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Honeybee production practices in Sekota district, northern Ethiopia

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ABSTRACT
This study was conducted to assess honeybee production practices in Sekota district, northern Ethiopia. The district comprises a total of 33 kebeles (peasant associations at the lowest admistrative level) which were classified into three highland (1800-2200 m.a.s.l.), 24 midland (1500-1800 m.a.s.l.) and six lowland (<1500 m.a.s.l.) areas. From these, two, four and three kebeles were randomly selected from the highland, midland and lowland areas, respectively. A total of 90 beekeeping households were selected purposively: ten from each kebele based on their experience in keeping honeybees and involvement in extension activities. Primary data were collected through household interviews and key informants using a semi-structured questionnaire. Quantitative and qualitative data were collected on household profiles, number and types of hives used, type of beekeeping equipment used, honeybee floras, honey flow season, honey yield and price of honey. The quantitative data generated were analyzed using the SPSS software and qualitative data obtained were summarized in the form of tables. Results indicated that there were three types of honeybee production methods which are traditional, transitional and modern production and the beehives were exclusively kept in backyards in all production methods. Although, Zander modern hives were recently introduced in the area, modern beekeeping method attracted the attention of most beekeepers. As a result many farmers were shifting to box hive beekeeping activity. The price of honey increased from 2.3 and 3.1 to 3.9 and 5.2 US$/kg for crude red honey and pure white honey, respectively over the four-year period (2011-2014). The most important sources of honeybee forage (in terms of preference by honeybees and abundance) were: *Becium grandiflorum, Euclea shimperi, Sorghum bicolor,* and *Echinops* spp. Others were *Acacia tortolis, Acacia seyal, Acacia asak, Terminalia glaucescens, Hypoestes trifolia, Ocimum bacilicum, Aloe* spp., *Bidens* spp., *Euphorbi*a spp. and *Vicia faba*. It was further revealed that majority of the important honeybee floras in the area flower between August and September. *Ocimum bacilicum* was the dominant swarm attractant plant used while dried cattle dung was the most used smoking material in all the agro-ecologies. Returning the swarm back to colony as a method of controlling swarming was rarely practiced since the honeybee colonies were very important income sources for the household economy as the colonies can be sold at satisfactory price (up to 400 Ethiopian Birr/colony). For sustainable apicultural development in the area, provision of training to beekeepers on colony management and establishing market linkages of producers with processors and exporters is important. Moreover, research on the effects of materials used as smoker fuels (materials used for smoking during hive inspection) and swarm attractants on the quality of honey is required.

Key words: Beekeeping, Ethiopia, honey production, Sekota

RÉSUMÉ
Cette étude a été réalisée pour évaluer les pratiques de production d'abeilles dans le district de Sekota, dans le nord de l'Éthiopie. Le district comprend un total de 33 associations paysannes au niveau administratif plus bas, qui ont été classés dans trois régions montagneuses (1800-2200 m.a.s.l.), 24 dans le centre-ville (1500-1800 m.a.s.l.) et six zones de plaine (<1500 m.a.s.l.). À partir de ces associations, deux, quatre et trois associations ont été choisies au hasard parmi les régions montagneuses, moyennes et basses terres, respectivement. Au total, 90 ménages apicoles ont été choisis à dessein: dix de chaque association en fonction de leur expérience dans la conservation des abeilles et l'implication dans les activités de vulgarisation. Les données primaires ont été collectées au moyen d'entretiens chez les ménages et personne

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ressources utilisant un questionnaire semi-structuré. Des données quantitatives et qualitatives ont été collectées sur les profils des ménages, le nombre et les types de ruches utilisées, le type d'équipement d'apiculture utilisé, les fleurs, la saison d'écoulement, le rendement et le prix du miel. Les données quantitatives générées ont été analysées à l'aide du logiciel SPSS et les données qualitatives résumées sous forme de tableaux. Les résultats indiquaient qu'il existe trois types de méthodes traditionnelles de production d'abeilles domestiques, de transition et de production moderne. Bien que les ruches modernes de Zander aient récemment été introduites dans la région, la méthode de l'apiculture moderne a attiré l'attention de la plupart des apiculteurs. En conséquence, de nombreux agriculteurs se tournent vers apiculture. Le prix est passé de 2,3 et de 3,1 à 3,9 et de 5,2 US $ / kg pour le miel rouge brut et le miel blanc pur, respectivement sur une période de quatre ans. Les principales sources de fourrage d'abeille (en termes de préférence et abondance) étaient: Becium Grandiflorum, Euclea shimperi, Sorghum bicolor et Echinops spp. Aussi la majorité des ressources florales importantes des abeilles dans la région fleuraient entre août et septembre. Retourner l'essaim à la colonie comme méthode de contrôle était rarement pratiqué puisque les colonies d'abeilles étaient des sources de revenus très importantes pour l'économie domestique, car les colonies pouvant être vendues à un prix satisfaisant. Pour un développement durable de l'apiculture dans la région, il est important de former les apiculteurs sur la gestion des colonies et d'établir des liens de marché avec les transformateurs et les exportateurs. En outre, des recherches sur les effets des matériaux utilisés comme combustibles pour créer la fumée et les atouts de l'essaim sur la qualité du miel sont nécessaires.

Mots clés: Apiculture, Éthiopie, production de miel, Sekota

INTRODUCTION

Beekeeping is a sustainable form of agriculture, which is beneficial to the environment and increases yield of food and forage crops through the pollination action of bees. Beekeeping is a very long-standing practice among the farming communities of Ethiopia (Martin *et al.,* 2012). It is a promising sideline farm activity for the rural households. It directly and indirectly contributes to the income of households and the economy of the nation (MoARD, 2003). Despite the long beekeeping tradition, having the highest bee density and being the leading honey producer as well as one of the largest beeswax exporting countries in Africa, the share of the apiculture sub-sector to the gross domestic product (GDP) has been minimal in Ethiopia. Productivity of the sub-sector has always been low, leading to low utilization of hive products domestically and relatively low export earnings. Thus, the beekeepers in particular and the country in general are not benefiting from the sub-sector as expected (Tadesse, 2001a; Adgaba, 2002). This is because apiculture is one of the sub-sectors of agriculture in Ethiopia that has received limited attention.

Recently, the Ethiopian government as well as non-governmental organizations (NGOs) operating in the country have recognized the contribution of beekeeping to poverty reduction, sustainable development and conservation of natural resources. The Amhara region, particularly Sekota district, has recently put beekeeping as one of the important development strategies to reduce poverty and to diversify farmers' income and national export commodities. For example, the Organization for Rehabilitation and Development of Amhara Region (ORDA) as well as NGOs like Save the Children (UK) have put the beekeeping subsector as one of their development priorities.

In the eastern parts of the Amhara Regional State, there are large areas of inaccessible lands (escarpments, hills and undulating mountains) for crop cultivation and livestock grazing. These areas are covered with various types of bushes which are relatively potential areas for beekeeping activities (BoA, 2003).

Sekota district which is located in the eastern part of the Amhara Region is identified to be a potential area for beekeeping and it has a long history in honeybee production practices. However, to date, there is no published information on honeybee production practices in Sekota district. Therefore, this study was designed to assess honeybee production practices in the district in order to identify problems and opportunities associated with honeybee production and to formulate appropriate development strategies pertinent to honeybee production practices.

MATERIALS AND METHODS

Study site

Sekota district (Figure 1) is located between 12^0 23' and $13^0$16' north and 38 ^{0}44' and 39 ^{0} 21' east (BoFED, 2007). The district extends 98 km in the north south direction and 67 km in the east west direction. It is located at 720 km north of Addis Ababa (capital city of the country). The annual rainfall is erratic in distribution and varies between 350 and 650 mm (CSAE, 2009). The topography is dominated by a number of deep gorges, ups and downs and series of rugged massif.

Sampling procedure

Sekota district comprises a total of 33 kebeles (the lowest administrative unit) which were classified into three highland (1800-2200 meters above sea level), 24 midland (1500-1800 meters above sea level) and six lowland (<1500 meters above sea level) areas (Figure 1). From these, two, four and three kebeles were randomly selected from the highland, midland and lowland areas, respectively. From the selected kebeles, a total of 90 households (ten from each kebele) were selected purposively based on their experience in keeping honeybees and involvement in extension services. The experience in beekeeping and involvement in extension services were identified by the help of development agents of the respective kebele. A single household respondent, one who is responsible for keeping the bees, was used as sampling unit in this study.

Data collection

Primary data were collected through household interviews and key informants using a semi-structured questionnaire. The questionnaire was designed to generate data on household profiles (sex, age, family size, education level), honeybee production methods (number and types of hives used, type of beekeeping equipment used), types of honeybee floras, honey flow season, trend of honey yield and price of honey over years in the study area. Pre-testing of the questionnaire and record sheets was made as a pilot survey, and based on the information obtained at this stage, modifications were made on the questionnaire. The collection of information was made at household level. Secondary data was also used to supplement the primary data. This was done through reviewing different reports of previous research findings and other published and unpublished materials.

Data analysis

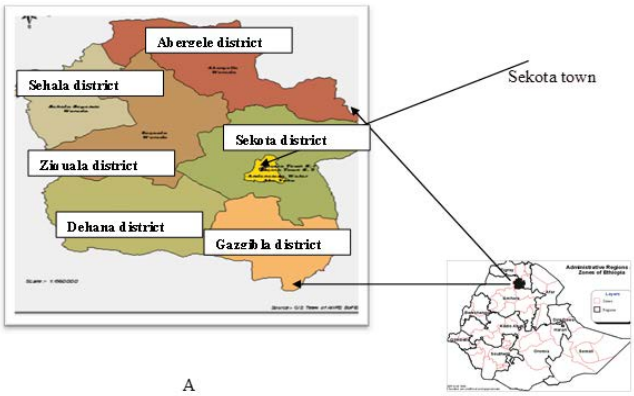
The quantitative and qualitative data were analyzed for the honeybee production practices using the collected primary and secondary data. The quantitative primary data were analyzed using SPSS software version 16 (SPSS, 2011) and was summarized using descriptive statistics. Qualitative data obtained during the survey study were described using percentages, frequencies, and was summarized in the form of tables and graphs.

RESULTS

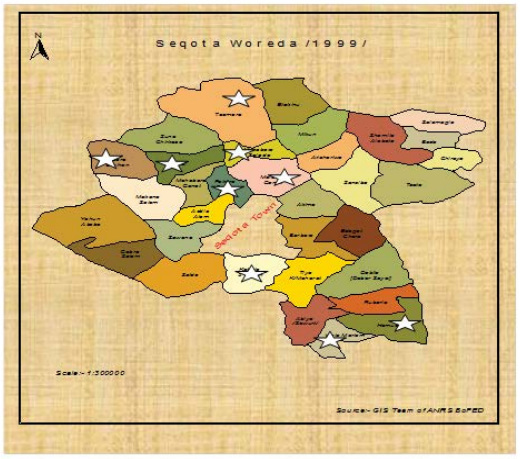
Household characteristics. Sex of household heads, age of household heads, family size and educational status of beekeepers of the area are indicated in Table 1. Majority of the beekeepers (89%) were men and most of the respondents (71%) had a family size of greater than five. Of the visited beekeeping households heads, 46% had attended formal education while 37% were illiterate. Half of the respondents were between 41 and 65 years of age (Table 1).

Based on the levels of technology and management practices used by the beekeepers, three honeybee production methods were identified in the study area: traditional, transitional and modern honeybee production methods (Table 2). Majority (75%) of the honeybee colonies of the area were kept in traditional hives (Figure 2). Figure 3 demonstrates the traditional honey harvesting practice and picture of crude honey of the study area.

Major honeybee floras and their flowering calendar. The respondents have ranked the honeybee floras found in the area (interms of preference by honeybees and abundance). The most important honeybee floras in the area and their flowering calendar are indicated in Table 3. In terms of preference by honeybees and abundance, the most important sources of honeybee forage were: *Becium grandiflorum, Euclea shimperi, Sorghum bicolor, Echinops* spp. Others were *Acacia tortolis, Acacia seyal, Acacia asak, Terminalia glaucescens, Hypoestes trifolia, Ocimum bacilicum, Aloe spp., Bidens* spp., *Euphorbia* spp. and *Vicia faba*. Most important honeybee floras of the area flower between August and September (Table 3). Majority of the honeybee plants (about 66%) were shrubs and herbs (Table 3). This could be due to the low and erratic rainfall distribution which varies between 350 and 650 mm (CSAE, 2009).



A



B

Figure 1: Map of Waghimra Zone (A) and Sekota district (B). Areas marked by the star symbols are the study sites (selected kebeles) (BoFED, 2007)

Figure 2: Traditional beehives used in the study area

Figure 3: Traditional honey harvesting and picture of crude honey of the study area

In the lowland agro-ecology, most important honeybee floras were: *Acacia asak, Terminalia glaucescens* and *Sorghum bicolor*. On the other hand, the most important sources of honeybee flora (both in terms of abundance and preference by honeybees) in the highland and midland kebeles of the study area were: *Becium grandiflorum, Euclea shimperi* and *Vicia faba*. The rest of honeybee floras mentioned above were distributed in all agro-ecologies of the district.

Controlling swarming and swarm attractants

There were different methods of controlling swarming of honeybee colonies in the study area. The most important were: harvesting honey combs during brood rearing period, suppering for modern hives and adding gushgusha for traditional hives (gushgusha is extension or addition of similar sized traditional hive next to the original hive during honey flow season), removal of queen cells and returning the swarm back to the colony. However, most of the respondents (98%) used suppering for modern hives and gushgusha for traditional hives to control reproductive swarming.

In the study area, there were many different floral species identified by the local beekeepers which attract swarms (Table 4). These include aba tsemare (*Ocimum bacilicum*), zikakibye (*Ocimum* spp.), kesie (*Lippia adoensis*), teji matebiya (*Hypoestes trifolia*), gishra, letrena, chochona, ankua and hamhamgulmza. However, majority (98%) of the respondents use the plant *Ocimum bacilicum* as a swarm attractant (Table 4).

Trends in honeybee colony and honey yield

In the study areas, the number of honeybee colonies kept in modern hives (zander) and transitional hives (Kenya top bar) was increasing while the numbers of colonies in traditional hives (tube basket made from bamboo and grass, Figure 2) were found to decrease over time (Figure 4). The productivity of modern hives was higher than both the transitional and traditional hives (Figure 5).

Marketing of honey in the study area

About 59% of the respondents sell their honey directly to local and transit consumers (Table 5 and Figure 6). In 2011, the price of honey per kilogram was 40 and 115 Ethiopian Birr (ETB) (2.2 and 6.4 US$) for crude red honey and pure white honey, respectively (Table 5). The crude red honey was obtained from traditional and transitional hives and pure white honey was obtained from modern hives. Figure 7 (A, B and C) shows typical white, yellow and red honey types, respectively produced in Sekota district. The mean price of pure honey was 72 ETB/kg (4 US$/kg) while price of crude honey was 55 ETB/kg (3.1 USS/kg) over four consecutive years (2011-2014) (Table 6). On the other hand the mean prices of white honey and red honey were 82 and 44 ETB/kg (4.6 and 2.4 USD/kg), respectively in the study area.

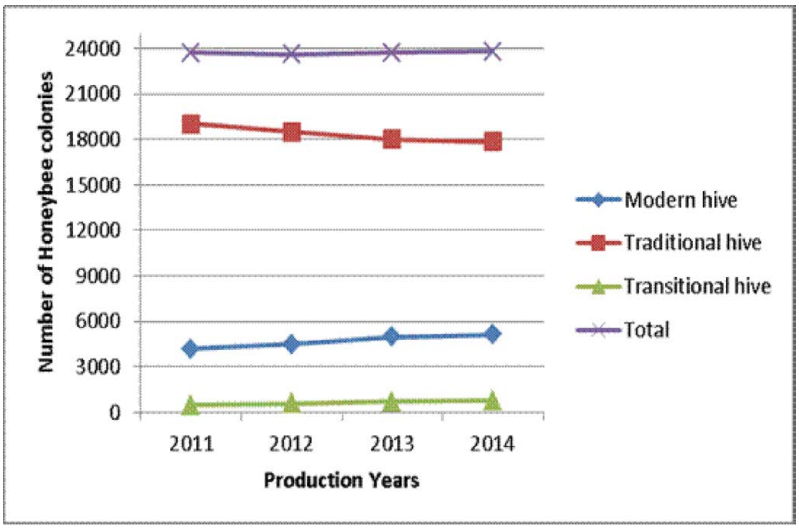


Figure 4: Trends in the number of honeybee colonies in Sekota district

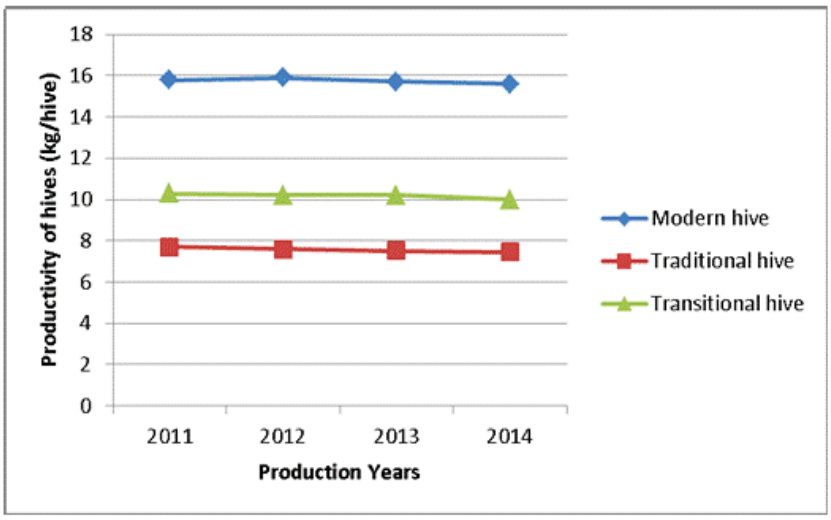


Figure 5: Trends of productivity of hives in Sekota district

Figure 6: Local marketing of honey in the study area (Tsemera market)

A

B

C

Figure 7: Honey types produced in Sekota district (A = white honey, B = yellow honey, C = red honey)

Smoker fuels (materials used during hive inspection) used during colony inspection. During colony inspection, the beekeepers use Woira (*Olea africana*), ekima (*Terminalia glaucescens*), corn comb, tid (*Juniperus procera*), seed of noug (*Guizotia abyssinica*), kalkalda (*Euphorbia* spp.), old cotton cloth, cattle dung and fatika (a local plant species) for smoking (Table 7). But all these materials are not equally available in all agro-ecologies. Dried cattle dung was the most dominant smoking material used by all interviewed respondents in the low-, mid- and highlands of the study area (Table 7). *Terminalia glaucescens* was most commonly used and preferred smoking material in the lowland agro-ecology during colony inspection. However, in the mid- and highlands, *Terminalia glaucescens* was not available.

DISCUSSION

Profiles of the sample households

The majority of the beekeepers (89%) in the study area are men, although beekeeping is an activity which can be done regardless of sex. The result of this study is in agreement with the work of Ejigu *et al.* (2007) who indicated that beekeeping was the dominant occupation of men and only a few women beekeepers were found in Enebse district. This is due to the traditional idea that underlines beekeeping to be men's job owing to the physical activity it requires.

All the interviewed beekeepers were within the age groups ranging from 20 to 65 years which indicates that the majority of the respondents are found in

economically active age groups. Thus, there is high potential of labor input for beekeeping in the study area.

About 46% of the beekeeping household heads had attended formal education while 37% were illiterate. The rest of the respondents were those who can read and write but did not attend formal education. Educational level of the farming households can have significant importance in identifying and determining the type of development and extension services that need to be designed for the area. Gichora (2003) indicated that for more advanced beekeeping, one should have a good understanding of bee biology and behavior and needs to exercise better bee colony management practice. The result of this study indicates that most respondents of the study area can easily adopt the extension services and bee related technologies provided.

Honeybee production methods

Majority of the honeybee colonies of the area were kept in traditional hives (tube basket made from bamboo and grass). However, the number of traditional honeybee hives is decreasing from year to year as the beekeepers are transferring their colonies to improved hives. About 3% of the honeybee colonies were kept in transitional hives. The distribution and ownership of transitional hives in the area were less compared to the modern hives. As the beekeepers of the study area were well introduced to modern hives, there were fewer tendencies by the farmers to stick to the traditional and transitional production methods.

About 22% of the honeybee colonies of the area were found in modern hives (Zander hives). It was also common to see a combination of the different production methods at the backyards of a beekeeper in the study district. As stated by Wolteji (1999), a modern hive has advantages over traditional and transitional hives because of its suitability for internal inspection of the colony, adding or reducing super, internal feeding, swarm control, inserting of queen excluder and honey harvesting. Although modern hives were introduced recently, they attracted the attention of most beekeepers of the study area. Many beekeepers of the study area are familiarized with the improved hives and have made a visible change in incomes of their households from the apiculture sub-sector. As a result, the demand for modern hives is increasing tremendously in Sekota district. These days, non beekeepers in the area are also attracted by this income generating activity due to the encouraging production of honey from such hives.

Major honeybee floras and their flowering calendar. Availability of potential flowering plants is the main parameter for an area to be considered as potential for honey production but on the contrary honeybee flora is diminishing from time to time in the study area as a result of expansion of agriculture, soil erosion and rapid population growth. Among the honeybee forages identified, the majority (63%) were shrubs, herbs and cultivated crops. This agrees with the study result of Tesemma *et al*. (1993) who reported that the country's forest cover is quite small which is estimated to be below 3% and that of Amhara region is less than 0.7%.

The main rainy season usually begins in early July and ends late August. The peak honey harvesting period is from October 15 to November 15. During Belg (minor rainy season), though not frequent, some plants flower in March through April and small quantity of honey is harvested in June. Thus, the study area has major and minor nectar flow seasons occurring during August to September and March to April, respectively.

Controlling swarming and swarm attractants. Reproductive swarming is the natural instinctive behavior of honeybees to reproduce; however, control of reproductive swarming is a very important activity of honeybee management in order to increase honey yield per hive. Although the swarming time of honeybee colonies in the study area is from July 15 to September 30, the peak time of occurrence is from August 15 to September 15. During this peak period the beekeepers of the study area become very busy and active to prevent and/or control swarming. At this particular period one member of the family stays at home for this purpose.

Conditions that lead to swarm preparations in colonies include overcrowding of bees in the hive, presence of old queen and races of bees. Among the different methods of controlling swarming of honeybee colonies in the study area, removing of queen cells sometimes has a problem in that the colony might lose the chance to replace old and unproductive queens. Returning the swarm back to colony is the method of controlling swarming which is practiced rarely in the area. According to the respondents, this is because the honeybee colonies

themselves are very important income sources for the household economy as it can be sold at a satisfactory price (up to 400 ETB /colony).

There are many different floral species identified by the local beekeepers which attract swarms. These species of plants are used for preparation of new hives or other temporary swarm catching equipment, that is, rapping these plants against the hive or the equipment so that they will release a typical odor that will attract swarms.

The most common swarm attractant used in the study area is *Ocimum bacilicum*. According to the respondents, *Ocimum* spp. has the same power of attracting swarms as *Ocimum bacilicum* but it is not commonly available. *Lippia adoensis, Hypoestes trifolia, Gishra, Letrena, Chochona, Ankua* and *Hamhamgulmza* were used by few of the interviewed beekeepers as swarm attractant plants. Therefore, these are considered as secondary swarm attractants in the study area.

Trends in honeybee colony and honey yield in the study area. An increasing trend in the use of modern beehives was observed in Sekota district between 2011 and 2014 (SWARDO, 2014). However, the demand by beekeepers of the study area for improved hives was much more than the distributed average in which the suppliers were unable to satisfy their demand.

The numbers of honeybee colonies in modern and transitional hives were increasing while the numbers of colonies in traditional hives were found to decrease over time. This is attributed to the increase in the supply of improved hives by governmental and non-governmental organizations and transferring colonies from the existing traditional hives to improved hives. But, the overall number of honeybee colonies over the past four years (2011-2014) in Sekota district has shown a declining trend due to various reasons (mainly drought, honeybee enemy and disease).

The productivity of modern hives was higher than both the transitional and traditional hives. According to the respondents, it is common to harvest 30 to 40 kg of honey per modern hive per annum and a respondent had reported harvesting 50 kg of honey per annum from his single modern hive. This might be the reason why the beekeepers showed more interest for modern hives. The average productivity of modern, transitional and traditional hives in the four consecutive years (2011 to 2014) in the study area was 15.8, 10.2 and 7.56 kg per hive, respectively. The result indicates that average honey yield per colony for traditional hives of the study area was above the national average of 5 kg (Tadesse, 2001b). On the other hand, average honey yield/colony/year of the study area for intermediate and movable frame hives were within the national average of 12-15 kg per year (MoARD, 2003) and 15-20 kg per year (Tadesse, 2001b), respectively.

The productivity and number of honeybee colonies of the study area showed a declining trend over time. The major causes for the decrease in the productivity and number of honeybee colonies as mentioned by the respondents were: drought, pests and predators, lack of bee forage and application of chemicals.

Marketing of honey in the study area

Sell of honey

Consumers are the most important customers of the beekeepers in the study area. Honey cooperatives (retailers) are the second most important customers of the beekeepers. A team of beekeepers specialized in honey marketing namely Sekota District Honey Marketing Cooperative was established by the district's Agricultural and Rural Development Office at kebele and district levels. The teams in the kebeles (kebele is the lowest administrative unit) have their own members that have a mandate of selling the honey they produce to the cooperative. The profit obtained by the cooperative is shared among the members.

The major actors in the marketing of the honey are cooperatives, local and transit consumers, tej (traditional alcoholic beverage produced from honey) brewers, local and neighbor district traders and village-level collectors. Thus, the honey ultimately reaches towns such as Mekelle, Lalibela, Bahir Dar, Dessie and Addis Ababa city (Emana and Begna, 2006). In recent years after the advertisement of the honey made by the non-govermental organization, Market-led Livelihoods for Vulnerable Population (MLVP), the destination and customers of the honey have been diversified.

Trend of honey price in the study area

The price of honey is increasing from one production season to another very rapidly due to different reasons: advertisement of honey of the study area, improvement in the quality of honey produced, that is, producing pure honey using modern hives, increase in consumer number and inflation of the currency.

The price for white honey for both the crude and pure forms was increasing rapidly (at a rate of 139% and 136.8% for pure white and crude white, respectively) between 2011 and 2014 production years. In general, the mean price of white honey type was found to be 46% higher than the red honey. This shows that consumers are highly attracted by the color of honey than any other characteristics. Even though the physicochemical properties of honey is important in determining the quality grade, at the moment, traditional quality indicators (color, taste, purity and cleanliness) are used for grading and pricing honey in Sekota district.

In order to ensure a reliable market for honey (*Wag Wolela*) produced in the study area, it is important to establish well organized cooperatives to undertake honey processing and packaging and create linkages with honey exporters. This is not only to add value to the product, but also helps to attract consumers through provision of quality and reliable product. Through improving pre- and post-harvest management, *Wag Wolela* could be competent in the dometic and international markets and thereby benefit beekeepers of the area.

Smoker fuels (materials for smoking) used during colony inspection. Beekeepers in the study area use different smoking materials for smoking while doing colony inspection. However, the effect of these smoker fuels on the quality of honey is not known. Therefore, scientific study on the effect of the smoker fuels on honey quality is important so as to recommend to beekeepers which smoker fuel to use for smoking purposes and thereby minimize quality deterioration of honey produced in the study area.

Table 1: Demographic characteristics of the respondents (n=90)

Household characteristics	% of total respondents
Sex of household heads	
Male	89
Female	11
Age of household heads	
20 to 30 years	18
31 to 40 years	32
41 to 65 years	50
Education level of household heads	
Illiterate	37
Reading and writing	18
Grade 1-8	41
Grade 9-12	4
Family size per household	
One to 5	29
Six to 13	71

n = number of interviewed beekeepers

Table 2: Honeybee production methods and number of honeybee colonies in Sekota district

Hive type	Number of colonies	%
Modern	5141	22
Traditional	17851	75
Transitional	789	3
Total	23781	100

Source: Sekota District Agricultural Office (SWARDO, 2014)

Table 3: Major honeybee plants, floral types and flowering calendar in Sekota district

Local name (Agewugna)	Scientific name	Floral type	Flowering calendar
Mentesie	*Becium grandiflorum*	Shrub	August 15-September 20
Dedho	*Euclea shimperi*	Shrub	Year round
Mashila	Sorghum bicolor	Crop	September to October
Kushashle	*Echinops* spp.	Herb	January to February
Abika	*Acacia tortolis*	Tree	March to June
Keyi girar	*Acacia seyal*	Tree	March to June
Tsalwa	*Acacia asak*	Tree	Year round
Ekima	*Terminalia glaucescens*	Tree	Year round
Qundoberbere	*Schinus molle*	Tree	Year round
Teji matebiya	*Hypoestes trifolia*	Herb	September
Aba tsemare	*Ocimum bacilicum*	Herb	August 15-September 20
Sibkana	*Albezia amara*	Tree	May to August
Kenteftafa	*Pterolobium stellatum*	Shrub	March
Wanza	*Cordia africana*	Tree	October to December
Eret	*Aloe* spp.	Shrub	September to October
Agam	*Carissa edulis*	Shrub	October to December
Yeferenji suf	*Helianthus annuus*	Crop	September to October
Adey Ababa	*Bidens* spp.	Herb	August 15-September 20
Beles	*Opuntia* spp.	Shrub	April to June
Bahirzaf	*Eucalyptus camaldlensis*	Tree	May
Giba	*Ziziphus spinachristi*	Tree	September to February
Kalkalda	*Euphorbia* spp.	Shrub	Year round
Gishra	-	Herb	July to September
Goza (bedana)	*Balanite aegyptica*	Tree	January to February
Noug	*Guizotia abyssinica*	Crop	September
Bakela	*Vicia faba*	Crop	August 15-September 20
Dikuan tilla	*Verbena officinalis*	Herb	July 15 to December
Bisana	*Croton macrostachyus*	Tree	January to February
Ambacho	*Rumex nervosus*	Shrub	March
Selit	*Sesamum indicum*	Crop	August
Sesbania	*Sesbania sesban*	Shrub	January
Maluza	*Asparagus* spp.	Shrub	March
Kessie	*Lippia adoensis*	Herb	September
Kinchib	*Euphorbia tirucalli*	Shrub	Year round
Firtata	*Adansonia digitata*	Tree	June

Table 4: Swarm attracting plants found in the study area as reported by the respondents (n=90)

Local name (Agewugna)	Scientific name	Type of flora	% of total
Respondents			
Aba tsemare	*Ocimum bacilicum*	Herb	98
Zikakibye (Besobila)	*Ocimum* spp.	Herb	17
Kesie	*Lippia adoensis*	Herb	9
Teji matebiya	*Hypoestes trifolia*	Herb	2
Gishra	-	Herb	1
Letrena	-	Herb	2
Chochona	-	Herb	2
Ankua	-	Tree	2
Hamhamgulmza	-	Herb	2

n = total number of respondents.

Table 5: Sales outlets of honey produced in Sekota district (n=90)

Customers of the producer	% of total respondents
Middle men (village level collectors)	25.6
Cooperatives (retailers)	32.0
Consumers (local and transit)	58.9
Teji (local beverage) makers	25.6

n = total number of respondents.

Table 6: The average price (Birr/kg)* of different honey types over four years in the study area

Type of honey	Production year				
	2011	2012	2013	2014	Mean price (Birr)
White					
Pure	70	79	90	115	88.5
Crude	60	70	80	95	76.25
Yellow					
Pure	60	64	75	95	73.5
Crude	40	50	60	75	56.25
Red					
Pure	40	48	60	70	54.5
Crude	25	30	38	40	33.25

Source: Sekota District Agricultural Office (SWARDO, 2014); *At the time of this study, the exchange rate of US Dollar to Ethiopian Birr was 1 US$ = 18 ETB.

Table 7: Smoker fuels used in the study area (n=90)

Local name (Agewugna)	Common/scientific name	% of total respondents
Kubet	Dried cattle dung	100
Ekima	*Terminalia glaucescens*	40
Woira	*Olea Africana*	35
Korekonda	Corn comb	29
Tid	*Juniperus procera*	28
Kalkalda	*Euphorbia* spp.	15
Butito	Old cotton cloth	10
Yenoug zer	*Guizotia abyssinica*	100
Fatika	-	5.5

n = total number of respondents.

CONCLUSION

In the study area, there were three types of honeybee production methods (traditional, transitional and modern). Many beekeeping farmers in the study area were shifting to modern (box) hive beekeeping activity. The study also revealed an increasing trend in price of honey. The most important sources of honeybee forage (in terms of preference by honeybees and abundance) were: *Becium grandiflorum, Euclea shimperi, Sorghum bicolor* and *Echinops* spp.

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STATEMENT OF NO CONFLICT OF INTEREST

The authors declare that there are no competing interests in this publication.

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