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Beekeeping practices, trends and constraints in Bale, South-eastern Ethiopia

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The study was planned to assess beekeeping practices, trends and constraints of beekeeping production in Bale, south-eastern Ethiopia in 2014/2015. Three districts were considered based on variations in agro-ecology (high, mid and lowlands). From each districts, two Rural Kebele (RKs), from each RK, 30 beekeepers and a total of 180 beekeepers were selected using purposive sampling method. The selected beekeepers were interviewed using pre-tested structure questioners and single- visit - multiple formal survey method to collect the data. The data revealed that the majorities (98.26%) of the respondents follow traditional production system. An average honeybee colony holding size of the study area was about 6.18 per head with 5.70 kg mean honey yield per traditional hive and no record for transitional and movable-frame beehives. From result of this study, the major challenges of beekeeping identified were: Application of herbicides and pesticides, pests, lack of beekeeping equipment's, shortages of bee forages, lack of improved beehives, migration, absconding, lack of extension services, swarming, and death of bee colonies in order of their importance. The study identified major beekeeping constraints and beekeeping practices in Bale zone. Hence, it requires high attention and both techniques and technology intervention to make benefit of the large beekeepers in Bale zone and the country in general.

Key words: Beekeeping, practices, trends, honeybees, constraints, marketing, Bale.

INTRODUCTION

Beekeeping has been practiced since ancient times and honey has been considered by many cultures as a valuable and precious commodity that is used in traditional rituals, healing or as food (Lietaer, 2009). In nearly all countries of the world bees and their products are not only well known and have wide consumer preference, but provide sustainable livelihoods to many small scale farmers and other rural and non-rural people (FAO, 2012).

Ethiopia has a longstanding beekeeping practice and

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endowed with huge apicultural resources and it has been an integral part of other agricultural activity, where about one million households keep honeybees. More than 5.15 million hived honeybee populations are found in the country (Adgaba et al., 2014). Owing to its varied ecological and climatic conditions, Ethiopia is home to some of the most diverse flora and fauna in Africa. Its forests and woodlands contain diverse plant species that provide surplus nectar and pollen to foraging bees. Beekeeping is one of the oldest farming practices in the country. There is an ancient tradition for beekeeping in Ethiopia which stretches back into the millennia of the country's early history (Girma, 1998). Of all countries in the world probably no country has a longer tradition of beekeeping than Ethiopia (Hartmann, 2004). Ethiopia is a leading country in Africa and ninth in the world in honey production, respectively. Similarly, it stands first in Africa and third in the world in beeswax production (CSA, 2012; MoARD, 2013).

Although there was long tradition of beekeeping in Ethiopia, having the highest bee density and being the leading honey and beeswax producer in Africa, the share of the sub-sector in the GDP has never been commensurate with the huge potentiality for beekeeping. Productivity per bee colony as well as the product quality has always been low, leading to high domestic utilization, and low export earnings. Hence, the beekeepers in particular and the country in general are not benefiting from the sub sector (Nuru, 2002).

Beekeeping in Bale has been practiced for a long time. The nature of diversified flowering plant species and agro-climatic conditions has enabled the area to sustain a number of honeybee colonies. Bale is generally known by its great potential for honeybee resource (Paulos et al., 1999). Beekeeping in this zone is the basic sources for cash income generating to subsistence farmer, supplementary food and environmental conservation (Solomon, 2007). So far, in Bale there is no/little compiled and reliable information on beekeeping practices, production potentials and constraints of beekeeping. The numbers of beekeepers, number of honeybee colonies, amount of honey produced, type of beekeeping practiced and way of handling honeybee products are not well known. On the other hand there is high global demand for natural products like honey and beeswax with huge difference between supply and demand. Moreover, farming system approach to research and development is recognized as the most appropriate method used to describe, diagnose and gain knowledge of the technologies and factors affecting production at farm level (Amir and Knipscheer, 1989). Hence, this study was proposed aiming to investigate information on beekeeping practices, trends and constraints of beekeeping production in Bale.

Therefore, the overall objective of this research was to avail all valuable information on beekeeping practices, trends and constraints of beekeeping production that improve the understanding of users both for more competitive local and international markets with the following specific objectives:

1. To asses beekeeping practices, trends and constraints of beekeeping production and productivity,
2. To identify market constraints and flow of honey and beeswax.

MATERIALS AND METHODS

Description of the study area

Location, climate and vegetation

The study was conducted in Bale Zone of Oromia Regional State which is located in Southeastern part of Ethiopia within 7°, 00'N and 39° 45'E and 7°, 30'N and 39°, 30'E of latitude and longitude, respectively (Ethiopian Mapping Authority, 1988). The study focuses on high, mid and low altitude where natural forests exists which includes Dinsho (07°, 07' and 39°, 51' latitude and longitude, respectively with 2860 m altitudes), Dellomenna (06°, 24'N and 39°, 50' latitude and longitude, respectively with 1278 m altitudes) and Adaba (07°, 02'N and 39°, 27' E of latitude and longitude, respectively with 2386 m altitudes) districts. The districts were purposively selected for the study which representing different agro-ecologies of Bale Zone (Figure 1).

The study area had a mild subtropical highland with annual mean minimum and maximum temperature of 2 and 20°C, respectively (Williams, 2002). Temperature tends to be severing with a high probability of frost during the night time particularly at higher altitude of Sannate, Dinsho and Rira areas. The area receives a bimodal rain fall (SARC, 2001). The main rainy season extends from August to December and the short rainy season stretch from March to July. Rainfall is highly seasonal on the northern slopes of the mountains, with most of the mean annual rainfall occurring between July and September.

Bale is very glorious which has unique and diverse fauna and floras in which dominant flowering plants exist. The most known and common flowering trees found in the area are: *Alnizia schimperiana, Azadirachta indica, Cajanus cajan, Cordia Africana, Croton Macrostacyus, Dombeyatorri, Erica arborea, Eryythrina abyssinica, Hygenia abyssinica, Hypericum revoltum, Hypericum roeperianum, Moringa olefera, Nuxia congesta, Olea europaea, Prunus Africana, Schefflera abyssinica, Syzygium guineense, Vernonia amygdalina, Ziziphus Mauritian, Coffee arebica (Forest coffee),* and *Erythrina brucei* (SARC, 2014).

Site selection and sampling techniques

The study was designed to assess beekeeping practices, trends and constraints of honeybee production in the study area through interviewing beekeepers. In the study, a total 180 farmers male and female were purposively selected based on owing bee colonies (minimum three to five bee colonies) to participate in the study interview. For this background information of each beekeeper was collected from secondary sources, mainly zone/district livestock agency offices of each study district. In addition, some secondary data was also taken from books, journals and research publications and internet. Informal interview was conducted in the study area involving district and rural kebele's officials and extension agents. Semi-structured questionnaires was developed and used to collect reliable data /information.

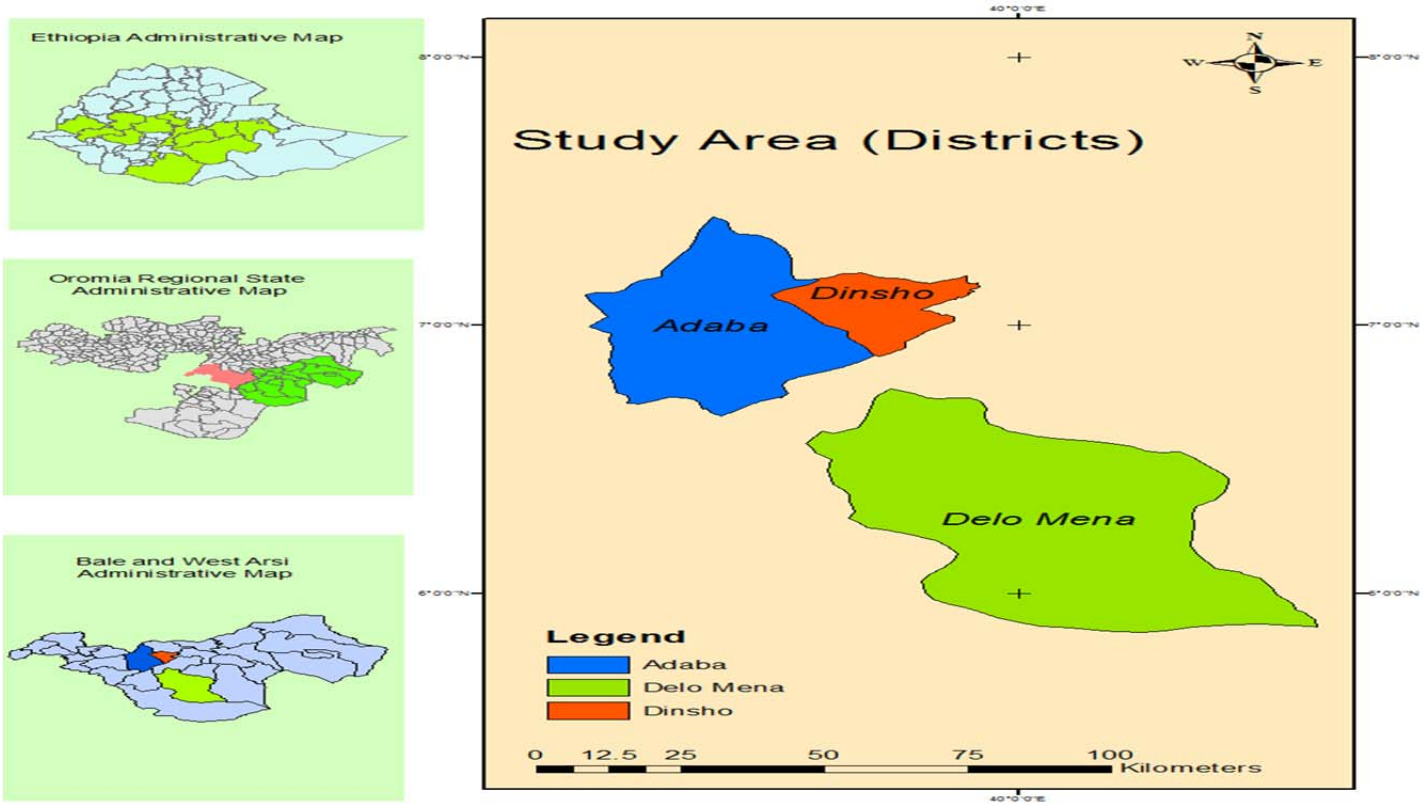

Figure 1. Map of study areas.

Single-visit-multiple-subject formal survey method (ILCA, 1992) was employed to collect data on various aspects of beekeeping production and management practices. The enumerators who had knowhow on beekeeping were recruited to collect the data under the supervision of the researcher after training on the methods and the whole concepts of the data collections.

Data collected

Wide range of information with regards to beekeeping practices, trends and constraints of honeybee productions were gathered both qualitative and quantitative data through the aforementioned conventional survey method, which includes the following major data categories:

1. Socio-economic characteristics of the respondents: Sex, age, family size, and honeybee colonies holding.
2. Beekeeping production practices: The present number of hives owned and type of hives use.
3. Constraints of beekeeping in the area: Honeybee pests and agro-chemicals application.

Data management and statistical analysis

All data was entered in to MS- Excel spread sheets after the completion of data collection work from the study areas. Then the data was analyzed using *SPSS version 20* Software and the data was summarized using descriptive statistics (mean, mean comparison, frequency, percentages and ranges). Multi-response analysis was also used for variables needs to be ranking.

RESULTS AND DISCUSSION

Socio-economic characteristics of the household

Out of the total 180 household respondents participated in the study to generate qualitative and quantitative data on beekeeping, about 99.44% were male headed and the rest 0.56% were female headed households. This arises from the traditional believe that beekeeping is a man's activity and women are therefore not allowed to undertake beekeeping activity in the study area. It is a cultural taboo restricting women to harvest honey and therefore, the few women that are involved in this study employed men to undertake most of the tasks ranging from hive construction, hanging of hives on trees and subsequent bee product harvesting. Similarly Hartmann (2004) reported that in Ethiopia traditionally beekeeping is men's job and Workineh (2006) also reported beekeeping as male-headed households dominated activity in AtsbiWemberta District of Eastern Zone of Tigray Region of Ethiopia.

Survey result showed that the beekeepers household head age ranges from 20 to 81 years old with mean age of 43.46 (Table 1) out of which more than 72% of the

Table 1. Mean comparison of age, beekeeping experience and family size of the respondents.

Variable	Total sample sizes (N= 180)							
	Adaba (N= 60)		Dinsho (N= 60)		Dellomenna (N= 60)		Overall	
	Range	Mean ± SE	Range	Mean ±SE	Range	Mean ±SE	Range	Mean ±SE
Age of respondent	22-67	40.78±1.52	20-81	45.33±1.78	22-80	44.27±1.92	20-81	43.46±1.01^{NS}
Total family size	1-18	7.55±0.43^{b}	1-13	7.37±0.42^{b}	1-20	9.10±0.53^{a}	1-20	8.01±0.27
Beekeepers' Experience	1- 32	13.17±1.12^{b}	1- 60	15.78±1.70^{ab}	2-70	19.60±1.96^{a}	1-70	16.18 ±0.96

ab = The mean difference is significant at the 0.05 level; NS = Non significant; SE = standard error; N = number of respondents.

Table 2. Proportions of beekeepers religion of sample respondent.

Variable	Total sample sizes (N= 180)			
	Adaba (N= 60)	Dinsho (N=60)	Dellomenna (N= 60)	Overall
	Percentage	Percentage	Percentage	Percentage
Religion				
Orthodox	68.3	23.3	0	30.6
Muslim	28.3	76.7	100	68.3
Protestant	3.3	0	0	1.1

respondents age was less than 50 years old. The result indicated that there were no significant difference (P>0.05) in age between the studied districts, that is, Adaba (40.78), Dinsho (45.33) and Dellomenna (44.27). This result showed that beekeeping can be performed by all age groups and reasonably without any difficulties and more actively performed by younger age groups. Similarly Chala et al. (2012) reported the most productive age are actively involved, accommodating experiences from elders and finally become independent beekeepers.

The average family size per household during study time in Dellomenna (9.10) was significantly higher (P<0.05) than that of Adaba (7.55) and Disho (7.37), but, there was no significant difference (P>0.05) between Adaba and Dinsho districts (Table 1). The overall mean family sizes of respondents were 8.01 and ranges from 1 to 20 persons per household. Workneh (2006) stated that family sizes of 6.6 and 5.9 for beekeepers technology adopters and non-adopters, respectively in AtsbiWemberta District of Eastern Zone of Tigray Region, showing high beekeepers household which might suggest adopting beekeeping somehow alleviate the problem of food and competition for other resources arisen from high household member. The higher family sizes observed at Dellomenna might be because of the higher practices of polygamy found in the area.

Survey results revealed that there were significant different (P<0.05) in Beekeeper's experience between Dellomenna and Adaba districts with no significant difference (P>0.05) between Adaba and Dinsho, and Dellomenna and Dinsho districts (Table 1). The total mean of the three locations were 16.18 years' experience with range of 1 to 70 years. Besides, the correlation between age of beekeepers and beekeeper's experience indicated that strong positive and highly significant relationship (r = 0.582, N = 180, P = 0.00), showing engagement in beekeeping from early age (Gichora, 2003).

Regarding religion, in the surveyed area about 68.3% peoples were Muslims and the remaining 30.6 and 1.1% were Orthodox and protestant respectively (Table 2) and it indicated that Muslim religion was the dominant religion in the study area. Moreover, the correlation analysis indicate that there were positive association between religion and number of bee colonies owned and adoption of improved beehives, but negative association between religion of the respondent and their beekeeping experiences. This is might be because of both Christians and Muslims uses honey during holy days and also Christians use beeswax in Church for light.

Beekeeping practices in Bale

Beekeeping is not new practice or activity in Bale and generally in Ethiopia; it is an ancient farming activity which is practiced as a sideline with other farm activities. Yet in Bale there are three types of beekeeping which include: Traditional, transitional and movable-frame based on the types of beehives used.

Traditional bee hives

The data collected from the study area showed that traditional beehives was categorized in to three different

Table 3. Average honeybee colony holding in traditional hive per households.

District	Minimum	Maximum	Mean±SE
Adaba	1	98	4.47±1.60[b]
Dinsho	1	45	4.04±0.87[b]
Dellomenna	1	105	10.27±2.0[a]
Overall	1	105	6.26±0.92

ab = The mean difference is significant at the 0 .05 level; SE = standard error.

Figure 2. Traditional beekeeping at backyard on the top and in the forest at bottom.

types; this includes: Log*(Bidiru)*, Mud (*Dogogo*) and Basket hive type, but all were oval in shape with the dimension of around 90 to 100 cm in length and a diameter of approximately 30 cm. As information gathered from the respondents, they were plastering interior of hive by mud and cow dung to protect bees from cold weather conditions and external part were covered with grass and bamboo sheath (*hoyine*) to protect from rain and sun.

According to the survey result, the mean honeybee colony holding in traditional hive in Dellomenna (10.23) was significantly higher ($P<0.05$) than that of Adaba (4.47) and Dinsho (4.04) districts. But, there were no significant difference between Adaba and Dinsho (Table 3) in owning bee colonies in traditional beehives. The overall mean of bee colony holding in traditional was 6.26 and the minimum and maximum were 1 to 105 per household respectively. Hartmann (2004) reported that in high land of Ethiopia farmers normally do not possess more than 10 beehives.

According the survey result, until now traditional beekeeping is practiced in two forms, traditional forest beekeeping which is practiced in forest by hanging beehives on long trees and with no management given for bees and bee products. This way of beekeeping is the dominant ways of honey and beeswax production system in the study area. The second form is traditional back yard beekeeping which is practiced around homestead with relatively better management provided to bee colonies as compared to forest beekeeping (Figure 2).

Transitional beehive

It is one of the improved methods (technology) of beekeeping practiced in the study area. However, its

Table 4. Mean and range comparison of honey yields in kilogram per traditional hive.

Districts	Total sample sizes (N= 180)		
	Minimum	Maximum	Mean ±SE
Ababa	3	15	5.64±0.33[b]
Dinsho	1	10	4.37±0.28[c]
Dellomenna	1	20	7.07±0.39[a]
Overall	**1**	**20**	5.70±0.21

abc = The mean difference is significant at the 0 .05 level; SE = standard error; N = number of respondents.

dissemination is very limited and this might be due to poor beekeeping extension services in the study area. The study showed the average transitional bee owning per households were 1.75 which is insignificant as compared to traditional beekeeping practice. However, there is a recent effort by GO (research center and Bureau of Livestock Health and Marketing) and NGOs in introducing transitional Kenya top bar (KTB) beehives as well as providing training to framers. The training was focused on hand on practices that equip the beekeepers with skill to prepare his own KTB from locally available material to overcome the high cost of investment.

Moveable-frame hive beekeeping practice

The quantity and quality of hive products production primary depend on the type of beehive used. According to the result of this study, the use of movable-frame hive was very low as compared to traditional beehive with overall mean holdings of 3.57 and maximum 8 and minimum 1 hives per household. This is probably because of poor beekeeping extension services and weak intervention on beekeeping by government and non-government organizations in the study area. Currently, the costs of movable frame hive ranges from 36.5 to 54.8 USA dollars which is not affordable by small holder farmers as information gathered from livestock development and marketing office of Adaba, Dinsho and Dellomenna districts. Moreover, movable-frame hives allow appropriate colony management and use of a higher level technology, with larger colonies, and can give higher yield and quality honey but are likely to require high investment cost and trained man power (Crane, 1990).

Hive products from different types of beehive

The amount of any hive products differ from place to place and from hive to hive type depending on different factors (like the availability of flora, colony strength and management given) exists. The overall mean of honey yield harvested in the study area during study time was 5.70 kg with minimum 1 kg and maximum 20 kg was recorded from traditional hives. There were significant difference ($P<0.05$) between Adaba (5.64±0.33), Dinsho (4.37±0.28) and Dellomenna (7.07±0.39) (Table 4) districts in honey yields per hive from traditional hives. This was probably because of the fact that the variability of flora and whether condition differences exists between districts and also difference in management practices of beekeepers. The lowest honey yield per hive was recorded at Dinsho; this was also because the most cold weather condition and the highest yields were reported at Dellomenna which is the low land area and relatively higher flora could be found at Dellomenna. From this study, it is realized that lowland area is more conducive for beekeeping than high land areas. The current result was similar with Ethiopian national average and Workneh (2006) that stated the average amount of honey harvested per traditional hive in West, South West and North Shewazones to be 6.2 kg. In this study, honey yield from transitional and movable frame was not compared with each other and traditional hive because there were no product records on all districts. Furthermore, there were also no results of beeswax yield presented because no data/information gained from beekeepers. This is might be because beekeepers in the study area did not start using beeswax and even they have not known about this product.

Indigenous knowledge of beekeeping

In the study area beekeepers have good indigenous knowledge of traditional beekeeping. According to the responses of the sample respondents, the indigenous knowledge used by the interviewed beekeepers were smoking baited hive by swarm attractant materials like *Ekebergia capensi* (*anonu*), honey harvesting time by smelling, observation at the beehive entrances for what resources the honeybees are collecting and insert stick to beehive to check for honey presence, controlling reproductive swarming by removing brood, strengthening of colony by feeding like *harcee* (over lefts of flour of different grain), honey as local medicine, control of honeybee enemies by different means like cleaning around apiary and using metals and strings (*kiyyo*) around the entrance of the apiary site for honey badger,

Table 5. Causes of decreasing trend of beekeeping in Bale.

Causes of decreasing trend of beekeeping	Total sample sizes (N= 180	
	Percentage	Rank
Lack of bee forages	30.0	2nd
Drought	17.6	7th
Migration	24.8	4th
Absconding	27.4	5th
Pests and predators	20.4	3rd
Bee diseases	5.5	9th
Pesticides and herbicides application	49.6	1st
Death of colony	16.4	6th
Lack of credit	20.0	8th
Lack of attention	1.8	10th

For each rank, the causes of absconding trend can be evaluated out of 100% by multiple response analysis method and the winner take its percentage.

swarm catching, identification of adulterated honey by smelling, tasting and looking color of honey. Similarly, Solomon (2009) and Tessega (2009) reported as beekeepers have deep indigenous knowledge of beekeeping. Moreover, it requires scientific support from research; indigenous knowledge of the beekeepers contributions to the beekeeping development of the area is significant and has paramount importance to improve quantity and quality of honey as well as other hive products.

Beekeeping trends in bale

The majority (98.26%) of the respondents follow traditional production system with only few beekeepers started using transitional (0.38%) and movable-frame (1.36%) beekeeping production system. It is also most similar with the data obtained from districts Office of Livestock Development, Health and Marketing office that indicate about 96.66% of the farmers use traditional, 2.70% transitional and 0.64% movable-frame bee hive production system. Shunkute et al. (2012) reported in Kaffa, Sheka and Bench-Maji zones of Ethiopia traditional beekeeping practice is the dominant system accounting for more than 99% of the total, while intermediate and modern hives are less used (<1%).

Out of the 180 interviewed beekeepers the majority (70%) agree on the decreasing trends in the yields and the number of honeybee populations due to the effects of climatic change from time to time (Table 5) and this finding agree with Tessega (2009) and Haftu and Gezu (2014) who reported shortage of bee forages, drought, pesticides and herbicides application, lack of water, decreasing in number of bee colony, lack of improved beehives and poor management as reasons for the products and honeybee population decline. Whereas, 29.4 and 0.6% of the rest respondents agree with increasing and unchanged way of production system respectively. However, those categorized as increasing production system asked what the reason for increasing production system and they were given responses as availability of good honeybee's floras, added more bee colonies, good market price for bee products, awareness of beekeeping production system and start use of new beekeeping technologies in the area.

On the other hand the survey data indicates that beekeeping production system of the study area has shown slight improvement from 2010 to 2014 in beekeeping trends from traditional production system to improved transitional and movable –frame beekeeping production system (Figure 3).

Beekeeping constraints in bale

The major beekeeping constraints are technical and institutional which come from honeybee's characteristics or environmental factors that are beyond the control of the beekeepers, whereas others have arisen with poor marketing infrastructure and storage facilities. Based on the information of the sample respondents, there are a number of difficulties and challenges that are hostile to achieve the success of desired honey production. The identified and prioritized major problems facing the beekeeping activities as indicated in Table 6.

Honeybee pests and diseases

According to the result of the current study, presences of pests are major challenge to honeybees and devastate their products. The ranks of top ten harmful pests were indicted in Table 7. Shunkute et al. (2012) reported that great loss of total honey production per annum can be caused by honeybee enemies (40.7%) mainly by pest.

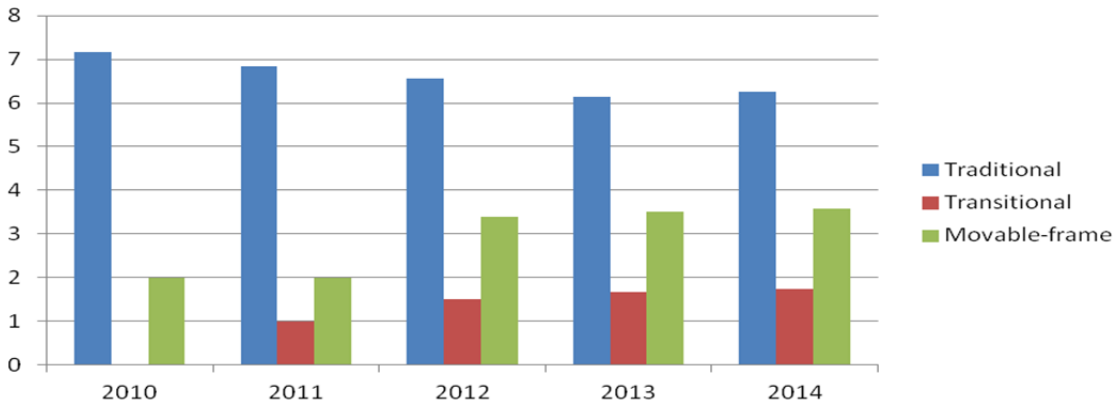

Figure 3. Beekeeping trend in the study area from 2010 to 2014 (source: resurvey result).

Table 6. Major constraints identified by respondent beekeepers in the study area.

Major beekeeping constraints	Total sample sizes (N= 180)	
	Percentage	Rank
Application of herbicides and pesticides	54.9	1st
Pests and predators	30.2	2nd
Lack of beekeeping equipment's	22.1	3rd
Shortages of bee forages	14.7	4th
Lack of improved bee hives	16.1	5th
Migration	11.0	6th
Absconding	12.5	7th
Lack of extension services	20.0	8th
Swarming	11.8	9th
Death of bee colonies	12.5	10th
Lack of good market	14.3	11th
Drought	1.3	12th
Lack of bee colonies	0.6	13th

For each rank, the constraints can be evaluated (competed) out of 100% by multiple response analysis method and the winner take its percentage.

Table 7. Major honeybee pests and predator found in Bale.

Pests and predators	Total sample sizes (N= 180)	
	Percentage	Ranks
Honey badger (*Mellivora capensis*)	49.2	1st
Spiders (*Cheiracanthium punctorium*)	27.5	2nd
Bee-eating birds	18.2	3rd
Ants(*xuxi*) (*Dorylus fulvus*)	24.3	4th
Bee lice (*Braula coecal*)	16.4	5th
Beetles (*Aethina tumida*)	28.6	6th
Snake	33.3	7th
Wax moth (*Galleria mellonella*)	13.4	8th
Monkey	3.6	9th
Wasps (*Vespula germanica*)	50.0	10th

For each rank, the predators can be evaluated out of 100% by multiple response analysis method and the winner take its percentage.

Figure 4. Traditional means of protecting honeybees from pests (Honey badger).

Other researches also reported similar findings (Desalegn, 2001; Tesfaye and Tesfaye, 2007; Tessega, 2009) in the central highlands of Ethiopia, in eastern mid rift valley of Ethiopia and in Burie District of Amhara Region respectively. According to this study, honey badger attack was a serious problem regarding the animal to be number one honey bee enemy of the area. About 98.26% the traditional honey production system is vulnerable and easily attacked by honey badger for being situated far away from residential areas where protection is so minimal. As a result of the honey badger attack a considerable amount of honey and other hive products was lost and bees absconded. Following honey badger spider and bee-eating birds with 27.5 and 18.2% took the second and the third most serious bee enemies' position presented in the area (Table 7).

There were numerous traditional and indigenous knowledge of ways practiced by the beekeepers to control/prevent pests in the area. However, these traditional means of pest control/protections are not effective to alleviate the problems, calling for research support to develop good prevention mechanisms. For instance, beekeepers traditionally put ash around hive stand to prevent the attack of most common pests like ant and also fix smooth iron sheet on the trunks of a tree where hives are hanged to prevent the up climbing of honey badger, destroying ants nests, remove old comb, fumigation hive with different smoking materials, hanging hives on long trees, chasing honey badger using dog, killing badger using *wax mad* (Figure 4) are still widely and commonly practiced by the beekeepers of the areas as means of controlling bee enemies.

Concerning bee diseases, about 25.6% of sample respondents had observed honeybee's diseases in their hive; some of the respondents called this honeybee disease *Mansa* which weaken the colony, unable to fly, dead bees fall on floor and bee death in mass were some of its symptoms. According to the sample respondents, this disease mostly occurred during dearth *Bona* season when honeybees become weak. But the majorities (74.4%) of sample respondents have not observed honeybee diseases and have no any clue about it. This is not indicating absence of honeybee diseases rather it showed lack of awareness.

Agro-chemicals poisoning

Agro-chemicals poisoning are agricultural inputs used to control weeds, pests and fungus in order to boost yield of crops or used to control ecto-parasites of animal. Farmers in Bale primarily produce wheat, Barely, bean, field pea and horticultural crops. They use various types of agro-chemical without any consideration to damage it cause to honeybee colonies. Beekeepers indicated that a number of bee colonies either die or abscond from their hives due to the extensive and unsafe use of agro-chemicals to mainly control crop pests. Sample respondents have been requested to mention presence of agro-chemicals that poison honeybees in their locality and most (93.9%) of the respondents replied that as poisoning chemicals used and only 6.1% was said not used in their locality. The main agricultural chemicals reported to be used in the study area were 2,4D (two four D), Pallas, Topic,

Table 8. Factors needs agrochemicals applications with % reaction of the respondents to its effect on honeybees.

Chemical poisoning honeybee's	Total sample number (180)	
	Yes (%)	No (%)
Crop pests	94.8	5.2
Weeds	98.3	1.7
Malaria	11.6	88.4
Tsetse and other ecto-parasites	5.8	94.2

Round up, Malethine, DDT and other Fungicides types. Kerealem et al. (2009) and Taye and Marco (2014) reported similar issues about effect of agro-chemicals. These chemicals directly or indirectly affect the life of honeybees or honeybee's production. As sample respondents mentioned most agricultural chemicals used were in July (7.8%) August (39.5%), September (35.9%), October (10.8%), November (1.8%), April (0.6%), May (3%), and June (0.6%). This indicated that in the study area the main season agrochemical spraying ranges from July to October and for the second season spraying ranges from April to June. These chemicals were mostly used for control of crop pests (94.8%), weeds (98.3%), malaria (11.6%) and tsetse and other ecto-parasites fly (5.8%) (Table 8). Information gathered from respondents revealed that due to agro-chemicals application a number of honeybee's colony and honeybee production decreases from time to time. The chemicals affect honeybees in two main ways, first by direct killing a number honeybees on field and when bring nectars and pollen sacking to the hive a number of broods and adult honeybees in the hive and the second way is by killing honeybee's flowers on the field which otherwise used to serve as major food sources of honeybees. In short, these problems are technical, management and policy issues and can affect the production and productivity of beekeeping in the study area and in general in Ethiopia. Therefore, much focus has to be given to alleviate the effects of poisoning from agrochemicals to ensure productivity, quality and safety of beekeeping in the study area and in the country as a whole.

According to the sample respondents, planting flowering plants around their apiary, giving additional feeds during spraying time, moving honeybees colonies from the spraying area, closing hive entrances during spraying day(s), not to plough land around and leave for honeybees flowers, timely spraying before plants start to flower, adjusting time of chemical application are some of the mechanisms practiced to protect honeybee colonies from agro-chemicals spay effects.

Honey and beeswax marketing and market constraints

According to Mendoza (1995), marketing channel is the sequence through which the whole of honey passes from farmers to consumers. The analysis of marketing channel is intended to provide a systematic knowledge of the flow of the goods and services from their origin (produce) to the final consumer. During the survey, the majority (93.3%) of the respondents replied positively for the question if they sale honey with only 6.7% negatively. This indicated that most of the beekeepers in the study area undertake beekeeping to generate cash income from selling honey.

During the study period the average price of crude honey per kilogram was 85.75 Ethiopian birr with minimum 30 and maximum 180 Ethiopian birr per kilogram. It was also understood that there were price variations which based on honey quality mainly on the color of honey, tastes, season (time) and distance from market point. Honey price was low during the peak production season and high during the slack season. Also honey with light color and good tastes fetch better price. As well, occasional incidences of traditional ceremonies can upsurge honey prices while and increased distance from market point negatively affected the price. According to the opinion obtained through this study, honey with amber (golden) color and clear honey is highly preferred on the market. Whereas, dark color is inflict suspicious for the presence of foreign matters and regarded as low quality for which not preferred by consumers.

In this study, lack/absence of market information, lack of transportation, low price and price fluctuation at harvesting time, brokers *(dallala)*, lack of cooperatives, distance from market, were identified as the main bee products market problems. It was also understood that about 92.8% of the respondents responded increasing market trends that can be manifested in increased price of honey from time to time. This suggests high demand for honey that encourage the beekeepers to more involve in beekeeping activities through adopting improved and productivity and quality enhancing beekeeping technologies.

In the study areas, about 98.3% of the sample respondents sold their honey to the nearest local market and only few (1.7%) sold at their home. In the market the main customers of honey were '*Tej'* houses (55.6%), middlemen's (82.2%), retailers (54.6%), whole sellers (48.3%) and beekeepers co-operative (5.6%) (Table 9).

Table 9. Percentages of honey customers on market in the study districts.

Customers category	Who are your customers?	
	Yes (Percentage)	No (Percentage)
'*Tej'* houses	55.6	44.6
Middlemen	82.2	17.7
Retailers	54.6	45.4
Wholesalers	48.3	51.7
Beekeepers co-operative	5.6	94.4

Tessega (2009) reported the same idea. The supply and demand analysis of the honey showed very high (52.5%), high (20.5%), medium (11.2%), low (1.7%) and very low (14%) and the supply was not enough (79.3%), enough (20.1%) and excess (0.6%). This result revealed that the supply and demand on market is going on opposite direction which shows un-balanced way of marketing system calling for productivity enhancing interventions.

In the study area as a whole, collecting and selling of beeswax and other hive products by beekeepers was not known or started. Even in the area the beekeepers awareness about other hive products is very low. Therefore, future beekeeping intervention is very crucial in the area on bee products diversification to contribute to improved livelihoods of the community.

Conclusions

Beekeeping practices in Bale is an ancient farming activity which was practiced as a side line activity with other farm activities. It is a potential with full available resources. But, its development is still at infant stage and this is due to poor extension services. Based on the finding of this study, it can be concluded that beekeeping in the study areas is dominantly defined as men's job with only few women beekeepers involved. But, women play important role in the marketing of honeybee products. Survey data indicated that beekeepers in the area had deep indigenous knowledge of traditional production system. In the area three beekeeping production systems were identified, with traditional beekeeping dominating up to 98.26% being practiced in two forms (forest and back yard beekeeping) with transitional and frame beehive beekeeping accounting 0.38 and 1.36% of the production system, respectively. Based on this, a conclusion can be drawn that beekeepers did not fully benefited from this sub-sector.

This study also identified application of herbicides and pesticides, pests, lack of beekeeping equipment's, shortages of bee forages, lack of improved beehives, migration, absconding, lack of extension services, swarming, death of bee colonies, marketing problems, drought, and lack of bee colonies as major beekeeping challenges of the study areas.

Therefore, from the present study the following points can be forwarded and recommended:

1. Emphasis should be given to rigorous training program for the community focusing on the practical aspects of beekeeping and involvement of women and youth on improved beekeeping technologies to raise awareness and promotion of beekeeping.
2. Owing to the presently identified very weak beekeeping extension service in the area, strengthening the extension services is suggested.
3. Although there is a bee products price increasing trend, still bee products marketing in Bale zone is informal and lacks structure. Hence, establishing market networks and developing market information delivery system for bee products is paramount importance to bring price incentive development stimulation.

Conflicts of Interests

The authors have not declared any conflict of interests.

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