, establishing the market network and developing its information delivery system for the producers being bring the encouragement via enhancing their benefit from the beekeeping production. Therefore, strengthening the apiculture practices through researches and consolidating the extension system, so as to solve the challenges, exploiting the available opportunities and improving the marketing linkage could be play a significant role in the development of the GDP of the country.

Keywords: Beekeeping; Beeswax; Challenges; Honey; Opportunity; Marketing

Abbreviations: HBRC: Holeta Bee Research Center; TTBH: Tanzania Top Bar Hive; KTBH: Kenya Top Bar Hive; KTB: Kenya top-bar

Introduction

Beekeeping is a long standing practice in Ethiopia and it accounts 1.3% of agricultural GDP. Currently one out of ten rural households keep honeybees and the activity make a substantial contribution to rural income generation. Ethiopia is the leading honey producer in Africa and one of the top ten worldwide [1]. Similarly, it stands first in Africa and third in the world in beeswax production [2].

Ayalew [3] suggested the existence of five honeybee races: *Apis mellifera jemenitica* (in eastern lowlands), *A.m.monticola* (in the southern mountains), *A.m. litorea* (in the extreme western low lands), *A.m. adansonii* (in the southern mid-altitude areas) and *A.m. abyssinica* (central plateau and south western parts of tropical forest). The Studied results of

Meixner et al. [4] are in obvious disagreement with previously published analyses. In their analyses, the bees of Ethiopia are clearly distinct from *A. mellifera monticola*, however, in comparison to the other reference subspecies, they still appear to resemble the East African mountain bee. Also their results contradict the interpretations of later authors, who, again based on morphometric analyses, postulated the presence of up to five different subspecies of honey bees in Ethiopia. In a first analysis of samples from Ethiopia, Radloff & Hepburn [5-7] identified three statistically separable groups of bees, which they assigned to different subspecies on the basis of comparisons of single characters (such as hair length, cubical index, size and pigmentation) with published data. They also provide a comparison table with Mahalanobis distances between

each of their five groups and published samples of *A. mellifera jemenitica*, *A. mellifera scutellata*, "*A. mellifera bandasii*", and *A. mellifera monticola* [5,6]. However, presentations of the analyses on which those values were based, including P values for the classification of their samples to these respective taxonomical units, were absent in this publication.

According to Holeta Bee Research Centre [8], there are four different types of beekeeping practices in Ethiopia namely, Traditional forest, Traditional backyard, Transitional and Improved Beekeeping. Traditional beekeeping is of two types: forest beekeeping and backyard beekeeping. In some places, especially in the western and southern parts of the country, forest beekeeping by hanging a number of traditional hives on trees is widely practiced. In other most parts of the country backyard beekeeping with relatively better management is common [9]. Transitional beekeeping started in Ethiopia since 1976 and the types of hives used are, Kenya top-bar hive, Tanzania top-bar hive and Mud-block hives. Among these, KTB is widely known and commonly used in many parts of the country [10]. The advantages of KTB over fixed comb hive and movable frame hive is discussed by [11]. Improved beekeeping hives have components like brood chamber, super (honey chamber), inner and outer cover. Improved box hive has advantages over the others in that it gives high honey yield in quality and in quantity. The other advantages of improved box hive is its possibilities of swarming control by supering the bees from place to place for searching honeybee flower and pollination services. On the other hand, its disadvantages are- the equipments are relatively expensive, requires skilled manpower and the equipment needs very specific precaution [8].

Honeybee management practice is the regular inspection of colonies to assess the status of brood condition, giving additional hive super for expansion of colony during flowering, distinguishing and harvesting of ripe honey, space reduction, feeding and maintaining colonies during dearth periods and detection and control of bee pests which enhances colony performance such as reduced absconding, improved colony strength and higher hive yields [12,13].

Opportunities for beekeeping in the country were the presence of natural resources and human capital, the current attention of the government towards the introduction of different beekeeping technology packages, the establishments of beekeeping association and the presence of governmental and non-governmental organizations who are involved in beekeeping activities and the presence of micro finance institutes at grass-root level. Still the country has potentials with enormous nectar and pollen resources that have not yet been exploited, and beekeeping could probably be a profitable activity to undertake [14] and also currently the government is highly supporting self-contained watershed developing program in which beekeeping is part and parcel. There is an increasing demand for honey for domestic consumption and export by different customers and organizations. Availability of rich culture and tradition of

beekeeping, suitable environment with different agro ecology, availability of farmers having indigenous knowledge, skills and keen interest to adopt improved technologies and to undertake beekeeping as a way of life are among the few to mention [15].

In Ethiopian, only about 10% of the honey produced in the country is consumed by the beekeeping households [16]. The remaining 90% is sold for income generation and of this amount, it is estimated that 80% is used for *tej* brewing (17). The honey price in the domestic market is mostly advanced than the international honey price which makes honey export less cost-effective in Ethiopia [18] and several of these companies have dropped out of the international honey trade and are now targeting the local markets which are still attractive. According to the study by Awraris et al. the whole domestic honey market lacks proper structure and legality. It is of lengthy chain of actors that widens gap for the access of producers to bigger and better paying markets. So, the beekeepers complain the business as not rewarding and even lacking the market for their product, while the consumers see the ever increasing price of honey as unfair.

Despite the high potentiality of the country for beekeeping and its extensive practices, beekeeping research conducted in the nation so far did not cover to characterize and document the apicultural resources and associated constraints of the sector for its proper intervention and utilization to specific potential regions [19]. According to HBRC [10,20,21], the major constraints in the beekeeping sub sector are the following: honeybee disease, pest and predators; indiscriminate application of agrochemicals, high price of improved beekeeping technologies, drought and deforestation of natural vegetation; unpleasant behaviours of bees (aggressiveness, swarming tendency, and absconding behaviours), lack of skilled manpower and training institutions; low level of technology used; poor post-harvest management of beehive products and marketing constraints, But all these problems may not be constraints 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. In Ethiopia, a lot of researches had been conducted; however, their data output not compiled to make easy for accessible information. Therefore, this paper was designed to review the beekeeping Practice, availability of opportunities, bee product market linkages, and the challenges of beekeeping in Ethiopia.

Literature Review

Overview of beekeeping in Ethiopia

Beekeeping is a long standing practice in Ethiopia and it accounts 1.3% of agricultural GDP. Currently one out of ten rural households keep honeybees and the activity make a substantial contribution to rural income generation. Ethiopia is the leading honey producer in Africa and one of the top ten worldwide [1]. Even though it is one of the important and the oldest farming activities in the country, there are no available records, which confirm when and where beekeeping was first started. However,

the Hieroglyphs of ancient Egypt refer to Abyssinia (ancient name of Ethiopia), as source of honey and beeswax and Abyssinia has been known for its beeswax export to Egypt for centuries when other items were not exported. It is, thus, assumed that the keeping of bees in baskets may have started about 5000 years ago in the northern regions along with the early settlements. No countries in the world may have ancient beekeeping as Ethiopia [22,23]. Moreover, the oldest basket hive in the International bee museum is from Ethiopia.

Ethiopia Owing to its varied ecological and climatic conditions, it is also home to some of the most diverse flora and fauna in Africa. Its forests and woodlands contain diverse plant species that provide surplus nectar and pollen to foraging bees [24]. The ideal climatic conditions and diversity of floral resources allow the country to sustain around 10 million honeybee colonies, of which seven million are kept in local beehives by farmers and the remaining exist in the forests as wild colonies. This makes the country to have the highest bee density in Africa.

Ethiopia, having the highest number of bee colonies and surplus honey sources of flora, is the leading producer of honey and beeswax in Africa. It produces about 43,373 metric tons of crude honey per year, thus shares 23.5% of Africa and 2.35% of world's honey production. Beekeeping is an important agricultural sector that utilizes natural nectar and pollen for production of honey, wax and other hive products that have a great contribution for the income of smallholder farmers. Nowadays more than 7000 species of flowering plants estimated to be found in the country, of which most of them are honeybee plants [25].

According to Amssalu & Betre [26] Beekeeping in rural areas is an activity practiced both by farmers and landless rural population. It is a non-farm income with specific importance to all those who do not have access to land, but some space in their backyard and communal areas. In Ethiopia, beekeeping has been a tradition since long before other farming systems practiced. Even though it is one of the important and the oldest farming activities in country, there are no available records, which confirm when and where beekeeping was first started. However, the Hieroglyphs of ancient Egypt refer to Abyssinia (ancient name of Ethiopia), as source of honey and beeswax and Abyssinia has been known for its beeswax export to Egypt for centuries when other items were not exported [27].

According Nuru the economic potential of the beekeeping sector in Ethiopia is large. Beekeeping has many advantages that help farmer beekeepers to improve their well-being. Comparing with other agricultural activities has mentioned the relative advantages of beekeeping as follows: Unlike cultivation of crops and animal husbandry, beekeeping does not disturb the ecological balances of an area. Instead, it is an environmentally friendly activity. Beekeeping does not compete for resources with other agricultural activities. Hence, it can be integrated with annual and perennial crop production, animal husbandry and

conservation of natural resources. Since beekeeping is light work, it can be done by women, aged men and people with disabilities. Moreover, since it is less labour intensive, it can be done as part time and side line activity. Beekeeping assists to utilize resources like pollen and nectar which otherwise are wasted. Man cannot utilize these resources in the absence of bees. Beekeeping can be run in areas which are not suitable for cultivation of crops and animal husbandry such as hills and escarpments. Bee products like honey and beeswax are not perishable and can be transported and stored for long periods and their prices do not fluctuate very much over seasons. 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 is shortage of land. Beekeeping is useful in improving the quality and quantity of crop yields and contributes for maintaining biodiversity through efficient pollination services of Honeybees.

The country is not only agro-climatically diverse, but also a centre of diversity for different species of plant and animal resources including honeybee races. The geographical races of honeybees found in the country, have been studied by different scientists and the existence of different geographical races was reported. Generally, most of the reports were not supportive of each other. Recently Amsalu et al. [28] have reported the existence of 5 geographical races of honeybees (*A.m. monticola*, *A.m. bandasii*, *A.m. scutellata*, *A.m. jemenitica* and *A.m. woyigambela*).

As far as morphometric analyses of Ethiopian honeybees are concerned, Smith [29] reported *Apis Mellifera monticola* from the Ethiopian plateaus and later, reported the presence of *A.m. scutellata* and *A.m. jemenitica*. Ayalew [30] suggested the existence of five honeybee races: *Apis mellifera jemenitica* (in eastern lowlands), *A.m. monticola* (in the southern mountains), *A.m. litorea* (in the extreme western low lands), *A.m. adansonii* (in the southern mid-altitude areas) and *A.m. abyssinica* (central plateau and south-western parts of tropical forest). Radloff & Hepburn [7] recorded *A.m. jemenitica*, *A.m. bandasii* and *A.m. sudanensis* from Ethiopia. However, these findings are inconsistent except for *A.m. monticola* and *A.m. jemenitica* and none of the results indicated the distribution, behaviour and biology of these honeybees for the whole of Ethiopia [31].

The research report of Meixner et al. [4] disagree with previously published research that reported by Smith [29] and later by Ruttner [6,32], Meixner did not support the hypothesis that the honey bees of Ethiopia belong to East African mountain subspecies, *A. mellifera monticola*, as first proposed [32]. *Apis mellifera monticola* occurs in the mountain systems of Kenya and Tanzania to the south, at least 1,000km away. Based on an apparent morphological similarity in regard to some characters, the bees of Ethiopia were thought to represent distinctive populations of this subspecies. According to this hypothesis, all East African mountain bees were considered relics of a Pleistocene bee population covering large areas of East Africa during more

humid climatic conditions between 18,000 and 7,000 BC [33-35]. In their analyses, the bees of Ethiopia are clearly distinct from *A. mellifera monticola*; however, in comparison to the other reference subspecies, they still appear to resemble the East African mountain bee. Although morphometric data alone are not sufficient to disprove the previously hypothesized common origin of the East African and Ethiopian bee populations, a more parsimonious explanation for this resemblance is provided by similar selective pressures prevailing at higher elevations, leading to larger and darker colour bees, as it has been demonstrated for bee populations of other mountain systems [36,37].

Meixner et al. [4] results also contradict the interpretations of later authors, who, again based on morphometric analyses, postulated the presence of up to five different subspecies of honey bees in Ethiopia. In a first analysis of samples from Ethiopia, [7] identified three statistically separable groups of bees, which they assigned to different subspecies on the basis of comparisons of single characters (such as hair length, cubical index, size and pigmentation) with published data. Thus, they attributed their samples from the north to *A. mellifera jemenitica*, those from central Ethiopia to *A. mellifera bandasii*, and samples from the south to *A. mellifera scutellata*. However, in a different publication, the same authors describe samples collected along a north-south transect in Ethiopia as *A. mellifera jemenitica*, "*A. mellifera bandasii*" and "*Apis mellifera sudanensis*" [38]. Subsequently, Amssalu et al. [28] conducted a morphometric study on a comprehensive sampling across Ethiopia, covering a wide geographical area and elevation range, and representing most of the ecological zones of the country. In addition to the three groups identified by Radloff [7], they recognized the presence of *A. mellifera monticola* in the northeast of Ethiopia and, based on data from two locations in the southwest, postulated the existence of a separate taxonomic entity that they named "*Apis mellifera woyigambella*". The conclusions of Amssalu et al. [39] were based on the results of principal component and discriminate analyses of their sampling, which, according to their interpretation, yielded five separable morphoclusters. They also provide a comparison table with Mahalanobis distances between each of their five groups and published samples of *A. mellifera jemenitica*, *A. mellifera scutellata*, *A. mellifera bandasii*, and *A. mellifera monticola* [7,32,38].

However, Meixner et al. [4] results did not give any indication for the presence of more than one subspecies of *A. mellifera* in Ethiopia. Instead, within the statistically distinct and clearly separate cluster of the Ethiopian samples, considerable clinical variation of morphological characters was observed. In particular, we did not find indications justifying the separation of a central high-elevation group from a northern mountain group ("*A. mellifera bandasii*" and *A. mellifera monticola*, respectively, as in Amssalu et al. [39].

The existence of clinical variation generally invites the postulation of subgroups, particularly if sampling coverage is incomplete. However, without any clear rationale for delineations

this is bound to remain arbitrary. Considering the rather coherent and very distinct group that the bees of Ethiopia formed in all our analyses, we thus regard them as one population confined to the Ethiopian mountain dome. The limitation of their geographic range towards the west is also supported by the morphometric analysis of the honey bees of the Sudan by Omer, which showed no resemblance to the Ethiopian bees.

Meixner et al. [4] results demonstrate morphometric separateness of the Ethiopian honey bees from adjacent subspecies of *A. mellifera*. This population possesses a clear geographic and ecological range connected to the volcanic dome of Ethiopia, with morphological variation through its elevation range, but without clear subgroups. Thus, our results support the hypothesis that these bees are to be considered as a separate subspecies. The data provide clear evidence that these honey bees are not *A. mellifera monticola*. The question then remains whether they have to be regarded as "*A. mellifera bandasii*" or "*A. mellifera woyi-gambella*". According to the rules of the ICZN (1999), both these names have to be considered invalid. As already stated by Engel (1999), the name "*A. mellifera bandasii*" has been proposed in the M.Sc. thesis of Mogga (1988), but was never published according to the rules of the ICZN (nomen nudum). The name "*A. mellifera woyi-gambella*" was introduced by Amssalu to describe a small portion of the honey bee population of Ethiopia in the south-western corner of the country. It is lacking the designation of a holo type and a type locality; further, the name violates Art. 11.9.4 of the code and can therefore not be considered valid.

However, Meixner et al. [4] indicated that to avoid further confusion, a new subspecies name for the honey bees of Ethiopia is introduced. We propose *A. mellifera simensis* with reference to the Simen Mountains as a typical geographic feature of the geographic origin of these bees. The type locality of the new subspecies is the western slope of mountain Wonchi.

Further study is needed to identify the local races because reports published so far are contradicting each other. Honeybees of Ethiopia are described as a new race of *Apis mellifera* and named as *Apis mellifera simensis*, on the basis of morpho metrical analyses [4] as contrasted to the several races reported by different researchers [7,29,31]. This implies that there is a need to conduct reliable research in this topic. Knowing the bees will enable to further study their performances and behaviour in the different agro-ecologies and seasons.

Beekeeping Practice in Ethiopia

The study Conducted in Kaffa, Sheka and Bench-Maji Zones of Ethiopia by Awraris et al. [40] and Tesfaye et al. [41] who state Beekeeping Practice in Bale Zone indicated that the beekeeping practice is undertaken by three types of bee hives, traditional, intermediate and Zander model box hives and also Malede et al. [42] By depending on their level of economic status, three type of bee hives have used by the sample beekeeper farmers around Gonder area. These were traditional, top bar (transitional) and

movable frame (modern) bee hives. According to Holeta Bee Research Centre, there are four different types of beekeeping practices in Ethiopia namely, traditional forest, traditional backyard, transitional and improved beekeeping.

Traditional forest beekeeping practice

In Ethiopia, traditional beekeeping is the oldest and the richest practice, which has been carried out by the people for thousands of years. Several million bee colonies are managed with the same old traditional beekeeping methods in almost all parts of the country [22]. Traditional beekeeping is of two types: forest beekeeping and backyard beekeeping. In some places, especially in the western and southern parts of the country, forest beekeeping by hanging a number of traditional hives on trees is widely practiced. In other most parts of the country backyard beekeeping with relatively better management is common [43].

It is placing of hives in the forest on very tall trees for catching swarms. It is commonly exercised in forest-covered areas of the country where the population of honeybees are abundant. The advantage of forest beekeeping is that the bees do not cause harm to the domestic animals and humans and the bees can get abundant forage plants in their vicinity. Its disadvantages are lack of close follow up and 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 [8].

According the survey Conducted by Tesfaye et al. [41] in Bale Zone until now traditional beekeeping is practiced in two forms, traditional forest beekeeping which is practiced in forest by hanging beehives on long trees and with no management given for bees and bee products. This way of beekeeping is the dominant ways of honey and beeswax production system in the study area (Figure 1).



Figure 1: Traditional beekeeping at backyard on the top trees and in the Forest.

Traditional backyard beekeeping practice

It 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; it does not also require skilled manpower; whereas 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, there is no partition to differentiate brood chamber and honey chamber [8].

According to Tesfaye et al. [41] study conducted in bale zone states that the second form is traditional back yard beekeeping which is practiced around homestead with relatively better management provided to bee colonies as compared to forest beekeeping and traditional beehives was categorized in to three different types; this includes: Log (Bidiru), Mud (Dogogo) and Basket hive type, but all were oval in shape with the dimension of around 90 to 100cm in length and a diameter of approximately 30 cm. As information gathered from the respondents, they were plastering interior of hive by mud and cow dung to protect bees from cold weather conditions and external part were covered with grass and bamboo sheath (hoyine) to protect from rain and sun.

Malede et al. [42] indicated that farmers around Gonder area have greater number of traditional hives because they have easily constructed from locally available materials such as clay pots, woven grasses. The productivities of one fixed comb hive were 7 to 15kg/ hive that harvested 1 to 2 or 3 times per year depending on honey bee flora but the honey production is not that much compare to other beekeeping system. Traditional beekeeping is mostly practiced with different types of traditional hives. The most universal type of traditional hives, known to have been in use is simple cylindrical type. Beekeeping started with traditional or fixed comb hives, so called because the combs are attached to the top and sides of the hive itself and the beekeeper cannot easily remove and replace them. In its primitive form, only one end of the hive could be open, but in more advanced forms each end of the cylinder will be fitted with a removable closure. The types of hives and the way of keeping bees vary from area to area. Based on locally available materials used for construction of hives, environmental conditions and positions used to keep bees, the following variants of basic design are found throughout the country: hollowed logs, bark hive, bamboo or reed grass hive, mud (clay) hive, animal dung (mixed with ash) hive, woven straw hive, gourd hive, earthen pot hive and so on.



Figure 2 : Placement of traditional hive in Haramaya district, hive under shed and hives on the trees.Source: [14,15,46,].

The beekeepers that are experienced and skilful in using these hives could do many operations with less facility. Gezahegne [44] stated that under Ethiopian farmers' management condition, the average amount of crude honey produced from traditional hive is estimated to be 5kg/hive/year. On the other hand, based on the survey conducted in West Showa Zone [43,45], the amount of honey harvested, from a traditional hive on average was reported to be 6.1kg/hive/year. Traditional husbandry is practiced with many millions of fixed comb hives particularly in the remote areas of the country (Figure 2).

Transitional beekeeping practice

It is one of improved methods of beekeeping practices. The types of hives are Kenya Top Bar Hive (KTBH) and Tanzania Top Bar Hive (TTBH). 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. Transitional (intermediate) beekeeping 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 [8]. It is a type of beekeeping intermediate between traditional and modern beekeeping methods. Generally, top-bar hive is a single story long box with slopping sidewalls inward toward the bottom (forming an angle of 115° with the floor) and covered with bars of fixed width, 32mm for east African honeybees [46,47].

Adjare [48] suggested that for technical and economic reasons, most African countries are not yet in the position to use movable- frame hives, and for them top- bar hive represents a satisfactory compromise. Although movable frame hives are recommended for experienced beekeepers that want to optimize honey production, the Kenya top-bar (KTB) hive has been proved to be most suitable because of its low cost and the fact that the beekeepers or local carpenters can easily construct it. Transitional beekeeping started in Ethiopia since 1976 and the types of hives used are, Kenya top-bar hive, Tanzania top-bar hive and Mud- block hives. Among these, KTB is widely known and commonly used in many parts of the country. The advantages of KTB over fixed comb hive and movable frame hive is discussed by Nicola [11,47]. Top-bar hive in an ideal condition can yield about 50kg of honey per year, but under Ethiopian condition, the average amount of crude honey produced would be 7-8kg/hive/year [44].

Based on the study, the only problem for constructing top-bar hive (TBH) by beekeepers were inabilities keeping the specific

size of top-bars. Due to this problem the hive distribution was very low. However, the productivity is greater than fixed comb hives next to movable frame hives. Top-bar hive has proved to be the most appropriate because of its low cost and the fact that the beekeepers or local carpenters can easily construct it [49].

Tesfaye et al. [41] who state that in Bale Zone transitional beehive dissemination is very limited and this might be due to poor beekeeping extension services in the study area. The study showed the average transitional bee owning per households were 1.75 which is insignificant as compared to traditional beekeeping practice. However, there is a recent effort by GO (research centre and Bureau of Livestock Health and Marketing) and NGOs in introducing transitional Kenya top bar (KTB) beehives as well as providing training to framers. The training was focused on hand on practices that equip the beekeepers with skill to prepare his own KTB from locally available material to overcome the high cost of investment (Figure 3).



Figure 3 : Transitional beekeeping.
Source: [1,46]

Improved beekeeping practices

Modern beekeeping methods aim to obtain the maximum honey crop, season after season, without harming bees. Modern movable- frame hive consists of precisely made rectangular box hives (hive bodies) superimposed one above the other in a tier. The number of boxes is varied seasonally according to the population size of bees. Practical movable- frame hive was invented in 1851 by Lorenzo Lorraine Lang troth in U.S.A. [50]. Later on different countries developed their own movable frame hives (for instance Zander, Dad ant) and Lang troth was the prototype of movable frame hives used today. In many countries Lang troth hive boxes have proved to be convenient for handling and management.

In Ethiopia, about 5 types of movable frame hives were introduced since 1970 HBRC [8] and the most commonly used are, Zander and Lang troth style hives. Based on the national estimate, the average yield of pure honey from movable frame hive is 15-20kg/year, and the amount of beeswax produced is 1-2% of the honey yield Gezahegne. However, in potential areas, up to 50-60kg harvest has been reported (HBRC, 1997). Movable frame hives allow colony management and use of a higher level of technology, with larger colonies, and can give higher yield and quality honey but are likely require high investment cost and trained man power.

It uses different types of frame hives. Sandra and Lang troth hives are the most common that exist in the country. Dad ant, Modified Sandra, and foam hive are found rarely. These hives differ in number and size of frames. The most commonly used hive type in Ethiopia is Sandra type. Improved beekeeping hives have components like brood chamber, super (honey chamber), inner and outer cover. Improved box hive has advantages over the others in that it gives high honey yield in quality and in quantity. The other advantages of improved box hive are its possibilities of swarming control by supering. On the other hand, its disadvantages are the equipments are relatively expensive, requires skilled manpower and the equipment needs very specific precaution HBRC.

Movable frame hives allow appropriate colony management and use of a higher level technology, with larger colonies, and can give higher yield and quality honey but are likely to require high investment cost and trained man power [51]. Modern beekeeping hive consists of precisely made rectangular box hives super imposed one above the other in tire and increase as bee population increase and decreases likewise Kerealem [49] but it requires high investment cost and trained man power. According to the respondent's response, the productivity of honey from the hive was good that honey harvesting ranging from 30-50 kg per hive. This agrees with the potential area of honey production from this hives (HBRC), but disagrees with [52].



Figure 4 : Movable frame hives beekeeping.
Source: [Tessega 2009,53]

According to the result of this study, that conducted by Tesfaye et al. [41] who state that in Bale Zone the use of movable-frame hive was very low as compared to traditional beehive with overall mean holdings of 3.57 and maximum 8 and minimum 1 hives per household. This is probably because of poor beekeeping extension services and weak intervention on beekeeping by government and non-government organizations in the study area. Currently, the costs of movable frame hive ranges from 36.5 to 54.8 USA dollars which is not affordable by small holder farmers as information gathered from livestock development and marketing office of Ababa, Dish and Dellomenna districts. Moreover, movable-frame hives allow appropriate colony

management and use of a higher level technology, with larger colonies, and can give higher yield and quality honey but are likely to require high investment cost and trained man power (Figure 4).

Honeybee management practice

Honeybee management practice is the regular inspection of colonies to assess the status of brood condition, giving additional hive super for expansion of colony during flowering, distinguishing and harvesting of ripe honey, space reduction, feeding and maintaining colonies during dearth periods and detection and control of bee pests which enhances colony performance such as reduced absconding, improved colony strength and higher hive yields [13,53,54].

Source of bee colony

According to Awraris et al. Beekeepers Kaffa and Sheka and Bench-Maji Zone have a mechanism of attracting honeybees to the newly and already used hives. They rub/clean the hives with *Clausena anisata* and *Capsicum frutescens* and fumigate them with a mixture of leave and bark of a plant *Ekebergia capensis* and wax together in Kaffa and Sheka Zone, but in Bench-Maji Zone they are using bark and scrap of *C. Africana* after the log hive construction and they hanged the beehives upon tree branches they only check for the occupying of the hives with bees.

Study conducted by Gebretsadik et al. in Gedeo Zone stated that from the total 90 respondents in this study, about 95% reacted occurrences of reproductive swarming in their apiary with the remaining about 5% had no knowhow about swarming. The respondents mentioned that frequency of swarming depends on the availability of honeybees flower and season of the swarming occurrences. About, 84.4% of the sample respondents had experience of catching the issued swarm and this result agrees with report of who recorded 85.80% experience in catching swarm for beekeepers in Burie District of Amhara Region. Also in this study about 72.8% of the sample respondents agree that issuing swarm had advantage to increase their number of colony and replace non-productive colony with only 27.2% responded swarm has no advantage.

The indigenous knowledge of beekeeping differs from beekeepers to beekeepers and also from place to place, depending beekeeper's experiences and exposure in beekeeping activities. When beekeepers were asked to explain how they were started beekeeping, about 98.3% replied that they were started beekeeping by catching swarms and only 1.7% was started through inheritance from their family. Chala et al. in Gomma district of Oromia Region reported that about 87.8% of beekeepers are started beekeeping by catching swarm. The result showed that catching swarm was the dominant sources of basis colony in the study area and the beekeeping production system was mostly traditional and this is also most probably because of poor extension services system, poor adoption of improved beekeeping technologies, high costs of beekeeping equipment,

lack of government and non-government organization dealing with beekeeping in the study area.

According to Gebremedhn [55] the use of baiting hives to catch swarm is part of the traditional beekeeping practices in the in Kewet District of Amhara Region. The new hive may be smoked until the internal colour of the hive gets brown. Similarly, Kerealem et al., Kebede & Lemma [56] and Workneh [57] reported that most of the beekeepers in the central Ethiopia had got their bee colonies by trapping swarms using bait hives.

Colony transferring

Kebede and Lemma [56] indicated that from mid-June to July in Dega agro-ecological areas and mid-August to September in Kolla and Woyna Dega agro-ecological areas are the peak colony transferring months. According to Adebabay et al. [58], in Amhara region it was indicated that August to September and April to June as the season of colony transferring. In three months (December, January and February), colony was not transferred as farmers reasoned out, because of that these three months are the main once characterized as dearth period on which no or some flowers are available (Figure 5).



Figure 5 : Colony transferring.
Source: WEEMA [53].

Inspection of honeybee colonies

Study conducted by Gebremedhn [55] in Kewet District of Amhara Region indicates that hive inspection by opening the hive is not a common practice in traditional beekeeping. Internal hive inspection is undertaken by not more than 33.3% of beekeepers (mostly respondents using modern beehive) during honey harvesting, swarming and when colonies attacked by pests. This is presumably because of fear of being stung, the risk of the colony absconding, lack of time and lack of awareness of the value of doing so. Moreover, almost all beekeepers in the study area perform external inspection and also clean their apiary to prevent ant and other insect pests from getting access to hives. The study conducted by Kerealem et al. [49], Kebede & Lemma [56], Nuru, Kerealem et al. [59] revealed that internal hive inspection of traditional hive is not very common or non-existent at all in their respective study areas (Figure 6).



Figure 6 : Inspection of Honeybee Colonies.
Source: Jaco [46].

Control of reproductive swarming

Reproductive swarming has a negative effect on honey production since it decreases the honeybee population in the hive. It occurs either due to low space available for bees in the hive or low egg production performance of queen. In the former case it can be easily prevented by adding supers in modern hive and providing additional space by removing honey combs in traditional and transitional hives prior to colony produces queen cells. Queen cells can be also removed during internal inspection. Majority of beekeepers in the study areas, however, do not put any effort to prevent or control reproductive swarming which seeks due attention by development organizations to create awareness. In fact, it's difficult to prevent and control reproductive swarming in traditional hives hence internal inspection on tall trees is cumbersome for a beekeeper. Similar scenario has also been reported in honey production systems in southwest Ethiopia.

According to Tessega in Burie District of Amhara Region indicated that the most frequently ways of controlling reproductive swarming by the respondent beekeeper were removal of queen cell (46.2%), killing queen of the swarm and reuniting of honeybee colony to its mother (28.2%), suppering (2.6%), use large volume of hive (1.7%) as colony increase and kill new emerged queen (0.9%). Moreover, some indigenous knowledge like smoking with bone of dead horse or mule (10.3%), spraying mule urine (5.1%), fumigating the hive with white etan (1.7%), 'ambacho teketila' 'and Yejart eshoh' (2.6%) were also exercised by beekeepers.

According to Fikru et al. [60] Reproductive swarming is a common phenomenon in honeybee colonies. As indicated below, in all respondent's colony there is an occurrence of swarming. In 57.14% respondents' apiary site, swarming occurs in every season of the year while in the rest farmers' apiary site (42.85%) it occurs every year that means once in the year. Respondents added that the seasonal swarming occurs every spring season this is the presence of surplus bee forage. Even though swarming is advantageous to the farmers, but most of the farmers are not capable of controlling swarming while a few of them are capable of controlling swarming. They can control swarming by removing queen cells, by using large volume hives, or by supplying empty hive. But those who fail to control swarming are due to lack of those listed techniques.

Honey harvesting

According to Demisew [1] Honey and Wax harvested three types of beekeeping practices are Traditional (90%) with the yield ranges from 5 to 9kg honey/colony (Av. 5.5kg/year) Yield from this type of practice of BK accounts 64% (34,650 tonnes) of honey and 85.8% (4,290 tonnes) of beeswax. Transitional (3%) Productivity ranges from 9 to 40kg/year crude honey/colony (Av. 15kg/year) this accounts 6% (3,150 tonnes) of honey and 7.7% (387 tonnes) of beeswax. Box (frame) hive (7%) Present national average 33kg/hive/annum (20-80kg/year) Using improved techniques, one can harvest 50-80kg/hive/year) 30% (16,170 tonnes) of honey and 6.5% (323 tonnes) of beeswax. Total honey and beeswax production are respectively 53,970 and 5000 tons.

Ethiopian honey differs not only in colour, taste and quality but also in the quantity produced and the timing of harvesting seasons that vary by region and type of honey. In Ethiopia, honey was harvested once or twice and in some cases even three times [61]. There are two major honey harvesting periods, November to December in the lowlands and midlands and from April to May in the highlands. However, in addition to these major harvesting periods, there are many small harvesting periods which depend on the availability of bee forage and rainfall patterns in different agro-ecologies as reported by Nuru, Haftu & Gezu [62] and Beyene and Phillips [63] in Hadiya Zone of southern Ethiopia Tessega, Tesfa et al. [64] in Western Amhara region, which experienced beekeepers and local people easily associate the harvesting season with the botanical origin of honey in their locality [65].

Moreover, Global Development Solutions LLC [66] reported that the main harvesting seasons in Tigray and Lalibela honey are October through December, with an additional harvest period for Tigray's white honey in June and July; November and December for yellow honey, April and May for white honey from the southwest and southeast Highlands; and February, March, May and June for dark-brown varieties of honey. This shows the possibilities of harvesting and supplying different types of honey at different time implying the possibility of continuous supply of honey along the market chain. The frequency and amount of honey harvested varied depending on seasonal colony management practices depending upon flowering condition of major bee forage and number of modern beehive Kajobe et al. [67].

According to Awraris et al. research finding the Beekeepers have experiences to know whether honey is ripened for harvesting or not. Appearance of high population of bees at the entrance of the hive, increasing of the defensiveness of bees, and completion of flowering periods of honey plants in the surrounding areas are some of the indicators for honey ripening. In Bench-Maji Zone, they check the ripeness by taking out honey combs from the hive hanged on trees. During harvesting all

respondents mainly use "Teff" straw smoke to subdue and push away the bees. Some also smoke *Vernonia amegdalina* leaves and animal dung for the same purpose.

According to Tesfa et al. [64] 5-6kg of honey is harvested per local hive. This result agrees with the report of Bo A, 5-6kg and Nuru, 5-8kg, respectively, from local hive per colony per annum. More than 25kg of honey is produced from top bar (both timber and non-timber made) hive and 11-20kg from frame hives is harvested, respectively Tesfa et al. [64] The result also show that honey harvested from frame hive is less than that of top bar hive which might be due to dwindling of honeybee floras in the Western Amhara which urge the beekeeping who own frame hives to only harvest honey once in a year than who own top-bar hives; and in these case there is no suppering of hive for additional honey production. October, November and December were regarded as the main honey flow season and harvesting period of the year as this period is the main flowering season of the year; whereas, May, April and June were regarded as the second honey flow season/harvesting period of the year. This finding also agrees with the reports of Nuru that indicated these months as the two main honey flow and harvesting periods of the year. In the first honey harvesting period, the main reasons might be the presence of flowering crops and in the latter period, potential flowering ability of Eucalyptus tree. This result is in line with Nuru & Kerealem et al. who states that Eucalyptus tree is the main dominant and potential honeybee flora in Western Amhara region.

Managements at the seasons of feed shortage/Dearth period for honeybees

The survey result which is reported by Tesfa indicated that in all months of the year there was feed shortage for honey bee despite variation in severity. The peak months in which feed shortage occurs are April (17.3%), March, and February (6.2%). These months are indicated as dearth period because there was no much flowering plant.

In these seasons (62.5%) beekeepers have the tradition of providing supplementary feed to keep the strength of their colony and to get additional honey yield. This also in line with the report of Solomon [68] who stated that during dearth period when there is little honeybee forage, beekeepers provided supplementary feeds. Beekeepers give additional feed for their honeybees when they think the time is dearth period (when there is no better pollen and nectar source). According to beekeepers the peak dearth periods of the year are dry season period (December to March) as there is no flowering plant as a source of pollen and nectar and during rainy season (June to July) as the pollen of the flowering plants is diluted and the nectar is washed by the rain and referred as dearth period. Sugar syrup, hot pepper, roasted pea flour, water, honey syrup, roasted bean flour, and roasted barley flour are the major feed types they used as a supplementary feed during dearth period.

According to Yetimwork et al. [69] supplementary feeding and migratory beekeeping practices to overcome the feed shortage at the dry season is a common practice. Majority (89.1%) of the beekeepers provide *besso* (roasted and grounded barley flour), *shiro* (roasted spiced pulses flour), sugar syrup and honey with water mainly from February to May (87.2%), May to June (0.6%) and June to September (1.3%). Moreover, Honeybees require large quantities of water in the hive to dilute brood feed and to cool the hive during hot temperature. The source of water comprises rivers, ponds, well and taps water. The beekeepers gave water or other solution by putting grass, stone and maize cobs in the solution container to avoid the sinking of bees during drinking.

Opportunities of Beekeeping in Ethiopia

As reported by Gallmann and Thomas [70], currently Ethiopia is listed as a third Country permitted to export honey by the European. The direct contribution of beekeeping includes the value of the outputs produced such as honey, bee wax, queen and bee colonies, and other products such as pollen, royal jelly, bee venom, and propolis in cosmetics and medicine [44].

There is an increasing demand for honey for domestic consumption and export by different customers and organizations. Availability of rich culture and tradition of beekeeping, suitable environment with different agro ecology, Indigenous knowledge, skills and interest of the farmers to adopt improved technologies and to undertake beekeeping as a way of life are among the few to mention Serda et al. [15].

On the other hand, the opportunities for beekeeping in the country were the presence of natural resources and human capital, the current attention of the government towards the introduction of different beekeeping technology packages, the establishments of beekeeping association and the presence of governmental and non-governmental organizations who are involved in beekeeping activities and the presence of micro finance institutes at grass-root level. Still the country has potentials with enormous nectar and pollen resources that have not yet been exploited, and beekeeping could probably be a profitable activity to undertake.

Availability of adequate apiculture flora and water resource

Ethiopia is endowed with various climatic conditions; topography and a wide range of altitude favouring the presence of different natural vegetation's that include forests, bushes, herbs, weeds and undergrowth. The flowering plants known in Ethiopia are between 6 and 7 thousand species Edwards [71]. The presence of this natural vegetation made the country the best home for honeybees. This assisted to exist more than 12 million honey bee colonies in the country Gezahegn [44]. Beekeeping has been and still is widely spread, economically important and integral part of the life of the farming communities of Ethiopia. Currently, more than 7000 species of flowering plants are

estimated to be found in the country, of which most of them are honeybee plants [72]. The variety of landscape from raggedness to undulating plain, with north-south latitude and east-west longitude differences, has given the country a contrast in climate and consequently a variety of seasons [73].

Existence of strong bee colonies

Ethiopia, having the highest number of bee colonies and surplus honey sources of flora, is the leading producer of honey and beeswax in Africa. Ethiopia produces about 43,373 metric tons of crude honey per year, thus shares 23.5% of Africa and 2.35% of world's honey production. This makes the country rank 1st in Africa and 10th in the world (AMP, 2007). The ideal climatic conditions and diversity of floral resources allow the country to sustain around 10 million honeybee colonies, of which 7 million are kept in local beehives by farmers, and the remaining exist in the forests as wild colonies. This makes the country to have the highest bee density in Africa.

Demand for the bee products and honeybee

According to Gibbon [74] Honey and beeswax also play a big role in the cultural and religious life of the people of Ethiopia. Another very important contribution of beekeeping is through plant pollination and conservation of the natural environment. Beekeeping is environmentally sustainable activity that can be integrated with agricultural practices like crop production, animal husbandry, horticultural crops and conservation of natural resources. Thus, it would be one of the most important intervention areas for sustainable development of poor countries like Ethiopia (The contributions of beekeeping in poverty reduction, sustainable development and conservation of natural resources have been well recognized and emphasized by the incumbent government of Ethiopia and non-governmental organizations (NGOs).

Presence of indigenous knowledge, skills and interest to improved technologies

Beekeeping is an indigenous activity inherited from father to son in southwest Ethiopia [17]. According to Birhanu [75] in Fuji and Boerne Zone of Oromia State beekeeping practice has a long history, as a fact that, the beekeepers have developed indigenous knowledge which was passing from generation to generation. The main areas of indigenous beekeeping knowledge are hive construction from locally available materials, swarm catching; hive fumigation, honey and swarming season identification, different medicinal values of honey, identification of important honeybee floras and identification of adulterated honey. This familiarity and pride with bee-keeping can support rapid uptake among additional beneficiaries.

As study conducted by Tesfaye et al. [41] in Bale, South-eastern Ethiopia beekeepers have good indigenous knowledge of traditional beekeeping. According to the responses of the sample respondents, the indigenous knowledge used by the interviewed beekeepers were smoking baited hive by swarm attractant

materials like *Ekebergiacapensi* (anonu), honey harvesting time by smelling, observation at the beehive entrances for what resources the honeybees are collecting and insert stick to beehive to check for honey presence, controlling reproductive swarming by removing brood, strengthening of colony by feeding like *harcee* (over lefts of flour of different grain), honey as local medicine, control of honeybee enemies by different means like cleaning around apiary and using metals and strings (*kiyyo*) around the entrance of the apiary site for honey badger, swarm catching, identification of adulterated honey by smelling, tasting and looking colour of honey.

Government efforts towards sector development

Government has increased its attention to develop the apiculture subsector as one of its strategies for poverty reduction and diversification of export commodities. Recent initiatives taken by the public and private sectors as well as non-governmental organizations (NGOs) are in the right direction towards improving the possibility of exploiting the potential of the apiculture sub-sector, and increasing its overall competitiveness through the introduction and promotion of modern hives in order to obtain honey of good quality for industrial processing.

Registration and control of pesticides, special Decree No. 20/1990 to lay a scheme of registration and control of hazardous chemicals to life and products of honeybees. Apiculture Resources Development and Protection Proclamation, No.660/2009 for development and protection of apiculture resources. Establishment of the competent authority MoLF to ensure apiculture development by strengthening extension

delivery system. Establishment of Ethiopian Apiculture Board (EAB) as an Apex body to coordinate professional Associations and other stockholders towards the implementation of policies and development activities. Encouraging and supporting of Associations like Ethiopian Society of Apiculture Science (ESAS) and Ethiopian Honey and Beeswax Producers and Exporters Association (EHBPEA). Facilitating conditions for existence of synergic public and private stakeholders (SNV, ACDI/VOCA, FC, MCF etc). Ethiopia has developed honey and beeswax Standards (ES 1202 and ES 1203), which comply with ISO and CODEX Standards. Ethiopia is listed as a Third Country permitted to export honey and beeswax by the European Commission since 2008 on the approval of residue monitoring plans submitted by third countries in accordance with Council Directive 96/23/EC, notified under document C(2010) 3548 (2010/327/EU). Since 2009 Ethiopia has investing a large amount of money to collect samples of honey yearly and send to laboratories recognized by EU and submit the report of analysis.

Currently the government is highly supporting self-contained watershed developing program in which beekeeping is part and parcel. Low cost modern hives is being produced using locally available materials and efforts are being made to organize farmers in groups and link them with local carpenters who produce modern bee hive. However, according to Malede et al. [42] the livestock sector has probably suffered more than crops and crops sectors from inappropriate government policies and the apiculture sub sector is no exception. So to improve and sustain apiculture sector the government give special attention to it in Table 1.

Table 1: Major beekeeping opportunities which is identified by different researchers in different parts of Ethiopia.

No.	Opportunities	Studied Areas	Authors
1.	Availability Bee colony and race	Jimma Zone Gomma district Gambela Zariain Able and God ere Wired	Chala et al., Shibru et al.
2.	Bee forage plants	Gomma district, Jimma Zone Wolaita and Dawro Zones Gambela Zuriain Able and God ere Wired	Chala et al., Tsegay et al., Shibru et al.
3.	Availability of water	Gomma district, Jimma Zone Wolaita and Dawro Zones Gambela Zuriain Able and God ere Wired	Chala et al., Tsegay et al., Shibru et al.
4.	Indigenous beekeepers knowledge & experience	Jimma Zone Gomma district Gambela Zuriain Able and God ereWired	Chala et al., Shibru et al.
5.	Socio economic value of Honey	Jimma Zone Gomma district Gambela Zuriain Able and God ereWired	Chala et al., Shibru et al.
6.	Marketing access/Demand	Jimma Zone Gomma district Wolaita and Dawro Zones Gambela Zuriain Able and God ere Wired	Chala et al., Tsegay et al., Shibru et al.
7.	Government policy	Wolaita and Dawro Zones	Tsegay et al.
8.	Extension service access	Wolaita and Dawro Zones	Tsegay et al.

9.	Credit access	Wolaita and Dawro Zones	Tsegay et al.
10.	Skilled manpower	Wolaita and Dawro Zones	Tsegay et al.
11.	NGO support	Gomma district, Jimma Zone	Chala et al., Tsegay et al.
12.	Establishment of Ethiopian beekeeping Association	Gomma district, Jimma Zone	Chala et al.

Beekeeping potentials which identified in different parts of Ethiopia by Chala et al. in Gomma district of Jimma zone, South-west Ethiopia, Stagey et al. [76] in Lolita and Dawro Zone and Shire et al. [77] Gambela Zaria in Able and God ere Wired were availability strong bee colony, bee forage plants, marketing demand of bee products, socio economic value of honey, indigenous beekeepers knowledge & experience, availability of water and government policy towards these sub-sector were the major opportunities in beekeeping in Ethiopia.

Marketing of Honey, Beeswax and Honeybee in Ethiopia

In Ethiopian, only about 10% of the honey produced in the country is consumed by the beekeeping households [16]. The remaining 90% is sold for income generation and of this amount, it is estimated that 80% is used for *tej* brewing. According to Mengistu [18] domestic honey consumption is increasing due to highly increasing demand for *tej*, increased consumption of processed table honey in most urban areas and increased demand for honey in the local industries. According to Assefa [78] and Tessega, the domestic honey market starts the smallholder beekeepers level, who majorly 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 a significant amount of honey they collect also goes 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 and hence compromise the quality of the honey. They also have low business concept (market information gathering and analysis, pricing, promotion, etc.) to be competitive.

The whole domestic honey market lacks proper structure and legality. It is of lengthy chain of actors that widens gap for the access of producers to bigger and better paying markets. So,

the beekeepers complain the business as not rewarding and even lacking the market for their product, while the consumers see the ever increasing price of honey as unfair. Moreover, the market faces challenges like smuggling that pushes the legal actors out of market. In many cases, adulteration of honey has been a frustrating factor for both the producers and legal buyers and sellers as the traceability and accountability is hardly possible [79].

The honey price in the domestic market is mostly advanced than the international honey price which makes honey export less cost-effective in Ethiopia and several of these companies have dropped out of the international honey trade and are now targeting the local markets which are still attractive. According to the study by Awraris et al. on honey production the case of in Kaffa, Sheka and Bench-Maji zones of Ethiopia, honey is used as a source of cash income and food that is, home consumption. About 97% of the respondents reported to sell their produce retaining some of it for home consumption. This study reveals that, honey production contributes about 50% to the total household cash income of small scale farmers involved in beekeeping. Their major buyers are ‘Tej’ brewers and middle merchants in the nearby markets. For 77% of the farmers’ market price of honey is promising. However, more than 97% of respondents mentioned the price is subjected to fluctuation with seasons. As usual, honey price decrease during main harvesting season in April and increase in other months of the year. The average price of honey from traditional, intermediate and improved box hives was 35, 35 and 55 ETB per kg respectively.

Honey marketing in Ethiopia

Ethiopia has perhaps the longest tradition of all African countries in marketing of bee products. The country has the potential to produce 500,000 tons of honey and 50,000 tons of beeswax per annum [80]. But currently, the annual honey and beeswax production of the country has been estimated at 53,680 and 3,658 tons respectively (CSA, 2010/11) [81]. This makes the country one of the largest honey producers in Africa and the fourth largest beeswax producers worldwide.

Ethiopia is one of few countries in the world with a long tradition of beekeeping that gave an opportunity of supplying honey and honey products to the international markets. The country is estimated to have ten million bee colonies, which is

the largest in Africa. The most important honey and beeswax producing regions in Ethiopia are Oromia (36%), SNNPR (31%), Amhara (19%), Tigray (5%) and other regions (9%) [82].

The market for honey in Ethiopia is generally not well developed, mainly due to a limited number of buyers relative to the number of producers (suppliers), poor market infrastructure and information. The local collectors (traders) also lacked basic business concepts (do not have sense of competition, poor in client handling, weak in information gathering, etc.). They also lacked facilities like container and processing materials. 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. According to Beyene and David [63] report 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 tonal levels, which directly deliver the honey to “tej” brewery houses in their localities and/or transport it to the big honey dealers (veranda) 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. These authors also stated that 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 labelled containers for local markets (super markets, food groceries and big hotels) and very often to export markets.



Figure 7 : Honey being sold in clay pots, buckets and 1kg plastic jars in Madero market.
Source: WEEMA [53]

It is not only the local honey market but also the export is increasing. The total volume of exported honey between 2000 and 2008 has been increasing recently, 1.5 tons in 2000, 275 tons in 2010 and more than 730 tons in 2012 [83,84] and the export trade of Ethiopian honey has reached more than 2.43 million USD. The involvement of honey and beeswax processing companies is also an important factor for the increased export volume. In 2008, 17 honey and beeswax processing companies were registered [83]. The major importers of Ethiopian honey include Sudan, Norway, UK, Saudi Arabia, Kuwait, Yemen and other European countries and USA [85]. The honey price at the domestic market is mostly higher than the international honey price which makes honey export less profitable in Ethiopia (Figure 7).

Beeswax marketing in Ethiopia

Beeswax largely collected from traditional hives rather than the modern hives, which presently promoted by the Ministry of Agriculture and several NGOs. The wax yield from traditional hives is 8 to 10 percent of the honey yield, compared to 0.5 to 2 percent from modern hives. The bulk of the supply of beeswax obtained as residual from *tej* production, a mild alcoholic beverage popular throughout Ethiopia. According to ITC, report, export of beeswax has had difficult times in the last 5 years, showing an average growth rate of 1 percent and even negative in period of 1999-2002. However, exports of beeswax from Ethiopia have increased spectacularly and reached 402 tons of beeswax (1.2 percent share in world market), destined to different countries (USA, Japan, Greece, Great Britain and Netherlands etc.), generating USD 936 thousands in 2003 [86].

Beeswax channel starts mainly from “tej” brewery, which collects the wax as a by-product of “tej” or “bird”. 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. With regarding export of beeswax, Ethiopia is one of the biggest wax exporters to the world market. An average of 270 tonnes was exported per year over the period 1984-1994 which in turn generated over ETB 2 million per annum to the national economy. Currently, the annual turn-over of the apicultural industry varies between 185 and 450 million ETB, of which only 5 million Birr worth beeswax exported [87].

Properties of samples of beeswax collected from different parts of the country at farm gates and at different beeswax processors and exporters’ stores. The physical and chemical properties that are relevant to beeswax quality like melting point, saponification cloud point, acid value, ester value and ester to acid ratio were tested based on the protocols of American Beeswax Importers and Refiners Association INC, 1968 as cited

in. Generally, the purified beeswax collected from different parts of Ethiopia met the world standards. The saponification cloud point ranged between 57.9°C and 65.0 °C, while the melting point lied between 61.0 °C and 63.9 °C. Acid value of 18.0 to 32.7 and ester value ranging between 66.4 and 98.0 were recorded, while the ratio of ester to acid values was found 4.2 to 4.0.

In Ethiopia, beeswax is one of the important exportable agricultural commodities. Currently, the annual production of beeswax is expected to be more than 5000 tones. Nuru indicated that this is around one tenth of the world annual beeswax production that is estimated to be around 50,000 tones. Because of its pliability, yellow coloration and other physical properties, the Ethiopian beeswax has been highly demanded and mostly used to blend beeswaxes from other sources. It is dominantly yellow in colour though white bees wax is produced in southeast and southwest parts of the country. Yellow coloration is mainly due to the pollen stored in combs and propolis polishing.

The smallholding beekeepers are the primary sources of beeswax in Ethiopia who sell the majority of crude honey to the *tej* brewers, hence most of marketable crude beeswax comes from them as a by-product of the beverage [16]. After the beverage production, the *tej* makers collect the crudebees wax and store it as it is in the crude form of “safe” or partially strained form of “kisses”. The suffer the partially processed *keskesis* collected from the *tej* makers. Traditional beeswax extractors are also the other intermediate sources who process these *fej* partially to rough beeswax blocks. Recently, many private firms collect *safe* and *kisses*, process and export beeswax. The channel of crude beeswax collection, processing and marketing in Ethiopia is very complex and the issue of traceability is a big concern. This is

one of the major challenges that is attributing to the increasing adulteration of beeswax with cheap materials like animal fat in addition to the ever increasing price that draws attention of the people involved in the mischief. Beeswax has good domestic market in Ethiopia. The traditional religious practice of the Ethiopian Orthodox Church followers to burn candle sticks called “turf” made from pure beeswax is believed to consume a significant amount of the beeswax produced locally even though not quantified so far. Moreover, the intensity of the improved bee keeping extension in the main beekeeping potential areas of the country launched by government and NGOs has created a huge demand of beeswax for foundation making for frame box hives. Currently, a kilogram of purified blocks of beeswax cost about 250-300 ETB (25-30 USD) in the local markets. Generally, the beeswax price at the domestic market is mostly higher than the international beeswax price which makes beeswax export less profitable in Ethiopia.

Exports of beeswax from Ethiopia have increased spectacularly and reached 402 tonnes of beeswax (1.2% share in world market), destined to different countries (USA, Japan, Greece, Great Britain and Netherlands etc.), generating USD 936 thousands in 2003 [54]. After 2003, the export volume is not far from 400 tonnes annually [84,85]. However, as personal communication, Ethiopian honey and beeswax processors and exporters association, 2013 cited by Gemechis the local beeswax market; the export of Ethiopian beeswax has threats as adulteration with cheaper materials has become a challenge for its quality and marketing. Exporters complain that significant proportion of the exported beeswax is refused by recipient companies because of compromised quality mainly due to adulteration with cheap materials (Table 2) Demisew [1].

Table 2: Honey and beeswax exports from 2011-2016.

Type of Product	Year						Total in the Last Six Years
	2011	2012	2013	2014	2015	2016	
Honey (ton)	520.3	876.7	839.6	742.4	681.2	592.6	4252.8
Beeswax (ton)	380.5	367.1	385.0	334.7	520.4	267.7	2255.4

Honey bee colony marketing

Colony population is declining from 5.15 million in 2009 [88] to 4.99 million in 2011 [89]. On the other hand, the demand for honeybee colonies is increasing in association with the interventions. Efforts are challenged by shortage of bee colonies due to absconding and reduction in swarming [90]. Colony multiplication and marketing using swarming colonies is an important source of income for sellers and source of bee colony for purchasers in the Northern part of Ethiopia [91,92]. Colony marketing is a common practice in Tigray. This is an important source of income for many sellers, both traders and producers, and an important source of colony for beekeepers; for start-up, expansion and replacement. In other parts of the country, colony

trapping using bait hives has remained as the main source of colony [93].

According to Research conducted by Teweldemedhn and Yayneshet [92] in Werieleke district of Tigray, Northern Ethiopia colonies supplied were nested in traditional hives; Made of cow dung which are either conical or cylindrical in shape. The number of colonies in markets varied via the season Lowest in July and peaked in 2nd & 3rd weeks of Aug in Maikinetal & Nebelet. It is open marketing in which actors negotiate to determine price based on strength & quality. Factors considered in price negotiation include: Docility and size of the colony. However, many purchasers lacked the capacity to properly evaluate colonies required assistance from knowledgeable people.

Nebelet and Maikinetal are the major market places located in Werieleke district of Tigray. Inter-annual colony price trends were Rises in price averaged 11.3% & 13.1 % per year over the period of 1999-2010 in Nebelet & Maikinetal, respectively. The mean price of honey bee colony was 231 ETB and 125 ETB in 1999 and grew to 925 ETB and 596 ETB in Nebelet and Maikinetal in Werieleke district and Yetimwork et al. reported that average colony price is 667 birr per colony in Eastern Tigray. This was in association with other prices, over all purchasing power of ETB, growing demand while the supply is stagnant or declining. Similar trends are expected as long as beekeepers are not empowered to produce adequate colonies.

Key risks during colony marketing for traders were loss of worker bees and for the purchasers was colony without queen, or infertile queen. Colony marketing is carried out at apiaries and central market places in Tigray region. Thus, colonies are being transported across the region, which can cause several consequences. Moreover, bee colonies are fragile; at the same time they can cause disasters to people and animals if safety rules are not followed during transport. Adverse effects may happen when large population of bee colonies are assembled at markets. Colony markets in Tigray are usually established near crowdedly residing town dwellers that are less familiar to bees [94] (Figure 8).



Figure 8 : Maikinetal colony market center in Werieleke district of Tigray.

Source: Teweldemedhn and Yayneshet [92]

Challenges of beekeeping in Ethiopia

Despite the high potentiality of the country for beekeeping and its extensive practices, beekeeping research conducted in the nation so far did not cover to characterize and document the apicultural resources and associated constraints of the sector for its proper intervention and utilization to specific potential regions. According to HBRC [8], Ayalew [20] and Edessa [21], the major constraints in the beekeeping sub sector are the following: the unpleasant behaviours of bees (aggressiveness, swarming tendency, and absconding behaviours); 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 constraints 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. Honeybee colonies are subject to a number of natural stress inducers and enemies including weather, natural disasters, pests, predators, parasites, and diseases [95] the bees and their products are vulnerable to various diseases, parasites and pests.

Honeybee disease

Like all living animals, honey bees were infected with disease and attacked by parasites and pests endangering their health and life [96,97]. These diseases of honey bees impose serious problem on honey bee production and productivity. The bees are vulnerable to different disease. The existences of two adult honeybee diseases namely *Nosema apis* and *Melipighamoeba mellifica* and their distribution was studied and reported by Gezahegn and Amsalu [98] and Desalegn and Amssalu [99]. The occurrence of brood disease known as Chalk brood in Ethiopia for the first time was reported by Desalegn [100]. The most commonly known honeybee diseases reported to exist in Ethiopia are *Nosema*, *Amoeba* and Chalk brood diseases [98-100].

Prevalence of pests and predators

The prevalence of pests and predators are interesting with life of bees [42]. As reported by Adeday [101], the honeybee pests and predators are ant, insects, spiders, monkeys, snakes and lizards, waxmoth (*Galleria mellonella*), bee-eater birds, bee lice (*Braula coecal*), honey badger (*Mellivora capensis*), monkey and small hive beetles (*Aethina tumida*).

Some major types of honeybee pests and predators, magnitude of their damage, and some possible solutions to minimize the damage they cause on bees and their products were discussed by Desalegn [102]. Moreover, the occurrence of small hive beetle (*Aethinatumida Murray*; *Coleoptera: Nitidulidae*) in honeybees was assessed by Desalegn and Amssalu [103] and recently the effect of ant (*Dorylusfulvus*) on honeybee colony and their products in West and Southwest Shewa zones was examined by Desalegn [100].

Application of chemicals

Application of chemicals such as fungicides, pesticides and herbicides hinder the productivity and production of honey bee colonies. Therefore, focus should be given to those chemicals, which are not harm full to honey bees and the application should not match with flowering seasons to minimize the poisoning effect on honey bee [42]. Investigation indicated that the number

of the honeybee colonies in the country has been declining and consequently the honey and beeswax production as well as export earnings fell down [23]. This is attributed to drought, ever-expanding population pressure and associated vegetation changes and indiscriminate applications of chemicals.

Market accessibility

The major constraint to increasing the welfare of smallholders is their inability to access markets. Enhancing the ability of poor smallholder farmers to reach markets and actively engage in them is one of the most pressing development challenges. Remoteness results in reduced farm-gate prices, returns to labour and capital, and increased input and transaction costs. This, in turn, reduces incentives to participate in economic transactions and results in subsistence rather than market-oriented production systems. Sparsely populated rural areas, and high transport costs are physical barriers to accessing markets; lack of negotiating skills, lack of collective organizations and lack of market information are other impediments to market access [104].

High cost and limited availability of improved technologies

The main challenges that are affecting the promotion and development of honey production and marketing are dependence on traditional and low technology input, poor pre and post-harvest management, inadequate extension services and poor marketing infrastructure. Furthermore, lack of smallholders' access to finance contributes to inhibiting the adoption of improved technologies for honey production. Poor quality, limited supply in the face of high local demand entailing higher domestic prices, coupled with the absence of organized market channels and lack of information have made Ethiopian honey uncompetitive in the international market [105].

According to IVCA [105] an introduction of improved hives and working tools to the rural community are beyond the pockets of farmers and not so easily available even for those who could afford it. Many beekeeping projects that were implemented by government and various organizations to boost honey and beeswax production were not successful mainly due to inadequate management and above all the beekeepers lack of awareness and interest. Likewise, it was not implemented on the bases of identification of potentials, constraints, attitudes and economic level of the communities. So, it is very essential to identify the potential development constraints. Thus, it

requires making efforts to address some of the major problems of beekeeping and to keep it productive in a sustainable way.

Moreover, the equipment's include box hive, casting mould, frame wires, honey extractor, and containers. In some parts of the country reported that the modern hive constructed by some private companies and cooperatives are of poor quality that is with wrong dimensions and made of poor quality timber. As a result, migration rate of honey bees in modern hive is very high [106].

Absence of cultivated bee forage

Cultivation of bee forage is not practiced in the country. This problem results critical honeybee forage scarcity and hindering the production and productivity increment of honeybee in the country. Absence of the bee flora calendar in most parts of the country is another severity to the development of honeybee feeding development strategies. In a review of the state of resource for beekeeping in Ethiopia, and also describes the degradation of natural resource and bee forage in Ethiopia. Ethiopia is suffering from the ecological deterioration of its natural resources and this means the basis of any honey production is threatened.

Absconding and migration behaviour of the bees

Mulisa and Fekadu [107] indicated that Honeybee colonies abandoned their hives at any season of the year for different reasons. Accordingly, reasons for absconding of bee colonies were lack of forage, incidence of pests and predators, during harvesting, sanitation problem, and bad weather condition and bee diseases. The reason why there is high migration could be associated with lack or scarcity of bee forage in the area.

The problems as a challenges in beekeeping sector in different parts of Ethiopia was Shortage of bee forage, application of chemical, pests, predators and disease, marketing, lack of beekeeping equipments, absconding were the major challenges which was identified by Chala et al. in Gomma district of Jimma zone, South-west Ethiopia, Malede et al. [42] in and Around Gondar, Stagey [76] in Lolita and Dawro Zone and Yetimwork et al. in Eastern Tigray Zone, Northern Ethiopia (Table 3 & 4). The most important pests and predators in honey production were ants, wax moth, Honey badger, spider, birds, lizard and snake which challenge beekeeping in Ethiopia which was identified by Yetimwork et al. in Eastern Tigray Zone, Chala et al. in Gomma district of Jimma zone, South-west Ethiopia, in and around Gondar [108-114].

Table3: Shows the major beekeeping challenges which is identified by different researchers in different parts of Ethiopia.

No.	Challenges	Studied Areas	Authors
1.	Bee forage	Eastern Tigray Zone Jimma Zone Gomma district In and Around Gondar Lolita and Dawro Zone	Yetimwork et al., Chala et al., Malede et al., Tsegay et al.

2.	Application of Chemical	Eastern Tigray Zone Jimma Zone Gomma district In and Around Gondar Lolita and Dawro Zone	Yetimwork et al., Chala et al., Malede et al., Tsegay et al.
3.	Pests and Disease	Lolita and Dawro Zone	Malede et al.
4.	Pests and predators	Eastern Tigray Zone Jimma Zone Gomma district In and Around Gondar	Yetimwork et al., Chala et al., Malede et al.
5.	Predators	Lolita and Dawro Zone	Malede et al.
6.	Disease	Jimma Zone Gomma district	Chala et al.
7.	Lack of Knowledge of beekeeper	Jimma Zone Gomma district Lolita and Dawro Zone	Chala et al., Malede et al.
8.	Marketing	Eastern Tigray Zone Jimma Zone Gomma district Lolita and Dawro Zone	Yetimwork et al., Chala et al., Tsegay et al.
9.	Beekeeping equipments	Eastern Tigray Zone Jimma Zone Gomma district Lolita and Dawro Zone	Yetimwork et al., Chala et al., Tsegay et al.
10.	Modern Beehive	Lolita and Dawro Zone	Stagey et al.
11.	Absconding	Eastern Tigray Zone Jimma Zone Gomma district Lolita and Dawro Zone	Yetimwork et al., Chala et al., Tsegay et al.
12.	Swarming	Eastern Tigray Zone Lolita and Dawro Zone	Yetimwork et al., Tsegay et al.
13.	Storage facility/Post-harvest handling	Eastern Tigray Zone Jimma Zone Gomma district	Yetimwork et al., Chala et al.
14.	Poor Extension Service	Jimma Zone Gomma district	Chala et al.
15.	Honeybee Colonies	Eastern Tigray Zone Lolita and Dawro Zone	Yetimwork et al., Tsegay et al.
16.	Death of Colonies	Eastern Tigray Zone Lolita and Dawro Zone	Yetimwork et al., Tsegay et al.
17.	Shortage of Water	Eastern Tigray Zone	Yetimwork et al.
18.	Lack of Rain fall	Jimma Zone Gomma district In and Around Gondar	Chala et al., Malede et al.
19.	Financial Limitation	Lolita and Dawro Zone	Stagey et al.
20.	Apiary Site Limitation	Lolita and Dawro Zone	Stagey et al.
21.	Lack of Labour	Lolita and Dawro Zone	Stagey et al.
22.	Others	In and Around Gondar	Malede et al.

Table 4: Indicates the major pests and predators which are identified by Different Researchers in different parts of Ethiopia.

No.	Pests and Predators (Challenges)	Studied Areas	Authors
1.	Ants	Eastern Tigray Zone Jimma Zone Gomma district In and Around Gondar	Yetimwork et al., Chala et al., Malede et al.
2.	Wax moth	Eastern Tigray Zone Jimma Zone Gomma district In and Around Gondar	Yetimwork et al., Chala et al., Malede et al.
3.	Bee lice	Jimma Zone Gomma district	Chala et al.

4.	Beetles	Jimma Zone Gomma district	Chala et al.
5.	Spiders	Eastern Tigray Zone Jimma Zone Gomma district In and Around Gondar	Yetimwork et al., Chala et al., Malede et al.
6.	Wasps	Jimma Zone Gomma district	Chala et al.
7.	Prey mantis	Jimma Zone Gomma district	Chala et al.
8.	Lizard	Eastern Tigray Zone Jimma Zone Gomma district	Yetimwork et al., Chala et al.
9.	Birds	Eastern Tigray Zone Jimma Zone Gomma district In and Around Gondar	Yetimwork et al., Chala et al., Malede et al.
10.	Honey badger/Hama got / <i>shelemetmat/</i>	Eastern Tigray Zone Jimma Zone Gomma district In and Around Gondar	Yetimwork et al., Chala et al., Malede et al.
11.	Snake	Eastern Tigray Zone Jimma Zone Gomma district In and around Gondar	Yetimwork et al., Chala et al., Malede et al.
12.	Termite	In and around Gondar	Malede et al.

Conclusion and Recommendations

In Ethiopia, beekeeping is an integral part of the life style of the farming communities, and except for a few extreme areas. Beekeeping practice in the country is undertaken by three types of bee hives: traditional, intermediate and modern hives. The opportunities of beekeeping in the country are the presence of indigenous knowledge, skills, keen interest to adopt improved technologies, availability of natural forest with adequate apiculture flora and water resource, and existence of strong bee colonies in the producers. The increments of demand for the bee products, establishments of beekeeping association, the involvement of governmental and non-governmental organizations in the beekeeping activities are also the major opportunities of beekeeping in the country. The local honey market of the country lacks proper structure and legality that is lengthy chain of actors so as it creates a barrier for those honey bee producers from get benefit from the actually markets. So, the beekeepers complain the business as not rewarding and even lacking the market for their product, while the consumers see the ever increasing price of honey as unfair. Honeybee disease, prevalence of pests and predators, application of chemicals, market accessibility, high cost and limited availability of modern beekeeping equipment's and accessories, drought and deforestation of natural vegetation were the major constraints of beekeeping practice in Ethiopia.

Based on the above conclusion the following recommendations forwarded:

a. It is necessary to establish and develop the market channel and information delivery system for bee products of the producers to enhance their benefit.

b. Considering the potential challenges have been listed, it better to supply the improved technologies of beekeeping through using the agricultural extensions or other non-governmental organization by affordable price to exploiting the available opportunities.

c. Further study is needed to identify the actual local honey bee races which found on ground of the country because different reports of different authors that published so far contradict each other.

d. Awareness creation is important for those beekeepers on the honey bee production, profit and easy management system of modern technologies than traditional hives.

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