Major Constraints And Mitigation Schemes For Declining Honey Bee Population In Ethiopia

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Abstract: Bee keeping is environmentally friendly and non-farm business activity that has immense contribution to the economies of the society and to the national economy as a whole. Ethiopia has a huge natural resource base for honey production and other hive production, and beekeeping is a well-established household activity in almost all parts of the country. The country produces about 43,373 metric tons of crude honey per year, thus shares 23.5% of African and 2.35% of world honey production. These makes the country rank first in Africa and tenth in the world. However, the benefit from the subsector to the nation as well as to the farmers, traders, processors and exporters is not satisfactory. The main challenges that are facing the promotion and development of honey production and marketing are dependent on traditional and low technology input, poor pre and post-harvest management, poor management (such as pesticide poisoning, pests and bee diseases), inadequate extension service and poor marketing, infrastructure. Furthermore, lack of small holders access to finance contributes to inhibiting the adoption of improved technologies for honey production poor quality, limited supply in the face of highly local demand entailing higher domestic process, coupled with the absence of organized market channels lack of adequate beekeeping trainings, and lack of information have made Ethiopian honey uncompetitive in the international market. Adopting improved technologies and market development, improved management practices such as proper use of agrochemicals and pesticides, effective honeybee health delivery service and appropriate control of pests and predators, proper management of natural resources, encouraging involvement of women in beekeeping development, applying of queen rearing technique and colony splitting technique, providing technical and professional trainings for beekeepers would greatly improve the yields and qualities of honey bee.
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Introduction

Beekeeping is a very long-standing and deep-rooted household activity for the rural communities of Ethiopia that stretches back into the millennia of the country's early history. It seems as old as the history of the country and it is an integral part of the life style of the farming communities (Tesfa, *et al*., 2013). The contrasting geomorphic landscapes of Ethiopia create favorable environment for the existence of a large and unique biodiversity both in plants and animals including honeybee subspecies (Kerealem, 2005).

Bee keeping is environmentally friendly and non-farm business activity that has immense contribution to the economies of the society and to the national economy as a whole. Ethiopia has a huge natural resource base for honey production and other hive production, and beekeeping is a well-established household activity in almost all parts of the country. However, the benefit from the subsector to the nation as well as to the farmers, traders, processors and exporters is not satisfactory (Beyene and David, 2007). According to the report of MOARD (2007), in terms of volumes of honey and bee wax harvested and traded, Ethiopia exceeds other countries in Africa by far. The country produces about 43,373 metric tons of crude honey per year, thus shares 23.5% of African and 2.35% of world honey production. These makes the country rank first in Africa and tenth in the world (ARSD, 2000).

Despite the long tradition of beekeeping in Ethiopia, having the highest bee density and being the leading honey producer as well as one of the largest bee wax exporting country in Africa, the share of sub sector in the GDP has never been commensurate with huge number of honey colonies and the country's potential for beekeeping. Productivity has always been low, and relatively low export earnings. Thus, the beekeepers in particular and the country in general is not benefiting from the sector (Gezahegne, 2001; Nuru, 2002). In Ethiopia there are three types of bee hives used for honey production. Thus are traditional, intermediate/transitional and modern hives. A total of about 4,601,806 hives exist in the country of which about 95.5% are traditional, 4.2% transitional and 0.20% modern hives (Beyene and David, 2007).

Though this sector has huge potential still traditional low productive systems has been observed. The main challenges that are facing the promotion and

development of honey production and marketing are dependent on traditional and low technology input, poor pre and post-harvest management, inadequate extension service and poor marketing, infrastructure. Furthermore, lack of small holders access to finance contributes to inhibiting the adoption of improved technologies for honey production poor quality, limited supply in the face of highly local demand entailing higher domestic process, coupled with the absence of organized market channels and lack of information have made Ethiopian honey uncompetitive in the international market (IVCA, 2009; Ayalew, 2008).

The low yield honey and other beekeeping products results from insufficient management practices and lack of adequate beekeeping trainings. Agricultural research has not given due emphasis to assessment and understanding of modern methods of bee farming especially in developing countries where the scholars and policy makers have not been able to adequately demonstrate the importance thus modern methods to livelihoods. Adopting improved technologies and improved management practices would greatly improve the yields and qualities of honey bee [10].

Thus, the objective of this review is to determine the major constraints and mitigation schemes for the declining of honeybee population in Ethiopia.

Major Constraints For Declining Of Honey Bee Population In Ethiopia

Shortage of bee forage: Shortage of bee forage due to population pressure, lack of land use policy and the high demand for farmlands put pressures on mountainous areas to be used for crop production and livestock grazing. These create deforestation, soil erosion and irreversible ecological degradation. Moreover, burning of undergrowth and destroying of forestland for expansion of farmland could trigger a reduction of honey producing floras and foraging areas. The elimination of good nectar and pollen producing tree species in many areas makes it difficult to maintain bee colonies without feeding (Kerealem, 2005).

Shortage of bee forage cause the honeybee colony to absconds to areas where resources are available for their survival. Absconding (the total movement of honeybee colony by leaving the hive) can happen due to different reasons. Lack of feed, honey bee pests and drought are the main problems that may cause absconding (Gidey *et al*., 2012).

Pesticides poisoning: The use of chemicals and pesticides for crop pests, weeds, Tsetse fly, mosquitoes and household pests control brings in to focus the real possibility of damaging the delicate equilibrium in the colony, as well as the contamination of hive products. Of the various kinds of chemicals only insecticides and herbicides are now major problems to the beekeepers. The chemicals used for crop protection are the main pesticides that kill the bees. Moreover, there are two other circumstances in which bees are killed on plants by chemicals. These are by insecticides applied to non-crop pests such as mosquitoes and Tsetse flies and by herbicides applied to plants on which the bees are foraging. Insecticides have a much more dramatic effect on population of bees, thus, the important contribution made by bees to the production of food and human nourishment is being jeopardized. On the other hand, herbicides, which are commonly not toxic to bees, destroy many plants that are valuable to bees as source of pollen and nectar. The types of chemicals used include Malathion, Sevin, DDT, 2-4 D and Acetone. As it wasseen from the beekeeper point of view, poisoning of honeybees by agrochemical has been increased from time to time. Some beekeepers lost totally their colonies due to agrochemical (Kerealem *et al*., 2009).

Honeybee pest and diseases: Ethiopia, as one of the sub-tropical countries, the land is not only favorable to bees, but also for different kinds of honeybee pest and predators that are interacting with the life of honeybees (Desalegn, 2001). The existence of pests and predators are nuisances to the honeybees and Beekeepers. Pests and predators cause devastating damage on honeybee colonies with in short period of time and even overnight. According to Kerealem (2005), ants, honey badger, bee-eater birds, wax moth, spider and beetles were the most harmful pests and predators in order of decreasing importance. A major category of diseases which cause economic loss comprises amoeba, nosema and chalk brood (Kerealem *et al*., 2009; Desalegn, 2006).

The existence of honeybees' disease and pests affect the honeybees' life, which leads them to absconding (Gidey *et al.*, 2012).

Marketing problems: It has been observed that in the Amhara region the marketing system of honey has many problems. Most of the local markets are far away from the beekeepers and are inaccessible. Beekeepers travel on foot for several hours to sell their honey. The lack of grading systems does not encourage farmers to produce high quality products, thus, the price of honey changes widely based on the good will of buyers (Kerealem *et al*., 2009).

The constraints to marketing of honey and beeswax in the country and these include low and discouraging price of honey and beeswax in local markets, lower quality of products, lack of market information, absence of organized market channel, transportation problem, lack of appropriate technologies for collecting, processing, packing and storage of honey to keep its natural quality, lack of government support in promoting market

development, and low involvement of private sector. Because of beekeepers have limited knowledge of the preferences of their target market, they do not try to make any changes in the quality of their product. Presentation of quality honey is generally poor. Most honey come to market is un-extracted, unstrained and poorly managed (Gezahegne, 2001).

Lack of improved technology and other technical constraints in beekeeping activities: The main challenges that are affecting the promotion and the development honey production and marketing are dependent on traditional and low technology input, poor pre and post-harvest management, inadequate extension service and poor marketing infrastructure. Furthermore, lack of small holder's access to finance contributes to inhibiting the adoption of improved technologies for honey production. Poor quality, limited supply in the face of highly local demands entailing higher domestic processes, coupled with the absence of organized market channels and lack of information have made Ethiopia honey uncompetitive in the international market(IVCA, 2009).

More over IVCA (2009), stated that an introduction of improved hives and working tools to the rural community are beyond the pockets of framers 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 bee keepers' lack of awareness and interest. Likewise, it was not implemented on the bases of identification of potentials, constraints, attitudes and economic levels of the communities. So it is essential to identify the potential development constraints. Thus, it requires making efforts to address some of the major problems of bee keeping and to keep it productive in sustainable way (Seid and Solomn, 2015).

Other technical constraints in beekeeping activities include poor extension systems (absence of coordination between research, extension and farmers), lack of credit service, and shortage of records and up-to- date information, shortage of reading materials regarding to beekeeping, and lack of research stations to address the problems related to apiculture (Kerealem *et al*., 2009).

Mitigation Schemes for Declining of Honeybee Population in Ethiopia

Still the country has potentials with enormous nectar and pollen resources that have yet been exploited, bee keeping could probably be profitable activity to undertake. The potentiality of apiculture could be backed up by research and the beekeepers' indigenous knowledge which should be assessed. In this regard it is important and right time to conduct apicultural research in order to assess the situation at the grass-root level: to identify the opportunities, challenges, socioeconomic importance, attitudes and analyze the performance of the existing beekeeping situation before any development program interventions (Tessega, 2009).

The major problems of honeybee production in the country can be tackled with the appropriate research and development. Researchers are needed for a number of investigation and strengthening simple and adaptive beekeeping practices that best suit the local condition and changing demands. In order to be effective, research must be targeted at the smallholder farmer. It must also be systems oriented, practical and adaptable. A careful assessment and analysis of the production environment is required in order to formulate apiculture development strategies that will lead to better use of local resources, improve the living standards of poor farmers and ensure the sustainable development of honeybee production (Kerealem *et al*., 2009).

Development of re-forestation program and utilization policies for the efficient use of natural resources: The potential of land for beekeeping depends on the nature of the vegetation it supports. Thus, vegetation characteristics of a region are considered to be an important indicator of its potential for beekeeping. As honeybees do not visit all plants for their nutrition, identification of the honeybee plants and assessing their abundance, their value to bees, time of blooming and flowering period have a paramount importance for practical beekeeping and in assessing the potential of an area for beekeeping as well as in planning appropriate seasonal management and effectively uses of the resources (Nuru and Hepbum, 2001; Amsalu, 2004).

Inadequate feed sources (nectar, pollen, and water) due to drought and deforestation is a major limiting factor to honeybee production, particularly during the long dry season. Most of the honey plants flower and provide ample nectar and pollen sources after the main rainy season (September to December). Indigenous honeybee floras of various location should be identified and study on species diversity, species composition as well as bee-plant interaction is required. Research into providing good quality, year-round nectar and pollen source plants for the honeybees is therefore very important. Re-forestation program and utilization policies for the efficient use of natural resources should be developed at regional and national level. Integration of beekeeping to others development activities such as conservation of natural resources and promote the sowing of multipurpose legumes as a soil conservation measures as well as a fertilizer saver and that retain moisture to the soil may help as best means to green the futures. They also

provide nectar and pollen for honeybees. Some browses can also occupy an important role in honeybees feeding, particularly during the dry season. This is because most browse species are drought resistant. These need to study. Generally, honeybee plants such as *Vernonia* spp., *Echinops* spp., *Acacia*spp., *Acanthus* spp., *Helminthotheca echodes* and *Cayluseaabyssinica* are well known for their dry period flowering and serving as subsistence forage to bees in dearth periods (Nuru, 2002; IVCA, 2009).

The agronomic characteristics of these honey plants need to be explored in order to achieve maximum benefit from them. Selection of honey flora suitable for integrated agro forestry-apiculture program should be undertaken. It was generally accepted that a colony must be left with portion of its honey or otherwise be given suitable substitute foods if it is to survive or remain in the hive. Thus flour of pulses and barley ('shiro', besso'), milk, sugar syrup and the like could be provided to bee colonies as supplementary feed during the dearth periods. Their feeding value and rates of incorporation need to be determined (Kerealem *et al*., 2009).

Proper use of agrochemicals: It is in no one's interest for bees to be harmed by agrochemicals. Their pollinating activity is a vital part of food production. However, bees can be harmed at any time by chemical sprays present on any plants where bees might forage, even the flowering weeds along the sides of fields. Many beekeepers lose their honeybee colonies every year due to agrochemicals applications. However, this is not considered as a serious problem by the government and other concerned bodies. Perhaps it is because of the generally low status of mere insects or the fact that bees are not highly visible livestock that the problem is not more fully appreciated. Since some agrochemicals have some residual effect on bee products, these residuals might be hazardous to human health. Although it is difficult to completely prevent the effect of chemicals on honeybees, their effect can be reduce by strengthening integrated pest management programs, using insecticides of relatively low toxicity and residual effect for bees and other pollinating insects, not applying insecticides toxic to bees when crops are flowering, use proper methods application, and the like. In this regard there is a need of timely advice and use of educational programs to beneficiaries, chemicals applicators and beekeepers on how to reduce poisoning by proper selection and application in insecticides. Techniques of beekeeping management (like moving bees out of hazardous areas, supplementary feeding and various protective measures) that will reduce the harmful effect of exposure to insecticides should be developed and practiced (Kerealem *et al.,* 2009).

Research should focus on the effects of agrochemical application on honeybees and means of minimizing their effects as well as on development of non-chemical methods of insect control. There is a need of establish better liaison between the members of the Ethiopian Beekeepers' Association and concerned officials who set up regulations for applying insecticides. The regional governments should provide insecticide free "sanctuaries" and crop zones where bees can be isolated from insecticides. The government should be also focused on formulating appropriate policies on proper use of agro chemicals and accountability regarding to application (Kerealem *et al.,* 2009).

Providing technical and professional trainings for beekeepers: Rendering training that covers the overall aspects of beekeeping and working tool (equipment) to training of trainers and beneficiaries should be given due attention. Priority should be given for training of technical and professional beekeepers and providing public education on modern beekeeping. Locally beekeepers would be train and then serve as extension agents in their own village. Development agents who would be involved in beekeeping must have the training first to enable them adequately provide technical assistance to beneficiaries. The farmers selected for beekeeping development program must have the knowledge about biology of honeybees, equipment and working calendar of the areas. Moreover, modern beekeeping requires close attention and giving technical assistance to the farmers who had little knowledge in operation techniques. In all of the working areas developing honeybee calendar, continuous supervision and some assistance in hive management would help farmers learn more and improve their working capacity better (Kerealem *et al.,* 2009).

Most of the beekeepers in the country are using local beekeeping technique that result in low hive products. Much of the honey produced by the beekeeper is of very low quality because it is mixed with wax, pollen and brood. Some of the products are even unknown or unexploited. Management systems need to be improved in order to improve the quality and quantity of hive products. The beekeepers should use a year-round plan of management favorable to the bee colony. The choice of beekeeping technologies varies across geographical areas because of differences in biophysical and economic conditions of beekeepers. Research should focus on development of appropriate bee equipment (hives, protective, honey and beeswax extractors and containers). Moreover, at any kind of beekeeping development the use of the necessary tools and appropriate hives is essential for effective result. Effort should be done to evolve the most suitable hives to the beekeepers local condition

so that they can understand and operate the hives without badly stung and destroying the colony. Knowledge on how to incorporate new technologies profitably into farm level production strategies will become more important (Kerealem *et al*, 2009).

Traditional methods need to be replaced by the improved and modern scientific methods for better management. Nevertheless, the use of improved modern beehives has not gained wide popularity mainly due to high cost (Gidey and Mekonen, 2010).

Figure1. Centrifugal extractor machine. Source: (Gidey and Mekonen, 2010).

Effective honeybee health delivery service and appropriate control of pests and predators: There are multitudes of honey bee pests including; ants (both black and red) and ant like insects (the greatest enemies), birds, spiders and lizards. Honeybee pests and diseases threaten most parts of the regions and cause high mortality rates and severe economic loss. The needs for effective honeybee health delivery service and appropriate control methods in order to reduce diseases, pests and predators constraint remain very important. In this regard research must focus on investigation and diagnosis of factors that endanger the health of local honeybees in different agro ecology zones and establishing ways of prevention and control measures (Kerealem *et al*, 2009).

Traditionally, farmers have their own control means including the application of ash, rope around entrance of hives (hanging the predator's neck), insect repellents (such as dirty engine oil), snap and light traps, mechanical killing of the pests etc. Pests were also protected through placing the wooden top-bar beehives on a small can containing water so as to float pests on the water (Fig. 2A). However, this pest management option is suitable only for the modern beehives. All the four legs of modern beehives are also protected by insect repellents such as dirty engine oil (Fig. 2B). Each leg of the stand is placed in a shallow container full of oil. Several other insects are also protected by spreading wood ash around the stand of the beehives (Fig.2B). Generally, as the pests are attracted to wards sweets such as honey sugar, nectar and bee's body, beekeepers should be able reduce the damage and protect the hives through the above mentioned and other related management options (Gidey and Mekonen, 2010).

Figure 2. A. Honeybee management option designed to float pests on the water; B. Appilication of ash and dirty engine oil to protect bee pests (insect repellents). Source: (Gidey and Mekonen, 2010).

Applying of queen rearing technique and colony splitting technique: Shortage of honeybee colonies is one of the constraints mentioned by beekeepers. To alleviate the problem queen rearing technique that can easily adopted by farmers should be practiced. Colony splitting technique is one of the easiest and promising ways of colony multiplication. Therefore, to implement this activity provides practical training to beekeepers and supports them with nucleus hives and

other beekeeping equipment have paramount important (Kerealem *et al*., 2009).

Efficient market and infrastructure development: More attention should be given to market development. Linking production and post-production components to efficient market information and extension services, infrastructure and marketing schemes, and establishing standards for quality control of bee products should be the major focus in hive products marketing. Farmer beekeepers should be encouraged to establish a "honey and beeswax producer cooperatives", trained in proper management and processing of locally produced hive products, thus creating better potential to the local and international markets. A central collection and processing center for both honey and beeswax should be established, with numerous local collection sites available to beekeepers. Much of the honey produced from local hives is mixed with wax, pollen and brood and this procedure has not changed because there is a high demand for the supply for the making of 'Tej'. Grading the incoming crops and basing payments on their quality will give beekeepers an incentive to try new methods of production. More emphasis should be given to unifying and merging the various beekeeping organizations, honey promotion institutions, honey packer and producers in to a strong regional organization with common goals and objectives (Kerealem *et al*., 2009).

There is a strong need for an apiculture development policy with appropriate guides and well defined goals in order to attain a thriving production sector with accelerating and environmentally sustainable growth. Technology packages have to be developed through farming systems research. A research system that benefits small-scale farmers operating in different farming systems and agro-climatic zones should be strengthened. Creating a system that develops a mechanism for strong links between research and extension services should also be an integral part of the envisaged development strategy and policy. A successful apiculture development strategy requires the formulation of natural resource management plans that complement the wider economic and specific agro-ecosystems objectives. The strategy will also need to consider the social, cultural, political and institutional elements that affect the management of natural resources. On the policy side, issues relating to land-use, bee resource conservation and development strategies, priorities for apiculture development and research capacity have to be addressed (Keralem *et al*., 2009).

To encourage the development further, consideration needs to be a number of factors, including improving access to credits, encouraging involvement of women in beekeeping development, making farmers aware of the usefulness recording and developing of reading materials to farmers regarding to beekeeping. Again, the implementation of action programs require both technical and institutional support and, equally important, government commitment and unlimited cooperation of all concerned (Seid and Solomn, 2015).

Conclusions And Recommendations

Ethiopia has generally adequate natural resources and a long tradition and culture of beekeeping. However, because of lack of technological changes, strong institutional supports and access to value chain development, most of the rural beekeeping households in particular have not been sufficiently benefited from the subsector. The major constraints to exploit the untapped potential of beekeeping activity in the country are lack of bee forage, pest and predators, pesticide poisoning, lack of beekeeping equipment and materials, honey bee disease, marketing problems and lack of improved technologies, lack of honey storage facilities, poor extension service, low involvement of women in beekeeping development and lack of knowledge of appropriate methods of beekeeping. Adopting improved technologies and market development, improved management practices, proper management of natural resources, encouraging involvement of women in beekeeping development, providing technical and professional trainings for beekeepers would greatly improve the yields and qualities of honey bee.

From the above conclusion, the following points are recommended for the future improvement of the sector.

- Research should focus on development of appropriate bee modern equipment.
- Beekeepers should be able to identify pertinent market information and collaborate with other interested organizations to gather and disseminate the information necessary for collection, processing and marketing of honey products.
- Impressive training on modern beekeeping practice and credit facility should be available to individuals who are willing to invest on improved honey production technologies, storage, processing facilities and packaging.
- The effect of agrochemicals or pesticides application on honeybees and means of minimization their effect should be addressed.
- Further scientific studies should be conducted on honeybee diseases and pests.

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