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Review on Trends of Beekeeping Practices and Economic Benefit the Sector in Ethiopia

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Abstract
The review summarizes on past and current trends of beekeeping practices and economic benefit the sector in Ethiopia. Mainly five types of honeybee races exist across different agro-ecological area based on adaptive behavior, which are characterized under three production system namely, traditional (forest and backyard), transitional (intermediate) and modern (frame type hive). All regions of Ethiopia produces honey, but their production potential is various based on suitability of the regions for beekeeping i.e. density of bee's forages across the region is different. About 95.89% of Ethiopia beehive population covered by traditional beekeeping practices while remaining 4.11% consists of transitional and modern hive types. In Ethiopia, beekeeping product like honey is below expected compared to potential because of dominated by traditional production system, it is lacks of improved technologies, skillful human power, expensive of equipment for translated to intermediate as well as frame type hive under rural and per- urban production activities. Economic benefit of beekeeping has been directly contributes to the incomes of households and the economy of the nation such as honey, beeswax, queen and bee colonies, and indirectly products such as pollen, royal jelly, bee venom, and propolis in cosmetics and medicine. From total volume of honey production in country, only about 10% of the honey produced in the country is consumed by the beekeeping households while the remaining 90% is sold for income generation and of this amount, it is estimated that 80% is used for tej brewing. Economic contribution and per-capital consumption of beekeeping product still unbalanced proportional to much amount honeybee population in country due to technical and socio-economic constraint. Therefore, enhance use of beekeeping sector provide attention for intermediate as well as frame type production system.
Keywords: beekeeping, races, economic, honeybee, honey, consumption
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1. Introduction

Agriculture plays a key role in the country. About 12 million smallholder farming households produce 95% of all agricultural goods (FAO, 2020). In 2000, the agricultural sector employed 76.4% of the working population gradually declining to 66.2% (UNDP 2019). This decline is accompanied by climate change (droughts), rural exodus and the change in policies and livelihood. Livestock is one of the component agricultural sector which is plays an important role in providing export commodities, such as live animals, hides and skins to earn foreign exchanges to the country and supplying food (CSA, 2021). Of the livestock sector, beekeeping subsector has been practiced in Ethiopia for over 5,000 years ago from 3,500 to 3,000 BC during the Queen of Sheba. Likewise, beekeeping practices at 13th century famously for King Lalibela. Indicated that a long standing practice in Ethiopia, which is a substantial contribution to rural income generation by leading honey producer in Africa and one of the top ten worldwide (Demisew, 2016).

Ethiopia is one of the African countries with a high potential honey and wax production were 39246.15 ton and 5,339 ton (FAOSTAT, 2020), respectively. According to Kenesa (2018) was also reported ninth in honey and third for beeswax production almost all regions. Ethiopia is a leading to honey producers in Africa around 24% of total production in the continent and one of the ten largest honey producing countries by contributing 2.4% of total honey production in the world (Addisu, 2019). The country is home to a rich flora and has Africa's greatest honeybee population due to its unique ecological and climatic circumstances (Sahle *et al.,* 2018).

Beekeeping sector is one of the non-farm business activities under taken by farmers and landless people, which plays a vital economic role in human nutrition and supplies food security, income in households and ecosystem services (Zkiros, 2019). Presently, traditional, transitional and modern hive production systems are used in beekeeping sector. From the total hive population, 95.89% covered for traditional beekeeping practices while the remain 4.11% consists of transitional and modern hive type in country (CSA,2021).Therefore, the aim of this review to familiarize growth status, productive performances, races distribution and benefit of Ethiopian beekeeping practices.

2. Distribution and Classification of Honeybee Species

Since the late 1700s about 9 species of honeybees have been recognized (Roubik, 1989), which includes: Apis

andreniformis, Apis cerana, Apis cerana indica, Apis dorsata, Apis dorsata binghami, Apis florea, Apis laboriosa, Apis mellifera and Apis vechti. Among the following, Apis cerana/indica, Apis dorsata, Apis florea and Apis mellifera are commonly-recognized major honeybee species of Apis (Bradbear, 2003). Only Apis cerana and Apis mellifera are kept commercially by man. Behavioral limitations of the dwarf and giant honeybees, particularly their practice of open-air nesting, prevents their being kept in man-made hives for reasonably long periods, while hiving colonies in specially-constructed containers is essential in that it enables the colonies to be manipulated (FAO, 1990).

The most widely used honeybees are European races of Apis mellifera, a species of honeybee also indigenous to Africa and the Middle East. Apis mellifera is not indigenous to the Americas, Australia, New Zealand or the Pacific islands, but during the last four centuries. European races of bees have been introduced to these regions (Bradbear, 2003). There are five distinct races of honeybees in Ethiopia and statistically separable morph clusters of bee occupying ecologically different area namely; Apis millifera jementica is found in the low land areas of eastern Ethiopia, A. m. litorea exists in southwest low lands, A. m. adansanii exists in south and western part of the country, A. m. monticola exists in Southeast Mountain of Bale-Dinsho, northern high and mountains part of the country, and A. m. abyssinica exists in highland area of central, west and southern parts of the country (Amsalu *et al*., 2004). They are very adapted and can live in tropical climates ranging from semi desert to tropical rain forests.

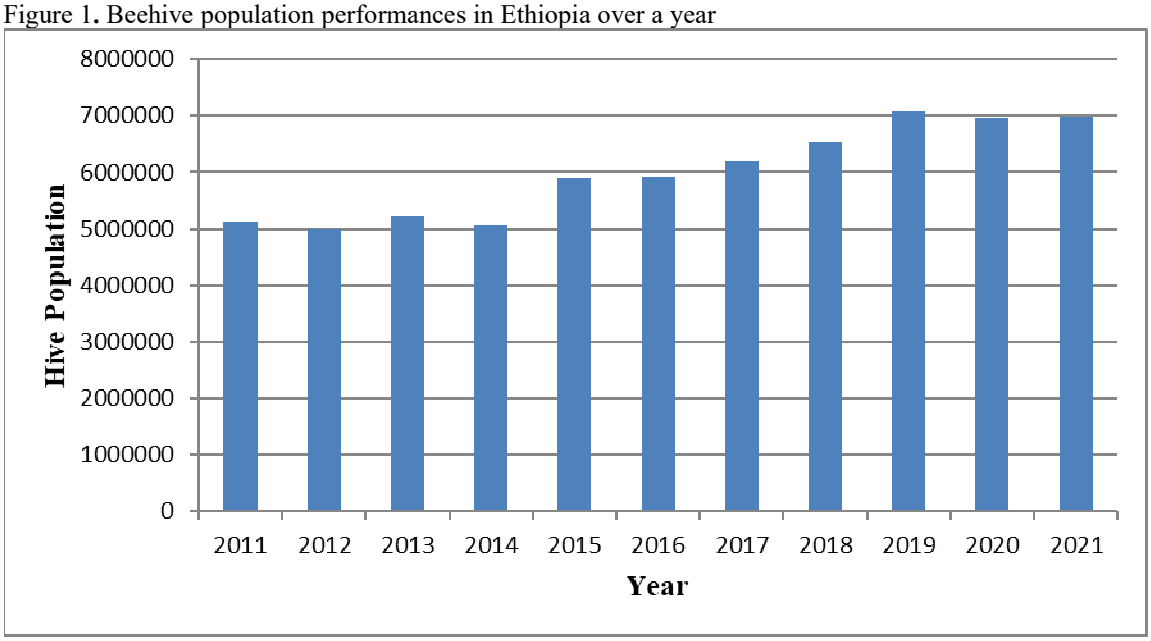
3. Ethiopia Beehive Population

Beekeeping, also called apiculture, is management of honey bee colonies for pollination of crops, and honey and other products (Bradbear, 2009). About 95.89% of the Ethiopia beehive population covers with traditional hive, while remaining 4.11% of consists of transitional hive (1.47%) and modern hive (2.63%) (CSA, 2021). Similarly, dominate honey production practices use traditional beehive (Benyam, 2021). The total number of hive is estimated around 6.99 million to be found in rural and pastoral sedentary area of the country.

The trends of hive population growth from 2015 -2019 over a year almost increased due to attention provision from regional, federal and local government and nongovernmental organizations, yearly flowering and variety floral availability, some small scale farmers highly experienced in apiculture farming, market access and high demand of apicultural products at nationally and international level, while the hive growth from 2019-2021 slightly decline because of pests and predators, pesticide threat and shortage of bee forage.

The beehive population distribution was high in Oromia and Amhara followed by South Nation and National People of Ethiopia (SNNP) and Tigray. According to CSA (2021) Oromia, Amhara, South Nation and National People of Ethiopia and Tigray region has about 53.96%, 17.36%, 19.75% and 4.19% of the total hive population at country level, respectively. Over all the population of beehive trends currently increased over the year 5.1 million (2011) to 6.99 million (2021) indicated that, government calling/provide attention an alternative income generating options for apiculture production sector under rural family, private enterprise and research center due to starts low initial investment.

Figure 1**.** Beehive population performances in Ethiopia over a year



Sources (CSA, 2011-2021)

4. Beekeeping Practices in Ethiopia

There are three production systems of bee products are underway in Ethiopia, namely, traditional (forest and backyard), intermediate (transitional) and modern (frame beehive) system. The critical classification of each production system is based on employed technologies and probable productivity of each system (AAU, 2015). The current trend and status of beekeeping practices dominated by traditional (forest and backyard) followed by modern (frame type hive) and intimidate (transitional) (CSA, 2021), indicated that in Table (1).

Table 1. Beehive population growth over a year under various hive type

Year	Hive		
	Traditional	Transitional	Modern
2011	4, 944380(96.38%)	41,684(0.81%)	144,258(2.81%)
2012	4, 772537(95.57%)	81,596(1.63%)	139,682(2.8%)
2013	4, 996933(95.96%)	54,991(1.06%)	155,376(2.98%)
2014	4, 768103(94.37%)	47,749(0.94%)	236,446(4.67%)
2015	5, 663492(96.23%)	71,900(1.22%)	149,871(2.55%)
2016	5, 706959(96.46%)	70,753(1.2%)	138,388(2.34%)
2017	5, 902624(95.37%)	80,832(1.31%)	205,873(3.33%)
2018	6, 327197(96.98%)	69,399(1.06%)	127,373(1.95%)
2019	6, 794424(96.03%)	80,164(1.13%)	200,600(2.84%)
2020	6, 680885(96.02%)	94,159(1.35%)	182,960(2.63%)
2021	6, 699219(95.89%)	102,957(1.47%)	183,924(2.63%)

Source (CSA, 2011-2021)

4.1. Traditional beekeeping practices

Traditional beekeeping is the major and oldest type of beekeeping practiced in Ethiopia. It is practiced by traditionally constructed hives which are mostly cylindrical in shape (about 1-1.5 meter in length and 30-50-centimeter width) and single chamber fixed comb (MoARD, 2007). This type of hive can be made from wood, mud/ clay. It has no internal structures; frames were provided for the bees; the bees created their own honeycomb within the hives. The comb is often cross-attached and cannot be moved without destroying it (Teklu, 2017). The traditional forest honey production which is practiced in south and southwest areas of Ethiopia where there is high vegetation cover and high honey bee colonies (Fikru, 2015). In this case the beekeepers hang several traditional hives on trees in the dense forest mostly far away from their settlement areas.

Honey hunting is common in this part of the country because of the existence of high population of wild bee colonies which make honey in hollow trees and caves. Other method is traditional backyard system which is undertaken in safeguarded area for honeybees mostly at homestead (Hackett, 2004). This system of beekeeping is mainly practiced in the central, eastern and northern parts of the country where there is relatively low forest coverage (EIAR, 2017).

A honeybee productivity performance directly depends on population of hive growth, feed accessibility and harvesting method. Amount of honey was harvested 9kg/hive/season for (Gebretsadik *et. al*., 2016), 8.62kg/hive/harvest season was notified (Getachew, 2018) and 13.6kg/hive/season was obtained from this type of hive (Benyam *et al*., 2021). Likewise, annual honey production per traditional beehive was scored 9.66kg/hive with range from 2 to 17kg (Gebrehaweria *et al*., 2018). The variation might be due to increment of hive population and harvested method. In Ethiopia, annual honey production yield from this type almost all similar to African country like Sudan, it was obtained 13kg/hive/season (Elzaki and Tian, 2020).

From the year 2011, the number of traditional hives found in the country was 4,944,380 and total production honey from this type of hive was 51,023.303 tons with an average honey production 10.32kg/hive/season. Since, in year 2021 it is estimated to be 6,699,219 hives and average honey production of 124,791.3 tons with average honey volume 18.63kg/hive/season (CSA, 2021). Currently, more than 95% of beekeepers use traditional hive management practices in Ethiopia, which affect honey yield. The factors responsible for low production of honey are ants, pests and predators, beekeeping equipments, absconding, pesticides and herbicides, death of colony and swarming are the most important constraints (Haftu and Yoseph, 2018).

Figure 2: Traditional hive beekeeping under shed and hive on the tree.

Sources: Serda *et al* (2015) , Tessega (2009)

4.2. Transitional System

A transitional system is a system between traditional and frame hive or modern system (CSA, 2021). Transitional system had started in Ethiopia in the year of 1976 and the types of beehives used are: Kenya top-bar beehives, Tanzania top-bar beehive, Mud-block beehives and Ethio-ribrab hive. But Ethio-ribrab is commonly used in many parts of the country (WB, 2015). 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 (HBRC, 2004). Beekeeping product like honey yield various based on production type and management activities.

According to Benyam *et al* (2021) and Getachew (2018) reported 16kg/hive/season and 13.13kg/hive honey were harvested for transitional production system, respectively. Likewise, 19.807kg/hive/season was obtained the same production practices (Gebretsadik *et. al*., 2016). The total honey production from this type of hive was 387.450 tons with an average production of 9.3kg/beehive/season the years of 2011 and 920.058 tons honey produced with an average production 8.9kg/hive/season the year of 2021. Currently, total volume of honey yield trend increased by 532.608 tons over ten years ago (CSA, 2021), the increment of product might be due to growth of transitional hive population as compared to last decay in country. But, average production yield kg/hive/season was not significant different between 2011 and 2021.

Figure 3: Transitional hive beekeeping

Sources: Demisew (2016)

4.3. Modern/Frame Hive System

The frame hive beekeeping methods aim to obtain the maximum honey crop, without harming bees (Bradbear, 2001). This is the most intensive system, which needs comparatively expensive inputs and relatively skilled manpower to manage the colonies successfully. The hives can generate greater quantities of better quality honey, which will command higher prices. Ethiopia starts frame beehives practices in 1970 (HBRC, 1997) such as Zandar, Langstroth, Dadant, Modified Zandar, and Foam beehives and the most commonly used frame beehive type in Ethiopia is Zandar type.

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. 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. From this type of hive, annual productivity in terms of quantity and quality very high as compared to traditional and transitional production system.

Modern beehive yield around 20kg/hive reported by Beyene *et al* (2016). According to Gebretsadik *et al* (2016) evidence 22.035kg/hive/year was recorded for improved honeybee production system. Recently also, similar amount of honey yield 22.kg/hive/year was obtained (Benyam *et al*., 2021). Total amount honey production from this type hive was 2,264.608 tons with average production 15.7kg/hive/harvest season at 2011 year and currently, after ten years ago at 2021 year the total volume of honey production for this type of hive was estimated 3,589.962 tons with average production of honey 19.52kg/hive/season (CSA, 2021).

Figure 4: Modern/movable frame hives beekeeping

Sources: Tessega (2009)

5. Economic Benefit of Beekeeping Practices

The beekeeping subsector has been directly and indirectly contributes to the incomes of households and the economy of the nation such as honey, beeswax, queen and bee colonies, and other products such as pollen, royal jelly, bee venom, and propolis in cosmetics and medicine (Ajabush, 2018). Development of the Beekeeping practices could significantly enhance crop production, food security, maintenance of plant diversity and ecosystem stability (AIS, 2018). Likewise, beekeepers of the country sell the largest proportion of their honey during harvest at low price mainly to meet their demand for cash to pay taxes, debts and other social obligation.

In Ethiopian, only about 10% of the honey produced in the country is consumed by the beekeeping households while the remaining 90% is sold for income generation and of this amount, it is estimated that 80% is used for tej brewing (Sebsib and Yibrah, 2018). Since this local brew doesn't require high quality honey, crude honey is the major type of honey produced in Ethiopia. The issue of quality has therefore never become a priority among Ethiopian producers and that has become one of the problems for the sector (Paulos, 2011).

Economic role, and their contribution to pollination service in agriculture crops is around 0.815 billion dollars in Ethiopia **(Zekiros, 2019)**. According to FAOSTAT (2021) the amount of honey produced when it translated into per capital honey consumption using currently more than 117 million population, it is estimated less than 0.53kg/head which is very low as compared to potential. In country, per capita honey consumption between 2011 to 2019 varies 0.39 to 0.46 which implies there is no significant growth parallel to population growth. Similarly, African countries which are honeybee cultivated like Kenya, Morocco and South Africa also have a very small annual consumption rate of 0.21, 0.18, and 0.06 kg per capita (FAOSTAT, 2019), respectively. The consumption of crude honey kg/capital/year in Ethiopia is high significant compared to above listed African

countries as indicated in figures (6) and also average honey consumption related to human population show in figure(5).

Figure 5: Trend of honey consumption with human population growth in Ethiopia

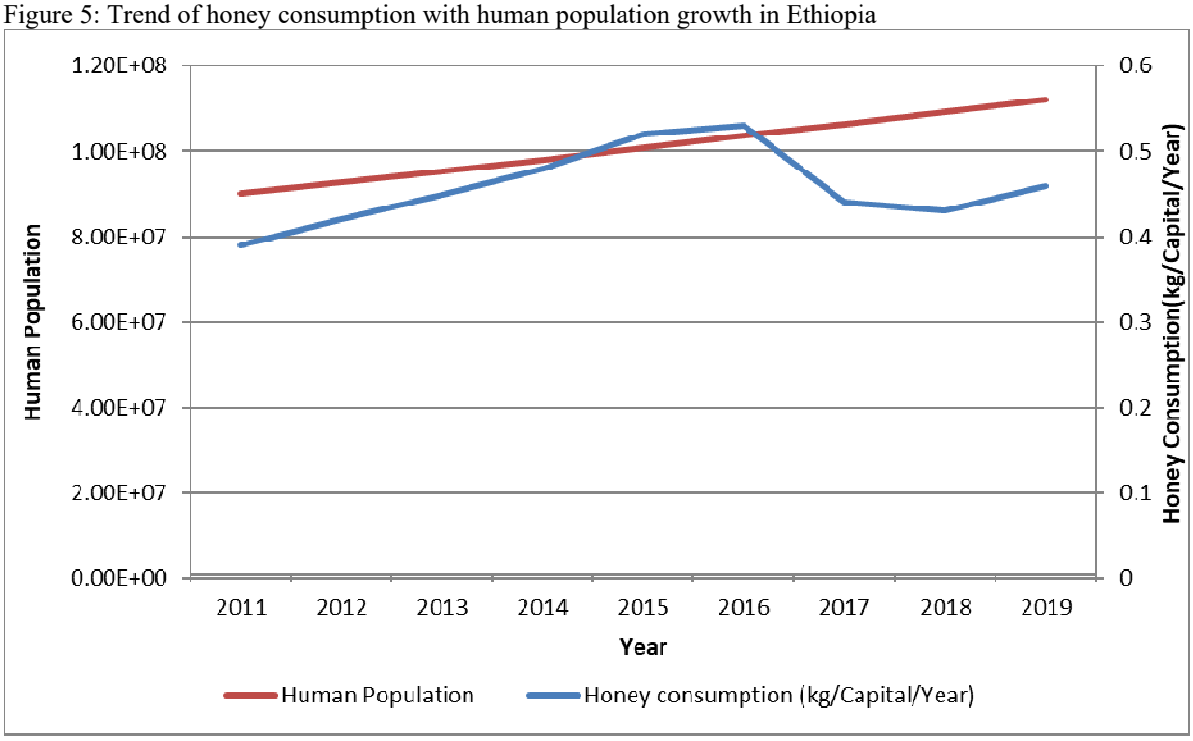
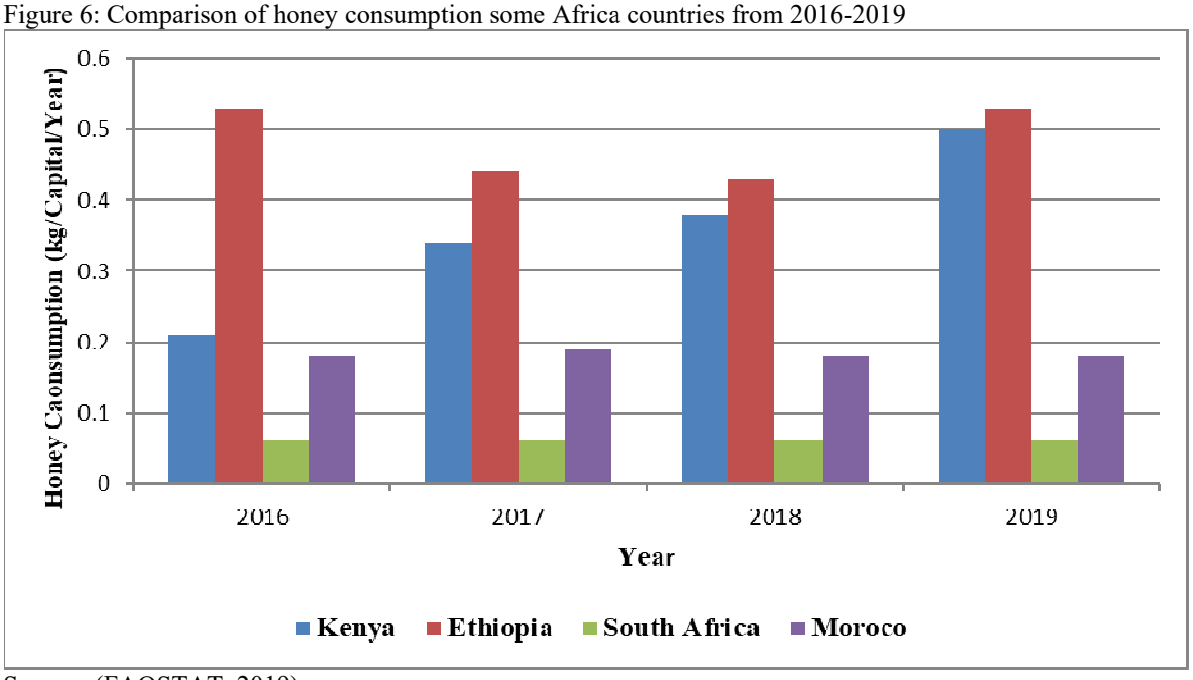


Figure 6: Comparison of honey consumption some Africa countries from 2016-2019



Sources (FAOSTAT, 2019)

6. Conclusion and Recommendation

The economic benefit of beekeeping production sector is below expected compared to huge beehive population because of technical and socio-economic constraints. Beekeeping is categorizing under three production system namely: traditional (forest and backyard), transitional (intermediate) and modern (frame type hive), and the most dominated is traditional beekeeping practices in country. Economic benefit of beekeeping has been directly contributes to the incomes of households, supplying food and the economy of the nation and indirectly for cosmetics and medicinal industries. From a year 2011 to 2021, the trends of total beehive population, honey yield and honey consumption in Ethiopia shows as increased for 5.1 to 6.99 million, 53,675.361 to 129,301.078

tons and 0.39 to 0.46 kg/capital/year, respectively. In country, races and honeybee production practices widely distributed in almost all over the country part based on suitable agro-ecological area and reared by rural family, some private beekeeping producer and government organization. Despite country's has suitable environment for rearing of honeybee, the productivity is low, which are poor/traditional honey harvesting, diseases, pests, predators, agrochemicals and deforestation are major constrains. Beside this, to enhance beekeeping sector in Ethiopia, beekeepers should be made aware regarding proper harvesting method and plant more tree to avoid of destruction of colony death and devastation of deforestation, respectively. Research center, government and non-government organization should be providing attention for transitional and modern beekeeping practices to overcome related quality and quantity problem in country.

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