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Full length Research

Assessment of major Honey bee flora resources on selected districts of Sidama and Gedeo zones of South nations nationalities and peoples regional state, Ethiopia

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Identification of nectar and pollen source and the establishment of flowering calendar are important steps in beekeeping development program. Honey samples pollen analysis was carried out following the methods adopted Louveaux (1978). The Social survey and Pollen analysis showed that Eucalyptus, Bahirzaff, Coffee Arabica, Guizotia, Grawa, Vernonia and Lipidium are the major honeybee source plants. Pollen analysis of honey also showed that Triffolium species, Adey Abeba, clover, Birbira, Acacia species, pisum sativum and grass species are minor pollen sources in the area. The result of the respondent farmers, Woreda experts, and Kebele development agents also indicated that this 14 honeybee plants were commonly identified as pollen source plants for honeybees. Some of the honey plants assessed with the respondents are similar with the honey plants identified through pollen analysis from honey samples. From analysis interview it was possible to identify different flowering season with two honey-harvesting seasons in the area. The major honey-harvesting season begins in Sidama zone from September to October as well as from May to June, and in Gedeo zone it is from January to February and June to August. This is because most of Gedeo areas are covered by with forest trees, herbaceous flora of weeds cultivated crops and shrubs. The trees, herbs and shrubs play major role for honey production with tree species dominate by bearing Bee flora yearly and therefore beekeeping should be integrated with the vegetation conservation for livelihood improvement and food security and income earnings from the sector. Existence of different sorts of flora across all the year, suitable agro -ecology for apiaries, availability of natural forest in almost all the study areas are some of major potential that encourage sectors improvement in the region. Even if there are some basic constraints that have to be taken a due considerations such as lack of improved honey bee flora and improved apiculture equipments, prevalence of honey bee enemies, limitation of introduced technologies to the sites; the existing potential could make the study area one of the model apiary site in not only in the region but also in the country level.

Keywords: Honey bee, flora resources, Sidama and Gedeo zones, Ethiopia

INTRODUCTION

Ethiopia is endowed with various climatic conditions, topography and a wide range of altitude favouring the presence of different natural vegetations that include forests, bushes, herbs, weeds and undergrowth. The flowering plants known in Ethiopia are between 6 and 7 thousand species (Edwards, 1976). The presence of this natural vegetation made the country the best home for honeybees. The forests and woodlands contain diverse species that provide surplus nectar and pollen to foraging bees (Ayalew, 1990). Beekeeping has been and still is widely spread, economically important and integral part of the life of the farming communities of Ethiopia (Verma, 1990, Fichtl and Admasu, 1994). There are an estimated 10 million bee colonies out of which farmers keep about seven million in traditional and modern hives, that the remaining exists in forests and cervices (EMA, 1981) and this represents the highest bee density in Africa.

Production of honey and other products depend on availability of floral resources (bee forage) and is a very important field for most beekeepers in the world (Rucker et al., 2002). Most of the methods for obtaining information about plants utilized in an area are based on direct field observations of foraging honeybees on flowers. The analysis of bee plants, pollen loads and melissopalynological analysis of honey sample (Hepburn and Radloff, 1995) can give a true picture of the honeybee flora of the area (Admasu et al., 2006).

As honey bee doesn't visit all plants for nectar and or pollen ,identification of plants which supply these resources, plant communities and the phonological relationship between honey bee plants and honey bees are paramount important for practical beekeeping and in assessing the potential of an area bee keeping. However, such knowledge in Ethiopia in Particularily in Africa in general is at infant stage (Nature and phenolgy of honey bee plants in centeral highlands of Ethiopia, Holleta Bee Research Center, p.o.box 34,Amsalu Bezabi)

The bees of world importance in beekeeping and the basis of the world's beekeeping industry are races and strains of the honeybee Apis mellifera. Honeybee colony normally has one queen, thousands of workers and hundreds of drones (Seely, 1985, Winston, 1987). Honeybees are dependent on flowering plants because plants provide bees with food in the form of nectar and pollen. Nectar and pollen are primary reward to insect pollinators in general, and to honeybees in particular. As honeybees require large quantities of nectar and pollen at particular time, they utilize particular species of plants for a limited period of time. During the flowering period, there is a considerable Movement by honeybees between plants of the same species. This in turn favors the successful cross-pollination of plants (Percival, 1965, Faegeri, 1979). Not all plant species are however equally good for beekeeping. Some supply both nectar and pollen abundantly when in the bloom and others still provides nectar or pollens for their brood rearing (Free, 1970).

Ideally, a good beekeeping area is the one in which nectar and pollen plants grow abundantly and with a relatively long blooming season. Such areas are however not always available or easy to find. Beekeepers must know the time and duration of the blooming season of every major honey plant including the environmental factors affecting them and carrying capacity of the area, which includes the number of colonies that can be put for maximum production (Rajan, 1980). Apiculture is one of the options that help to promote forest conservation and improve crop yield because of cross-pollination services rendered by honeybees (Adjare, 1990, Fichtl and Admasu, 1994). The income supplement at local level from apiculture is also very significant (Ayalew, 1990). In rural areas, any source of food or income that does not need land is potentially important. Apiculture is such an undertaking because beehives occupy minimal space and they can be placed on wastelands. So in relation to agriculture small holders or even landless peasants can do beekeeping. Besides these, beekeeping does not compete with other branches of agriculture for resources because bees collect pollen and nectar from wild and cultivated plants to make honey and such resources would be important if honey bee hive colonies are established to forage on them (Drescher and Crane, 1982).

Since the practice of modern beekeeping is relatively new in Ethiopia, the compilation of economic bee forages and the identification of areas suitable for beekeeping are still far from complete (Hussien, 2000). Since bees need food all year round, it is clear that they will produce more honey and consume less if they can find natural food most of the time (FAO, 1986). Calendar of flowering plants that have good nectar and pollen sources is a first step towards increasing honey yields. The flowering sequence of honey plants can be anticipated and so hives can be moved to exploit nectar flow. Those plants, which yield nectar or pollen throughout the year, can be identified and more of them can be grown to overcome dearth

periods shown in the calendar (Marden and Kiew, 1984).

The flowering plants known in Ethiopia are composed of between six to seven thousand species spread across diverse agro-ecological zones. This makes the country highly suitable for bee and beekeeping. Apiculture is the keeping and management of honey bees for various products: honey, bees wax, royal jelly, propels, bee pollen, and brood, as well as for pollinating flowering agronomic or tree crops (Debbissa Lemessa, 2007)

In this case, the identification of the important honey bee plants in the development of bee keeping has positive impact. This in turn requires the proper identification of honey bee plants and establishment of floral calendar. This study is thus expected to contribute towards the development of beekeeping, there by contributing to the overall improvement in food security. The intention of this survey was to assess major honey plants in the selected districts and to have the baseline information on the seasonal honey harvests based on the data on flowering season of areal potential resources.

Objectives of the study

Main Objectives

To identify major plants (shrubs, herbs, weeds and trees) foraged by honeybees and set the baseline information

Specific Objectives

- To document their sequence of flowering.
- To identify the main flowering and dry seasons and plants utilized by bees during the respective seasons

LITERATURE REVIEW

Beekeeping and Potential Availability of Bee Forage in Ethiopia

Beekeeping is one of the most important farming activities in Ethiopia (Workneh, 2008). According the previous studies of Ayalew (2001) and Gezahegn (2007) and Fitchl and Admasu (1994) Ethiopia has longer tradition on beekeeping than any country in the world. “Since the 4th century during the time of king Ezana, Christianity with strong emphasis on nomadic culture had a greater contribution for intensive growth of apiculture; because of the need for wax and honey needed for religious ceremonies and for making traditional beverages” (Fitchl and Admasu, 1994). Hence, bee keeping practice has been estimated that started five thousand years ago in the northern regions.

The favourable and diversified agro climatic conditions of Ethiopia, has endowed with above 7000 plant species estimated, which support foraging bees and many other insects (Admasu, 1996, Gezhagen, 2007, Gidey and Mekonen, 2010). Therefore due to this potential availability of diversified bee flora and other environmental factors, Ethiopia has the highest bee density and is the largest honey producer in Africa and 10th in the world

(Fitchl, and Admasu, 1994). Hence, in Ethiopia beekeeping is one of the oldest agricultural practice having passing from generation to generation without modification up to present time. It is only about 3 decades since improved beekeeping has been started in Ethiopia by introducing movable frame hives (Ayalew, 2004); this improvement makes beekeeping one of the good and best agricultural businesses and one of the income streams for rural peoples.

According to MoARD, (2003) the most important honey and bee wax producing regions in Ethiopia are Oromia, South Nations Nationalities and People regional state (SNNPR), Amhara and Tigray.

The diversified flowering plants in Ethiopia and their blooming season greatly vary from place to place; this enables the country to sustain a large number of honeybee colonies (Admasu, 1996). About 500 honeybee flora species identified by the previous study of Fitchl and Admasu (1994) with their importance for honeybees (as source of pollen and/or nectar). As Fichtl and Admasu, (1994) honeybee plants can be categorized as major and minor source of bee forage; for instance:

Major bee plants: are those plants, which are visited by honey bees throughout their flowering season. E.g. Triffolium species. (Clover), Eucalyptus species, Acacia species, and Vernonia species.

Minor bee plants: are those plants that are visited less often by bees or only when flowers of major bee plants are not in flower. E.g. clover, Birbira, Acacia species, pisum sativum and grass species

Bee Forage and Honey Production in SNNPR

Beekeeping practice is as old as farming and it has been traditionally practiced for a long period of time (Meaza, 2010). Although the stage of progress in changing the traditional practice is slow and the entire numbers of honeybee colonies are managing in the region is still traditional way (Fichtl and Admassu, 1994). As a result combination of traditional bee culture by farmers and available plant species favoring foraging bees still made the region the home of Though, beekeeping practice in recent years is improving, but the contribution of honey production of the region to national honey production is still small due to higher degradation of natural resource and/or degradation of honeybee flora that affect the diversity of honeybee plants.

Hence identifying the existing honeybee plants resources may help to assess the productivity, adaptability, and swarming, absconding and other basic behavior of the regional bee resource (Gebre, 2009). Natural vegetation in general forest plants in particular that covers the lands in study areas have been cut down leaving no remnants that helps to reinstate. The loss of these natural plants species, has undoubtedly affected the life pattern, products productivity of honeybees of the region (Ayalew, 2005). Yet, despite such big challenges, there are a wide variety of plants which are used as honeybee flora (Gidey and Mekonen, 2010).

Bee Forage and its Role for Honeybees

According to Gezhagn (2007) plants are the food source of honeybees. However, not all plants are important for honeybee, and those plants that supply both nectar and pollen abundantly when in bloom and these are often called honeybee plants (Akratanakul, 1990); honey bee plants are best suited for honey production as well as colony maintenance, in that bees obtain protein from pollen source plants and carbohydrate from nectar source plants (Bista and shivakoti, 2001).

Honeybees with their activity of extending their proboscis into the flowers are considered as nectar source and bees carrying pollen on their hind legs were determined as pollen source (Mbah and Amao, 2004). Based on studies conducted by Hill and Webster (1995) honeybees often forage on leguminous species, whether tree species or ground covers such as clovers (Trifolium spp). Honeybees also collect large quantities of pollen from zea mays, (Mbah and Amao, 2004). Pollen plants are important in beekeeping, especially at the time of colony build-up (Akratanakul, 1990).

Generally, assessing the potential bee flora and their importance as a major or minor for honeybee plant is very important in bee forage management (Mbah and Amao, 2004). According to the study conducted in Zaria northern Nigeria, About 57.1% of the bee visited plants are perennials while 42.9 % are annuals. Sanford (2003), noted that many plants produce pollen for the bees, it is usually nectar producing species that are the most interesting for beekeepers except few plants; and the most reliable nectar producers are:

Floral calendar of honeybee plants

Floral calendar for beekeeping is a time-table that indicates to the beekeeper; the approximate date and duration of the blossoming periods of the important honey and pollen plants Diver (2002). When we see the flowering time of single species, it begins from the full opening of the first few buds till the start of fruit formation end of flowering (Liseki and Boniphace, 2008).

The distribution and type of honeybee plants as well as their flowering duration vary from one place to another place due to variation in topography, climate, and farming practices.

Hence, every region has its own honey flow and floral dearth periods of short or long duration and this knowledge on bee flora helps in the effective management of bee colony during such period (Bista and Shivakoti, 2001).

From the analysis of the flowering periods of the bee plants and field interviews, it was possible to identify honey flow seasons, accordingly the honey flow season in sidama zone was found to be occurring from September to October as well as from May to June, and in Gedeo zone it is from January to February and June to August.

Generally, flowering calendars can make easier to plan various beekeeping management operations such as the sitting of hives near to particular crops and deciding the best time for honey harvest and/ or colony swarming. Hence adequate knowledge about bee flora including floral calendar is the prerequisite to initiate bee keeping (Bista and Shivakoti, 2001).

Previous study in Ibadan (south west of

Nigeria) by Mbah and Amao (2004), found out that; the main nectar flow is from July to February, with a peak in January when the largest forest trees are in flower, as a result, at this time there is enough nectar flow and the colony is strong with surplus honey to harvest.

Therefore honeybees can live only if they have forgeable plants (Ayalew, 2006). Liseki and Boniphace (2008) also explained that the best harvesting period should be before the start of the dearth period when few plants are flowering. This is the time when feeding of bees is advised to prevent absconding, and to ensure the colony remains strong enough for the forthcoming season.

Watershed Rehabilitation and Bee Forage Improvement

Watershed rehabilitation is recovering and or restoration of the watershed to the previous natural condition; and aims to increase the productivity of agricultural and other natural resources through a combination of re-vegetation and soil and water conservation (Turton, 2000). Watersheds, especially in the developing world, are increasingly being managed for poverty alleviation as well as environmental conservation objectives (FAO, 2006). Bedru et al.,(2006), revealed that a large amount of natural resources in Ethiopia are degraded and or deteriorating due to over utilization and inefficient use of natural resources, specially the forest resource. This deforestation as well as reduction in vegetation cover has negatively affecting the biodiversity of honeybees and/or bee flora plants.

According to the study conducted in Burie District of Amhara Region by Tessega (2009), bee keepers try to overcome the problem of reduction of honey bee plants; hence beekeepers grow different local bee forage plants near by the apiary site. Despite these local efforts, the national beekeeping resource base is deteriorating at a faster rate warranting sustainable intervention progress (Melaku, 2008). Hence, to address environmental problems as well as to improve household food security, a number of interventions have been made in Ethiopia; exclosures and other reclamation activities also implementing in a watershed approach to overcome the socioeconomic and environmental problems in sustainable way (Bedru, 2006).

Therefore most of the bee forages species are multipurpose for the people as well as for the environment, some of the multipurpose trees that are recommended for planting in reclamation of the area, moreover beekeeping should be incorporate into overall land management strategies and farming systems, so as to ensure abundant nectar and pollen for a good and successful apiculture development.

DATA COLLECTION METHODS

Social Survey Data Collection

The study was conducted in Sidama zone from shebedino and dale districts and from Gedeo zone in wonago and Kochere districts based on their potentiality for bee forage as well as its transport accessibility. To collect the required social data for the study individual interview, key informant interview and focus group discussion were conducted.

Household interview: to select the sample households for the study first discussion were made with woreda experts and cooperative members and model beekeepers. Accordingly 20 beekeepers households per woreda were used for the structured questioner interview. Therefore a stratified random sampling method was used to select the respondent households for the study. Accordingly 20 beekeeper respondents per study woreda have been randomly selected for the interview. Hence to collect information regarding bee forage plants and related parameter (like identification of common bee flora with their flowering time, importance, seasonal forage availability in relation to colony strength and honey production etc.) for the study, the sampled beekeepers were individually interviewed with structured questionnaire Pre-test and recognizance survey were also conducted to see effectiveness of the questionnaire for the study; and then the sampled respondents were interviewed with the help of trained enumerators and house to house interview and visual observation of the interviewed bee flora by the researcher.

Key informant interview: Key informant interview have been made with all study district beekeeping expert, development agents (DAs) of the study area, some individual beekeeper farmers. The qualitative information collected in

interview is used to supplement and crosscheck the data obtained through the household survey. Hence purposive sampling method was used for selecting members for the key informant interview.

Focus Group Discussions: Focus group discussions were conducted in the study area with purposively selected PA leaders, Das and bee technician, and some individuals, who are believed to be knowledgeable about bee flora plants in the area, were part of the discussion. Hence, purposive sampling method was used for selecting focus group discussion members.

Honey sample data: to strengthen the house3holds survey data on the assessment of type of honey plants, 10 honey samples per selected study woreda were botanically analyzed and the result described with major and minor observed pollen types in the laboratory.

Statistical Analysis

The data collected during the social survey were summarized using descriptive statistical methods (such as frequencies, percentage and graphs) and the data collected from honey samples botanical analysis were summarized and presented in the form of tables. Descriptive statistical procedures in SPSS version 20 and excel (word 2007) were used to summarized the data.

MATERIALS AND METHODS

Description of the Study Area

Sidama zone

The study was carried out in Sidama zone of Southern Nations, Nationalities and Peoples' Region (SNNPR) located in central part of the region. Astronomically it is situated between the coordinates of $5^0$45' and $6^0$45' N latitude and $38^0$39' and $38^0$29' E latitude with altitude ranging from 1100 to 3500 meters above sea level (masl) (BoFED, 2010). Rainfall pattern of the zone is bimodal type with small rainfall during the months of February to April followed by the main rainy season from July to September. Sidama zone consists of 19 districts with total area coverage of 10,000 km^2 (SDC, 2000).It has a diverse agro ecology classified as high lands (dega), midlands (woinadega) and semi-dry lowlands (kolla) covering 30%, 60% and 10% respectively (SDC, 2000). The farming system of the zone is characterized as mixed crop and livestock farming system. The zone is endowed with different livestock resources viz. Cattle, small ruminants, equines, poultry and honey bee.

Gedeo zone

Gedeo is a Zone in the South Nation Nationality and People Regional State (SNNPR) of Ethiopia. This Zone is named after the **Gedeo people**, whose homelands lie in this zone. The zone is well known by producing high quality coffee (Yirgacheffe-Coffee) to international market. Gedeo is bordered on the east, south and west by the Oromia region, and on the north by Sidama. Dilla is the administrative center; other towns include Yirgacheffe (which is provider of internationally high quality of organic coffee), Wonago, Fisahagenet Chelelekitu Gedeb and Bulle.

Physical features Location

Gedeo Zone is located in 369 km from Addis Ababa to southeon Addis Ababa-Moyale international road and 90 km from Hawassa (capital city of the region) in South Nation Nationality and People Regional State (SNNPRS). On the basis of the current border delineation, the land area of the region is estimated at 1347.04 square kilometers. Geographically, the Zone is located North of Equator from 50 53'N to 60 27'N Latitude and from 380 8' to 380 30' East, Longitude. The altitude ranges from 1500 to 3000m.

Climate The zone has sub-humid tropical climate receives mean annual rainfall 1500 with range of 1200 and 1800 mm. The rainfall pattern is bimodal, with short rain season between March and May accounting for 30% of total rain fall and long rain season between July and October accounting for more than 60 % of total rainfall. The mean monthly temperature is 21.5 oC with mean monthly maximum and minimum temperature of 25 oC and 18 oC, respectively. The Zone experiences three distinct agro ecologic Zone Namely 'Dega' (30%),'Woyina Dega' (67%) and 'Kefil-Kola' (3%).

Demography Based on figures from the CSA, in 2005 this zone has an estimated total

Table 1: presents the demographic characteristics of sample respondents in study woredas.

		Woredas					
Variables		shebedino	dale	wonago	Kochere	Total	X^2
sex	male	15	19	17	18	69	4.6299*
	female	5	1	3	2	11	-
age	mean	29.1263	1.98	32.5918	3.26	-	1.3696
Education level	illiterate	2	4	6	10	22	12.000
	1-6	10	8	8	3	29	-
	7-12	8	8	6	7	29	-
Family size	mean	6.2745	2.134	5.2200	11.223	-	5.717*
Marital status	single	5	5	2	3	15	1.9783
	married	13	14	17	17	61	-
	divorced	2	1	1	-	4	-

Source: Survey data.
**P<0.05, across column*

Table 2: Land ownership of the respondents

Woreda	Total land /ha	% of respondents	annual crops land/ ha	% respondent	perennial crops land	% of respondent	Grazing Land in ha	% of respondent	self-developed forest	% of respondent
Shebedino	1.15	10.5	1.11	58	.37	24.9	0.07	42.3	1.2	21.8
Dale	1.13	40%	1.5	24.1	.55	30.4	0.19	40	0.18	34.9
Wonago	2.25	12.5	1.80	10	.70	18	.25	15.0	.25	51.0
Kochere	3.5	20	2	3.1	1	9.6	0.47	18.1	0.52	40.4

population of 820,944; of which 411,163 were males and 409,781 were females with annual growth rate of 2.9%. 118,440 or 14.4% of its population are urban dwellers. Gedeo zone is one of the most densely populated regions in the country with an estimated population density of 617.53 people per square kilometer.

Survey data Analysis Results

Socio-demographic characteristic of farmers

The result of this finding (table 1)shown that 11 and 69 percent of the sample respondents were female and male headed households respectively. Sex of the household head in the all woredas has significant difference at 0.05 percent significance level.

Family size also showed variation at 0.01 percent significance level due to the same reason (5.22 in shebedino and 6.27 in wonago). Education level has shown no variations between the woredas. Only two percent of the respondents in shebedino woreda are illiterate whereas it is 10% in Kochere.

The study was encompassed 82% farmers from selected peasant associations of all study Woreda were males and the remaining 18% were female beekeepers (table 2).

As it is illustrated in the table the minimum land holding by small scale apiculture farming experienced farmer in both Sidama and Gedeo zone woredas is 1ha, but maximum land holding in Gedeo zone Woredas(Wonago and Kochere) was about 3.5 ha while it is1.15ha for Sidama Woreda(shebedino and Dale). The minimum land holding for farmers in the area is 1ha and maximum land holding is 3ha for apiculture activity experienced farmers. Majority of the farmers in the area have about 2h land (43.8%), 37.4% farmers and 22.1% allocate1.3ha and 1.75ha land allocated by interviewed farmers. AS to allocation of land to annual crop was concerned 40.5 % farmers allocate 1 ha land for annual crop,15.6 % of household allocate.26ha,.71ha and land for perennial crop

Table 3: List of some bee forages plants and their flowering period in Gedeo zone (Wonago and Kochere) and Sidama zone (shebedino and Dale) Woreda.

Flowering season	**Tree species/grass/legumes**	**Woreda**	**Flowering season**	**Tree species /grasses/legumes**	**Woreda**
September	Avocado **(****)**	Gedeo(Wonago and Kochere)	September	Pea, fababean, potato, eucalyptus tree, banana,haricot bean	Sidama(Shebedino and Dale
October	Bahirzaf, Avokado, Mango **(****)**	Gedeo(Wonago and kochere	October	Adeyabeba, weeds, haricotbean,maize,octtover,November	Sidama(Shebedino and Dale
November	Avocado, mango, bisana, wanza, (****)	Gedeo(Wonago and Kochere	November	Adebabeba,weeds,grasses,Grawa	Sidama(Shebedino and Dale
December	Birbira,avocado,mango,bisana,wanza	Gedeo(Wonago and Kochere	December	Papaya,banana,Rejicho **(****)**	Sidama(Shebedino and Dale
January	wanza,barzaf,avocado, birbira,girawa,bisana	Gedeo(wonago and kochere	January	Papaya, banana, mesencho **(****)**	Sidama(Shebedino and Dale
February	Avocado,buna,bisana, mango, ,giraw	Gedeo(Wonago and kochere	February	Coffee, ,mango,avocado,rejicho	Sidama(Shebedino and Dale
March	Zeytuna,avocado,Coffee,birbira,wanza,mango,bazaf,bisana,girawa	Gedeo(wonago and kochere	March	Coffee, ,mango,avocado,maize, harriotbean ,bissana,girawa	Sidama(Shebedino and Dale
April	Avocado, Coffee bisana,wanza,girawa,barzaf,adey abeba	Gedeo(wonago and kochere	April	Coffee,mango,maize,h/coat bean,avocado, bissana,girawa,mikicho	Sidama(Shebedino and Dale
may	Bisana, Coffee,wadicho,Tado,adey abeba,bahirzaf,mango	Gedeo(wonago and kochere	may	Coffee,avocado,mango, maize,h/bean bissana,girawa	Sidama(Shebedino and Dale
June	papaya,wanza, adeyabeba bisana,mango,avocado,barzaf	Gedeo(wonago and kochere	June	Maize,h/bean (****)	Sidama(Shebedino and Dale
July	bahrzaf,Avocado,,mango,bisana,wanza,girawa	Gedeo(wonago and kochere	July	Maize,h/bean (****)	Sidama(Shebedino and Dale
August	birbira,,avocado,mango,bisana,wanza	Gedeo(wonago and kochere	August	Maize,h/bean	Sidama(Shebedino and Dale

N.B (****) *– The areal dearth period for Bees.*

by 9.3% and 75% household farmers respectively. From total interviewed farmers almost all farmers (96.6%) possess natural forest in their vicinity that is so suitable for apiculture farming in the Woreda.

Major natural forests of Shebedino, wonago, Kochere and Dale Woreda

Some of Peasant Association in shebedino Woreda where natural forests exists in abundant were: Grawa, wanza, coffee, Bisana, Rejicho, Mesincho, grar, kulkual, bahirzaff Adelbole and others (table 3).

Availability of natural forest with adequate apiculture flora in the study areas

About 81.5 % and 94 % of household interviewed own natural forest nearby to their dwelling residence from Sidama zones

Table 4: Major natural flora tree species.

No.	Common name or scientific name of plants/shrub	Agro ecology where the plant grow potentially	Flowering seasons of specified plant
1	Eucalyptus species	Mid altitude	April –may
2	Wanza	Mid altitude	December-January
3	Girawa	Mid altitude	November –December
4	Bisana	Mid altitude	February-April
5	Girar	Mid altitude	March & September
6	coffee	Mid altitude	October -February
7	Bahirzaff	In all agroeology	Year round

Table 5: Major cultivated bee forage crops

No.	Common name or scientific name of plants/shrub	Agro ecology where the plant grow potentially	Flowering seasons of specified plant
1	Bean & pea	Mid altitude	September-November
2	Sorghum	Mid altitude	‘’
3	Maize	Low & Mid altitude	June-august
4	Telba	Low altitude	‘’
5	Haricot bean	Mid altitude	May-September
6	wheat	Mid altitude & high altitude	September
7	Yabesha gomen	Mid altitude	March - April
8	Fosolia	Mid altitude	September-October

Table 6: Major weedy bee forage crops and their corresponding potentially growing agro ecology

No.	Common name or scientific name of plants/shrub	Agro ecology where the plant grow potentially	Flowering seasons of specified plant
1	Mech	Mid altitude	October- December
2	Adeyabeba	Mid altitude	September -October
3	Clovers	Mid altitude	August –September
4	TurumbaAbeba	mid altitude	Year round
5	Serdo grass	Mid altitude	September –October
6	cowpea,sesbania	Mid altitude	November

(shebedino and Dale) and Gedeo zones (Wonago and Kochere) Woreda peasant associations respectively. as to existence of wide variety land size of natural resource of forest in Woreda, nothing is exploited concerning to apiculture production.

Diversity and seasonal availability of bee forages

The major hone flow season in Sidama zone woredas is from September to November in the first stage and from April to May in the second stage, and in Gedeo zone woredas, fist stage, June to July and second stage, January to march and it could be varied based on availability of rainfall and honey bee flora. More over these, bushes, trees, weeds and shrubs in the natural forest provide year round flora for apiary in the study area. The major bee forge bee plants identified in Sidama and Gedeo zones study Woredas illustrated in the table accordingly below. Most of these plants found in Natural forest of corresponding peasant association in Woreda and some found in their surrounding localities that developed artificially.

Major natural and cultivated bee forage crops (oil crops, pulses and cereals and their corresponding growing agro ecology) in study woreda.

In table 4,5,6, the major tree categories in the natural forest in this area consists of eucalyptus tree, Bahirzaff, gravilia, coffee,Tid, Grawa, wanza, and Warka. In addition to these horticultural fruits and vegetables in the specified village are Avocado, mango, banana and papaya.

Table 7: Sidama zone honey pollen analysis data result

No	Honey samples	Place of collection	Major Pollen/flora type	Minor type
1	Ss01	shebedino	Guizotia, Coffee Arrabica	Eucalyptus spp.
2	Ss02	shebedino	Eucalyptus globulus	Trifollium spp.
3	Ss03	shebedino	eucalyptuscamcldulensis	Coffee arabica
4	Ss04	shebedino	Guizotia	Pissam sativum
5	Ss05	shebedino	Brassica spp.	Guizotia
6	Ss06	shebedino	Eucalyptus spp.	Vernonia spp.
7	Ss07	shebedino	Eucalyptus spp.	Guizotia
8	Ss08	shebedino	Guizotia, Eucalyptus	Vernonia spp.
9	Ss09	shebedino	Guizotia, Datura Arborea	Eucalyptus,Guizotia
10	Ss10	shebedino	Vernonia spp., Eucalyptus	Unidentified
11	SD11	Dale	Accacia spp.,	Sorghum bicolor
12	SD12	Dale	eucalyptus Coffee Arrabica	Accacia,datura arborea
13	SD13	Dale	Accacia spp., Coffee Arrabica	Guizotia
14	SD14	Dale	Brassica spp.	Guizotia
15	SD15	Dale	Eucalyptus	Unidentified
16	SD16	Dale	Bidens prestinaria	Crassoephalumvitellinum
17	SD17	Dale	Eucalyptus, Coffee Arrabica	Coriadrum sativum
18	SD18	Dale	Cyprus., Coffee Arrabica	Hypoestes trifolia
19	SD19	Dale	Eucalyptus, Coffee Arrabica	Lipidium sativum
20	SD20	Dale	Eucalyptus	Coffee Arrabica

Table 8: Gedeo zone honey pollen analysis result

No	Honey samples	Place of collection	Major flora/pollen plants	Minor flora identified
1	Gw1	Wonago	Eucalyptus	unknown
2	Gw2	Wonago	Lipidium,Vernonia	Accacia spp.
3	Gw3	Wonago	Accacia spp.	Grass spp.
4	Gw4	Wonago	Eucalyptus	unknown
5	Gw5	Wonago	Vernonia, Lipidium	Trifollium
6	Gw6	Wonago	Triffolium, Lipidium	Vernonia
7	Gw7	Wonago	Lipidium	Coffee Arabica
8	Gw8	Wonago	Coffee arabica	Vernnia spp.
9	Gw9	Wonago	coffee arabica	Trifolium
10	Gw10	Wonago	coffee arabica	Triffolium
11	GK11	Kochere	Lipidium	Romex
12	GK12	Kochere	Lipidium	Guizotia
13	GK13	Kochere	Acacia	Vernonia
14	GK14	Kochere	Vernonia	Eucalyptus
15	GK15	Kochere	Coffee Arabica	Eucalyptus
16	GK16	Kochere	Lipidium	unknown
17	GK17	Kochere	Vernonia, lipidium	Unknown
18	GK18	Kochere	Eucalyptus	Coffee arabica
19	GK19	Kochere	Lipidium	Vernonia,acacia,grass
20	GK20	Kochere	Pisum sativum,	Brassica

Honey sample collection and Laboratory analysis

Fresh honey samples from different agro-ecologies at different seasons were collected for laboratory analysis. A total of 1 kg/farmer honey samples were collected per sites of the study area from 10 beekeepers across the actual surveyed farmers. The pollen analysis was made following the methods adopted by Louvuex 1978, for determination of botanical composition and frequency of pollen grains in the honey at Holleta Bee research center Laboratory. During the course of present investigation 10 honey samples were collected from 4 study districts between January 2014 to May 2014.

Sidama zone districts honey samples result

As shown in table 7, the majority of the shebedino and dale woreda honey samples were dominated by Vernonia, Eucalyptus, and Guizotia and Coffee Arabica species.

Gedeo zone districts honey samples result

As shown in the table 8, Majority of the

wonago and Kochere woreda honey samples were dominated by Lipidium, coffee Arabica, Eucalyptus and Guizotia species.

Major constrains of Honey bee production system in the study Districts

a. Limited knowledge of about the potential of the area

The main problem to beekeeping farming in Wonago and Kochere Woreda was that the relevant agricultural offices have limited knowledge about the natural potential and constraints of beekeeping sector in the districts. Although better potential in apiculture, Shebedino and dale woredas have better awareness in beekeeping activities than Kochere and wonago. Most of Woreda experts did not have clear idea about the existing system and potential for development of apiculture in the Woreda. As the result, the sector was not considered as a priority marketable commodity in the strategic plan of the Woreda of agricultural offices. However, during the assessment study and constraints and potential identification survey farmers in the area identified apiculture as one of priority marketable commodities and income earning activity for resource poor farmers in the Woreda.

b. Traditional way of harvesting and postharvest management system

As to on farm interview, the major constraint that hindered apiculture production and productivity in the area is apiary mismanagement, lack of awareness, and traditional way of harvesting honey bee products. All the farming societies in specified location perform hunting rather than following scientifically defined way of harvesting and collecting honey. In Kochere and wonago woreda of Gedeo zone, the farmers harvest honey by climbing to tree through rope and thoroughgoing the hive to the ground simply. Before througing the hives to ground, they prepare the plastic and or leaves with enset so that the honey will not be poured on the land. The farmers also prepare another new hives on strait upward to broken old hive so that the honey colony will back in to it.

c. Lack of organized marketing system and information asymmetry

The marketing system of honey bee products in wonago and Kochere Woreda characterized as traditional, one sided and full of constraints. The small scale farmers in the area are only price taker. It is the buyers that determine the price of honey. There are no more cooperatives formed for collecting and marketing honey bee products at specific area. It is somewhat better in Shebedino and Dale woredas of Sidama zone.

d. Lack of improved beekeeping, product processing equipment and better management option

As to the study, the small scale farmer in the Keble lacks: improved hives, access to improved beekeeping system and management options.

e. Lack of skill and knowledge of bee keeping

During the survey, it was observed that most of apiaries were kept in traditional way; all hangs their hives on big natural forest that was far away from their residence and difficult to immediate supervisions and checking ups. At the time of on farm assessment study it was understood that the small scale farmers hadn't accessed to any form of training and awareness creating research demonstration on apiculture farming. limited adoption of modern technology in Wonago and Kochere than shebedino and dale woredas.

f. Lack of established market system and institutional linkage

Traders are price makers and small scale farmers price takers, no cooperatives organized, marketing information sources are traders. As there was limited improved processing equipment and better understanding on apiculture, the small scale farmer forced to Market crude honey had a negative role for better exploitation and efficient utilization existing resources in all study woredas.

g. **Honey bee enemies and agricultural chemicals**

From the respondent farmers in table 9, almost all farmers apply chemical for their weeds in Gedeo and Sidama area and its surrounding in the time interval starting from 1hr AM until 12PM local time of afternoon while all the apiary are

Table 9: major honey bee enemies and control measures in the study area.

Major honey bee enemies	Major damages caused on bee	Rank on causing damage	Prevalence seasons	Controlling mechanisms Adopted
Ant	Disturbance,eating brood,honey bee and honey	First	wet season	Using Olomo plant, firing, daily follow up and using hot water, benzene
hamagot	Disturbance,breaking hives,and eating honey and wax and killing bees	Second	All year round	Fencing with 'eshoke',
Small Beetle	Honey and larvae eating	Third	All year round	Seasonal management and cleaning
Birds	Eating honey bees	forth	All year	Using 'wonchif'
Spider	Killing and Eating honey bees	seventh	All year	Cleaning, daily follow up
Human	Disturbance, thiefting of honey bee colonies	Sixth	All year	Community participation, gardening
Wax moth	Eating honey bees	Fifth	Wet season	Strict closing, daily supervision

Source: Survey data: 2005-2006Ec

active in the field by collecting pollen and nectars. One of major constraints that hindered farming activities the apiculture not to exploit the available were existence of honey bee enemies such as wax moth, ant, spider, human and chemical application at the time of optimal honey bee working hours..

The honey bee management and close up way was somewhat good in Sidama zone woredas as compared to other study Woredas on Gedeo. The very common honey bee enemies located in the area and constrained exploitation of apiculture farming comprises of hamagot,ant, birds, spider, wax moth and human.

CONCLUSION AND RECOMMENDATIONs

As to the study under taken in the selected areas, the apiculture farming is untouched, with lots of potentials, possibilities and resource endowment that could boost the sector in the region above all the rest areas in it. Existence of different sorts of flora across all the year, suitable agro -ecology for apiaries, availability of natural forest in almost all the study areas are some of major potential that encourage every citizen on the sector in the region. Even if there are some basic constraints that have to be taken a due considerations such as lack of improved honey bee flora and improved apiculture equipments, prevalence of honey bee enemies, limitation of introduced technologies to the sites; the existing potential could make the study area one of the model apiary site in not only in the region but also in the country level. Hence, giving due attention and implementing scientifically proven practices such as establishment of small scale farmer apiculture cooperative, capacity building, pre-scaling up of improved apiculture farming techniques, undertaking general assessments potential level of apiculture in the region and designing promoting and technology adoption strategies could help the sector to boost from the existing potential and could take a lot of small scale farmers out of poverty by assuring food security, and increasing income earning from the sector.

From this study it was ought to receive or learn that knowledge on flora resources data and their flowering time schedule is in the first place possible and which is more appropriate to local condition for honey bees productivity in Sidama and Gedeo zone .It is noted that, there are many bee visited plants in the area since the area have high forest resources, and Coffee, Grawa, Guizotia, Eucalyptus, Lipidium and Vernonia species dominate in all selected woredas both in social survey and honey samples botanical analysis data and, it is necessary to conduct further research on Flora plants should be identified at National herbarium level with honey samples pollen analysis and floral calendar should be prepared in agro-ecological base to the area and it is possible to have flora based organic honey from this area to national and international market with integration of value chain. Meanwhile, most of

the farmers in study districts raised that the Key Ababa or Tarfasa in Sidama and balewotet key Ababa in Gedeo is locally assumed to kill bees and it is necessary to conduct visual and laboratorial evaluation research on this plant either it kills or not.

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