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Review of Economical and Ecological Importance of Bee and Bee Products in Ethiopia

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ABSTRACT

This review attempted to assess the economical and ecological impact of bee and bee products in Ethiopia in order to support discussion of policy issues currently being considered. The beekeeping subsector has been directly and indirectly contributes to the incomes of households and the economy of the nation. The direct contribution of bee keeping includes the value of the outputs produced such as honey, beeswax, queen and bee colonies, and other products such as pollen, royal jelly, bee venom, and propolis in cosmetics and medicine. It also provides an employment opportunity in the sector. And it has a significant role in diversifying the income of subsistence Ethiopian smallholder farmer's mainly the small land holders and landless. Beekeeping does not consume large amounts of land – a backyard is sufficient – so it releases people from land-demanding activities and reduces pressure on land. As beekeeping requires relatively lower levels of investment and is a non-physically demanding work, it is also favorable for women and landless youth. So if such like off-farm activity be encouraged through special attention of women and youth, one step forwarded in terms of the country's plan of Agricultural Growth Program Phase two (AGPII) which Emphasize greater participation of women and young people. Ethiopia is endowed with abundant honey and wax that can be exported. In the first GTP-I period, honey and wax processing and export contributed 26.77 million USD to the economy while in the second GTP period more than 75 million USD is targeted. However, most of them simply consumed locally in uneconomical manner due to lack of processing technology, packaging and transportation.

Keywords: *Economical, Ecological, Beekeeping;*

INTRODUCTION

Ethiopia is recognized as one of the poorest and most food-insecure countries in the world. It is primarily a net exporter of agricultural products, with 85 percent of its population employed in agriculture. Ethiopian agriculture contributes more than 45 percent to the nation's gross domestic product (GDP) and significantly affects the country's export trade (USAID, AGP-AMDe, 2012). Resent reported point out that agriculture share in Ethiopian economy: 40.9% of the GDP (World Bank, 2015) is generated by agriculture and society 72.7% of the population depends on it for its livelihood (World Bank, 2013).As Demisew (2016) had presented to 5th ApiExpo Africa, the country's economy dependent on agriculture which accounts 90% of export commodity.

It has been widely acknowledged that the Ethiopian agricultural sector has the potential to drive the country's economic development, which could translate into a reduction in poverty and could increase the food security of its people (USAID, 2012).

Apiculture is a promising off-farm enterprise, which directly and indirectly contributes to smallholder's income in particular and nation's economy in general.Beekeeping is a long standing practice in Ethiopia and it accounts 1.3% of agricultural GDP (Demisew, 2016).It is believed that the country is known for its tremendous variation of agro-climatic conditions and biodiversity which favored the existence of diversified honeybee flora and huge number of honeybee colonies (Adgaba, 2007).Regional states of Ethiopia like SNNP, Gambella, Benshangul Gumz, Amhara, Tigry and Oromia have big apicultural potential having of about 10 million honeybee colonies (Demisew, 2016). Useful small-scale efforts to encourage beekeeping interventions can be found throughout the world, helping people to strengthen livelihoods and ensuring maintenance of habitat and biodiversity; strengthening livelihoods means helping people to become less vulnerable to

poverty. Hence sustainable beekeeping seeks to address the importance of beekeeping in terms of its ecological, social and economic benefits. Within ecological dimensions, bees are a source of pollinators that help increase crop yields. The economic benefits lie within bee products such as honey, royal jelly, propolis, bee pollen and beeswax that are highly valuable and have high market prices.There is a need for reviewing economic impact of beekeeping activity in the country for better understanding of the status of production of honey, income generating power of the activity and marketing of honey. This review will help for generating the topic for improvement on the production and encouraging the activity in general as national or local level.

Commodity Background

Beekeeping is a very long-standing and deep-rooted household activity for rural societies in Ethiopia. It appears as old as the history of the country and it is integral part of the life style of the community (Giday and Kibrom, 2010). Beekeeping by its nature doesn't need huge investment (financial asset), large size of land and complicated technical knowledge. Beekeeping requires little land and therefore is an ideal activity for small scale resource-poor farmers (Jinanus and Tamiru, 2016**).** Beekeeping gives local people an economic incentive for the retention of natural habitats such as forests and therefore is an ideal activity in any forest conservation. However, the financial outcome will depend on many factors such as skill and experience of the practitioner; the market available to the beekeepers as well as botanical resources available; climate and other factors (Nicola, 2009). Ethiopia is one of the top 10 producers of honey in the world, and it is the largest one in Africa (USAID, 2012). According to the CSA (2011), annual total production honey account for 53000 metric tons. The production shows an increment. For instance, in the year of (2001-2015), Ethiopia's honey production increases from 28,000 tons to 54,000 tons (Demisew, 2016).The honey produced in Ethiopia is expected to become a major commodity for acquiring foreign currency to improve the Ethiopian economy. The country already earns an average of 420 million ETB annually from the sale of honey (Gidey & Kibrom, 2010).

Production System and Productivity

Honey is produced in almost all parts of Ethiopia, with distinctive types of honey coming from different regions. Most of honey produced within the country (95.57% of total honey production) comes from traditional beehives that generally deliver low yields (5-7kg/beehive) and low quality of honey (Mikhail *et al*., 2013).Reports of (CSA 2006; 2008; 2009) indicate that colonies in traditional beehives account for about 97% of the total hived honeybee population. Beekeeping in south west part of the country entirely based on traditional practices which accounts for more than 99% while intermediate and modern hives are less used (Awraris *et al*., 2012). However it grows to be reduced to 90% as reported by Demisew (2016). The outer notified that three types of beekeeping practices handled in the country. From those traditional accounts about 90% with the yield ranges from 5 to 9 kg honey (Demisew, 2016). The productivity of traditional hives is extremely low and the average yield is only about 5–8kg/per colony/per annum (MoARD, 2007) while production from improved hives (including transitional hives) reaches levels of 18-30 kg per year(Paulos, 2011). Modern honey production that includes the use of modern style beehives is still in Ethiopia at a very low level (Mikhail*et al.,* 2013). Out of 4,993,815 beehives present in Ethiopia in year 2011, only 139,682 were modern beehives (CSA, 2012).

This widespread use of traditional technology in honey production results in relatively low honey supply and poor quality of honey harvested when compared to the potential honey yields and quality gains associated with modern beehives. Modern beehive yields around 20kg of higher quality honey (Mikhail*et al.,* 2013).Serda *et al.* (2015) reported from improved hive, on average of 15-20 kg even more is possible in Haramaya district of eastern Ethiopia. Similarly, yields about 21.02 kg/hive reported by Beyene *et al*. (2015) in mid Rift Valley of Ethiopia. At south of Ethiopia Getachew e*t al.* (2015) give evidence as honey yield (30.09 kg/hive/annum) was obtained from improved frame hive. Recently, Demisew (2016) had reported, honey from transitional beehive ranges from 9 to 40 kg/year crude honey/colony. Similar author had notified that as Box (frame) hive national average 33kg/hive/annum and it could be harvested up to 50-80kg/hive/yr using improved techniques.

The overall average annual honey productivity analysis undertaken in south west Ethiopia clearly revealed both improved frame hive and Ethio-ribrab hive types were significantly ($p < 0.0001$) higher than Kenya Top Bar Hive and traditional log hive types (Table1).

However, with these existing practices the annual honey production in the country is increasing and has reached quite higher than 53 thousand tons in 2012 (CSA, 2012).So, focusing on beekeepers skill, knowledge and capacity development through establishing strong research capacity and capability to improve efficiency in generating suitable technologies may get to the optimum production point followed by improve food secure.

Table1. *Presentation of honey and beeswax productivity of beehive types (Mean ± SD)*

Beehive types	Honey yield (kg/hive/annum	Honey productivity(kg/hive/season		Bees wax
		Major season	Minor season	
Improved frame hive	30.09a***± 2.69	18.5a*** ± 0.62	11.59a*± 2.98	0.3a ± 0.03
KTB hive	15.71b***± 2.22	9.33b ± 0.74	6.38ab± 1.92	1.57b** ± 0.22
Ethio-ribrab	9.22a± 2.69	20.0a*** ± 1.32	9.22ab± 2.36	2.92c*** ± 0.27
Traditional	15.36b± 0.86	9.83b ± 0.44	5.52b± 0.44	1.54b** ± 0.09

Different letters in each column indicate significant differences between treatment means.

** p < 0.05, ** p < 0.001, *** p<0.0001*

Source: *Getachew et al. (2015)*

Role of Bee keeping in Household Income and National Economy

Three types of national economic impacts are associated with the apicultural sector of beekeeping activity: direct and indirect economic effects. The direct economic impacts involve income (output) and employment contributions directly affiliated with apicultural operations in the country. Marketing of the product (Purchases from beekeepers/small scale farmers and resell to national and global market by adding required value) support additional levels of employment and wages(indirect effects).The total impact is the sum of direct and indirect effects.

Income Generating Power of Bee keeping Activity

In many regions of the country, beekeeping is considered as one of the income-generating activities for resource-poor farmers including women, youth and the unemployed sectors of the community (Gezahegn, 2001). Because agriculture is the main income-generating activity in Ethiopia, the lack of off-farm jobs increases pressure on land and hinders poverty reduction. Land holdings in the country are already low, averaging only 1.06 ha per household (CSA, 2015). By 2030, the Ethiopian population is estimated to increase from currently 99 million (World Bank, 2015) to 138 million people (UN, 2015). This will tighten the distribution of land. To tackle problems of land scarcity, off-farm jobs are necessary to support rural income generation. Beekeeping is a pro-poor and off-farm income generating activity (Mengistu, 2011).

For many farmers, beekeeping is a very lucrative business and a high proportion of their annual income is earned from beekeeping. Since honey is a cash crop, more than 95 % of the product is brought to market. Some beekeepers are able to earn 5,000 to 10,000 birr annually from honey selling only. In general beekeepers of the country are estimated to earn about ETB 360-480 (US$ 45-60) million annually from the total annual honey production (https:// www. researchgate.net, 2017).

Honey

Honey has been highly prized for its flavor, as well as nutritional and medicinal valuesby the local communities. In areas deficient in other sugar sources, it is highly sought after for its sweetness and energy-giving properties. According to information compiled in the National Apiculture Research and Development Strategy Program (ARSD, 2000), Ethiopia ranks 10th and 4th in the world in honey and wax production, respectively. The current annual honey production is estimated at approximately 24 thousand tones, accounting for about 24 and 2% of the total Africa and world honey production, respectively.

Beeswax

Natural honey is not the only product associated with this activity. Beeswax, propolis, royal jelly and honey comb are all by products of bee keeping. Beeswax is used in the production of candles and cosmetics. Due to the high value of especially beeswax, but also the other by-products, on the international markets it is crucial to recognize these as important sources of income for bee keepers in Ethiopia. The annual production of wax in Ethiopia is estimated at 3200 t (MoARD, 2005). But it is estimated that about 25% of the total beeswax production is ‘lost’ due to selling of honey with

the wax (not extracted).This includes the loss of beeswax that is sold to consumers with the crude honey. The above estimate is without considering much of the beeswax produced in remote areas where it is usually wasted without harvest. However, with all this wastages Ethiopia still stands 4th in the world in wax production next to China, Mexico and Turkey (EEPD, 2006).From the total amount of beeswax produced annually in Ethiopia, only lessthan 10% of it is used for export [EEPA, 2012]. The remaining large proportion of it is believed to be wasted at different levels. These may be comes from lack of awareness of the importance of beeswax, skill to collect, process and market beeswax are among many.

Employment

It not only produces a nutritious and high-value food product which generates income, but it also creates employment possibilities along the honey value chain (input provision, production, processing, and marketing). Beekeeping does not consume large amounts of land – a backyard is sufficient – so it releases people from land-demanding activities and reduces pressure on land (Mengistu, 2011). As beekeeping requires relatively lower levels of investment and is a non-physically demanding work, it is also favorable for women and landless youth. So if such like off-farm activity be encouraged through special attention of women and youth, one step forwarded in terms of the country's plan of Agricultural Growth Program Phase two(AGPII) which Emphasize greater participation of women and young people.

Honey production and beekeeping are environmentally friendly practices and relatively easy to engage in. Recently, the Ethiopian government is intensively working in organizing jobless urban and landless rural youth and women to involve in them in bee equipment production and beekeeping activities. A significant number of people are currently engaged in honey and beeswax collection, *"tej"* (honey wine) making, honey and beeswax processing and marketing (MoARD, 2007). These non farming business activities have the potential to provide a wide range of economic contributions. Two main economic values could be derived from engaging in beekeeping: income generation from marketing honey and its by-products (beeswax, royal jelly, pollen, propolis, bee colonies, and bee venom) and the creation of non-gender-biased employment opportunities.One key discovery has been the transformative power of new technologies. In the past, few women became beekeepers because traditional hives are usually placed high up in trees. But modern hives set on the ground make it far easier for them.

Traditional beehives mounted on trees in forest areas are usually managed by men, but transitional and framed beehives are located in the backyard, providing women with the opportunity to combine household activities with a remunerative beekeeping enterprise, increasing the number of females engaged in beekeeping activities by 160% (Paulos, 2011).

Figure1. *Modern hive managed by female*

Source: *Paulos (2011)*

Even though the country's honey production increases by about 90 %, several factors impede beekeeping in Ethiopia and it remains a largely untapped industry (ILRI and MoA, 2013). Among others, lack of modern production techniques, constraints in market access, missing financial support, and a low degree of institutionalization continue to be significant roadblocks (Mengistu, 2011). For example, Ethiopian beekeepers still largely rely on

traditional production techniques, like beehives in treetops, which yield only around 6 kilograms per harvest. Transitional and modern hives, on the other hand, can yield up to 20 kilograms and are managed at ground level (Tamrat, 2015). So, further improvement of utilizing modern bee technology should be due attention. Beekeeping is still operating in the old traditional ways implying the need for modernization. Low productivity and poor quality of bee products from traditional hives are the major economic impediments for rural beekeepers (Nuru, 1999)

Honey and Beeswax Marketing

In Ethiopia high portion of honey is sold for income generation. According to the study by Awraris *et al*. (2012) on honey production conducted in southern part of Ethiopia, honey is used as a source of cash income and home consumption. About 97% of the respondents sell their produce. The domestic honey market starts at the smallholder bee keepers level, who majorly sell crude honey to collectors in the nearest town/village markets (Asefa, 2009). Therefore, the producers are price takers. However others sell to different costumers. According to Taye and Marco (2014) conducted on Assessment of constraints and opportunities of honey production in Wonchi district South West Shewa Zone, Ethiopia, producers mostly sell their honey to local honey traders (33%), beekeepers association (27.8%), local honey consumers (22%), and to tourists (17.2%). 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. As usual of other agricultural products, most of beekeepers sell their honey immediately after harvest time with fewer prices. According to the study by (Beyene and David, 2007), 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. Similar authors notified that, the price of honey is also governed by different factors such as distance from market (28%), quality of honey (25%), consumers' preference (20%),color of honey (15%,) , and test of honey (12%). Honey price is differing by region and type of honey. The most expensive is Eastern Tigray's white honey, where the current retail price is ETB 170.00/kg. Lower retail prices (of around ETB 60–90.00/kg) are observed for other varieties of white honey, depending on the area and the honey's characteristics. The retail prices for yellow honey are around ETB 50–60.00/kg, while the least expensive red honey is sold at a price of around ETB 45–50/kg (USAID, 2012).

Beeswax has good domestic market in Ethiopia. The smallholding beekeepers are the primary sources of beeswax in Ethiopia who sell the majority of crude honey to the tejbrewers; hence most of marketable crude beeswax comes from them as a byproduct of the beverage (MoARD, 2003).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. However, the intensity of the improved beekeeping 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 (Gemechis, 2014). Generally, the beeswax price at the domestic market is mostly higher than the international beeswax price which makes beeswax export less profitable in Ethiopia.

Despite, the market demand for beeswax both in the domestic and international trade is very high and is one of the important exportable agricultural commodities [Nuru, A. 2007] and the annual production of beeswax is expected to be more than 5000 tones, challenges at the beekeepers' level that in some potential areas that they don't have awareness of the importance of beeswax, skill to collect, process and market beeswax are among many. Moreover, the existing beeswax processing technologies are very limited and traditional of very low efficiency

Ethiopian Honey Export

In 2013, FAO estimated that Africa accounted for roughly 9% of global honey production (155,789 t), representing a 10% increase since 2000, which has since increased to 13% by 2016, states non-profit organization ApiTrade Africa. Ethiopia (50,000 t), Tanzania (30,000 t), Angola (23,300 t) and Central African Republic

(16,200 t) are amongst the world's top 20 producing countries. Interestingly, Ethiopia is also the fourth largest beeswax producer in the world. Honey exports throughout the continent grew sharply by 613% from 2000 to 2013, which represented an increase to 3,195 t, worth €8.9 million. Whilst overall production is low in Egypt, most of it is exported (1,202 t in 2013), ahead of Ethiopia, which exported 904 t in 2013, up from just a single tone in 2000 (http://spore.cta.int/en/trade/honey-exports-take-off-in-africa.html, 2017).

In the Second Growth and Transformation Plan (GTP-II), the government of Ethiopia gives more emphasis on enhancing the nation's earning capacity through encouraging export. Even though there are several agricultural products which can be exported, most of them simply consumed locally in uneconomical manner due to lack of processing technology, packaging and transportation. Among these, Ethiopia is endowed with abundant honey and wax that can be exported (*Abebe, 2016)*. Similar author reported that in the first GTP-I period, honey and wax processing and export contributed 26.77 million USD to the economy while in the second GTP period more than 75 million USD is targeted. Even though there are slight changes in the export performance of the sector year after year, the country is not benefiting from the sector as per its potential. The major challenges crippling the sector include: poor stakeholder linkage, distorted market, poor quality of the products, insufficient laboratory facilities, poor incentive and limited facilitation. According to several studies by different bodies, due to knowledge gap, the nation is not benefiting from this huge source. In order to solve the problems and be competent in the global market, encouraging more research work so as to benefit small holder farmers should be undertaken.

Honey Bee and Environment

Honey bees, in addition to the economically important they produce, are valuable pollinators of both agricultural crops and natural ecosystems. Bees pollinate a wide range of crops and plants, playing a key role in the provision of food and nutrition. Without bees and other related insect pollinators, our lives would be negatively impacted (ftp://ftp.fao.org). Forest trees and other flowering plants provide food and habitat for bees, and by pollination, bees enable them to reproduce. In addition to pollen and nectar, bees also collect propolis, honeydew and water, and trees provide nesting places for the bees. There will be consequences from lack of pollination leading to reduced biodiversity. Most of plants need an animal to visit their flowers in order for them to produce fertilized seeds, fruit, and future generations of the plant. Around half of the animal pollinators of plants are bees.Despite the significant of Beekeeping activity on economical and ecological of the nation, for thousands of years beekeeping has been a craft using low impact technologies to deliver great benefits to people and biodiversity. So, if apicultural sector focused on expensive equipment, intrusive management, and the monitoring of disease. Honey production and pollination of monocultures will be prioritized over the health of the super organism and wider bee populations. Bees add to the value of trees and forests: Honey and beeswax are products that people can harvest which can be of world quality, and for which there are significant local and international markets. Beekeeping should always be taken into account when the economic importance of trees and forests are being calculated (ftp://ftp.fao.org)

Opportunity and Constraints of Honey Production

Mikhail *et al*. (2016) have conducted study on a cost-benefit analysis of modern versus traditional beekeeping technologies of honey production in Ethiopia and they give evidence as the following: In recent years, Ethiopian's honey-production potential and its likely contribution to poverty reduction have been recognized and incorporated into the working agenda of the Government of Ethiopia, especially the Ethiopian Ministry of Agriculture (MoA), National Research Centers (Holeta, Andasa), and various nongovernmental organizations (NGOs), such as SNV (Netherlands Development Agency), Oxfam GB, and SOS Sahel. These agencies share the belief that the Ethiopian honey value chain is an important part of the country's development strategy. Several other institutional bodies have also emerged to promote the Ethiopian honey sector—namely, the Ethiopian Honey and Beeswax Producers and Exporters Association (EHBPEA) and the Ethiopian Beekeeper's Association (EBA). These institutional actors work together to help establish the successful development of the honey value chain in Ethiopia. The EHBPEA and the EBA cooperate with the government to organize commodity-specific workshops, find solutions to industry problems, facilitate honey policy developments, and organize conferences and international honey expositions (e.g., ApiExpo).

To identify major constraints of the honey sub-sector, a review of literatures were made. Accordingly, some of the principal constraints and problems are highlighted below. Low quality of honey products, Lack of organized marketing channel, Inadequate government support in promoting apiculture development, Lack of skilled manpower and training institutions and Lack of access to world market (Fenet and Alemayehu,2016)

CONCLUSIONS

Beekeeping by its nature doesn't need huge investment, large size of land and complicated technical knowledge. Therefore is an ideal activity for small scale resource-poor farmers. Beekeeping is a non-physically demanding work; it is also favorable for women and landless youth. So if such like off-farm activity be encouraged through special attention of women and youth, one step forwarded in terms of the country's plan of Agricultural Growth Program Phase two (AGPII) which Emphasize greater participation of women and young people. Then it reduces attitude of cultural believe that beekeeping is recognized as a men's work with only a few ladies having the interest to take up the enterprise. This study also found out that several constraints affect beekeepers, including lack of beekeeping equipments, market available, bad pests and disease, inadequate skills and knowledge. It was also revealed out that farmers still own traditional hives employing less of the modern management techniques.

RECOMMENDATIONS

- Despite all these problems and constraints, there are still a lot of opportunities to gain from this sub sector in the future.
- Beekeeping is a non-physically demanding work; it is also favorable for women and landless youth. So if such like off-farm activity be encouraged through special attention of women and youth, one step forwarded in terms of the country's plan of Agricultural Growth Program Phase two (AGPII) which Emphasize greater participation of women and young people
- The government policy also highly encourages private investments in the processing and export of such products. Coupled with the government support, the increasing intervention of NGOs in the production, processing and marketing (including exports of honey products) and the existence several concerned associations are expected to create a breakthrough in the production
- The Ethiopian government has recognized the role of the apiculture and has put in its development agenda, mainly as a non-farm income generating activities, to increase income of the rural and urban households and to promote the export sector. There is an encouraging support from the government and NGOs to develop micro and small scale enterprises in apiculture. It should be also understood that the market problem, beekeepers 'knowledge gap and extension support increasingly improving (though a lot still remains). This will give a possibility of increasing bee product export revenue and improving the production efficiency.

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