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Full Length Research Paper

Sources of information and information seeking behavior of smallholder farmers of Tanqa Abergelle Wereda, central zone of Tigray, Ethiopia

Gebru Brhane[1*], Yared Mammo[2] and Gebremichael Negusse[3]

[1]Abergelle Agricultural Research Center, Tigray, Ethiopia, P.O.BOX 44, Abiadi,
[2]Haramaya University, Ethiopia.
[3]Tigray Agricultural Research Institute, Mekele, Ethiopia.

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Smallholder farmers have different information seeking behaviors which are changing through time. However, as far as the authors' knowledge is concerned, there is no research carried out to identify it in the study area. Therefore, this research is to reveal the information seeking behavior of the Abergelle woreda smallholder farmers. For the research design, from the 19 rural kebeles of the woreda, 5 kebele were randomly selected and 152 household head were selected by using simple random sampling technique proportion to their population size from the sampled kebeles. The study adopts both primary (household survey and focus group discussions); and secondary data sources (relevant published and unpublished materials). To analyze sources of information and information seeking behavior of the smallholder farmers, frequency and ranking were employed. The findings revealed that smallholder farmers prefer to seek information from farmers, agricultural professionals, health extension workers, radio and mobile-phone. The main challenges for seeking information, among others are shortage of infrastructure, lack of ICT and service fee, lack of interest and inadequate users' skill and knowledge. It is concluded that smallholder farmers' use multiple sources of information as no one source is sufficient in itself. Finally, it is advisable to repackage agricultural information into various formats to meet smallholder farmers' information seeking behavior.

Key words: Information seeking behavior, smallholder farmers, Tigray, Ethiopia.

INTRODUCTION

Agriculture is an information-intensive industry (Rutger, 2000). The livelihood of the population of Ethiopia is highly dependent on the performance of agriculture. Agriculture contributes 42.7% to GDP, about 80% of

*Corresponding author. gebru04@gmail.com

employment and 70% of export earnings (MoFED, 2013). Agriculture contributes 42.7% to GDP, about 85% of employment and 70% of export earnings (CSA, 2015). As most of the people in Ethiopia depend on agriculture, agricultural knowledge and information are the basic ingredients for increasing production as well as development in the country.

Information is power and an im portant working tool for the advancement of human and society (Apata and Ogunrewo, 2010). According to Malhaam and Rao (2004), knowledge and information have become significant factors for production of goods and services. And, the future of food security in the developing world is increasingly becoming dependent more on information and knowledge than inputs (IFPRI, 2004). The demand for agricultural production is growing from time to time but the land for cultivation is fixed while the population size of the study area is increasing; therefore, improving the productivity of the land through application of new methods of farming and technologies is crucial. In this new information age, information is becoming the key factor for agriculture production more than natural resources, cheap labor and financial capital (World Bank, 1992). Equally, vibrant communication on new ideas and technological innovations for the improvement of agricultural production and productivity is crucial as well.

Habtemariam et al. (2015) reported that rural farmers transfer their knowledge to their neighbors, friends, relative and children mainly through informal discussion, experience sharing and inviting other farmers to visit their own farms. Sources of agricultural information in the study area can be categorized as organizations and individuals. The individual information sources are development agents (DA), extension experts, model farmers, elders, neighbors, friends, relatives, agricultural researchers, health extension workers and administrators. Among others, organizations like *wereda* OoARD, Abergelle Agricultural research center, Mekele universities, Axum University and ILRI are indicated as sources of agricultural information for smallholder farmers in the study area as well.

Ethiopian government gives more emphasis on the five year growth and transformation plan in improving the agriculture sector to continue as the main engine of the national economy. One of the strategic pillars stated under the GTP II, is to increase productive capacity and efficiency to reach the economy's productive possibility frontier through rapidly improving quality, productivity and competitiveness of agriculture (MoARD, 2015).To make the plan real, the government is giving more emphasis to transfer information on best agricultural practices to smallholder farmers. Information dissemination resulted from the recognition of smallholder farmers needs to lead to innovativeness in solving existing agricultural problem. Information gap keeps rural people stagnant and they cannot participate actively in the process of agricultural production and productivity improvement.

Information is an important factor in the sustained development of any society since getting the required information on time helps to reduce uncertainty and improves the quality of decision made in solving agricultural problems. In this information society, information and knowledge play a key role in ensuring sustainable development (Koutsouris, 2010). Farmers' information seeking behavior is hindered by its poor relevance, usefulness and lack of technical advice for follow-up (Babu et al., 2011). Information seeking behavior is an essential component in the designing and developing of need based information sharing technique to meet the information needs of users. Without adequate information, particularly to the rural smallholder farmers, there might be lack of information on agricultural innovations. Lack of access to needed information by smallholder farmers reduces information seeking behavior of smallholder farmers.

In Tigray region in general and Tanqua Abergelle *Wereda* in particular, there is shortage of location specific empirical studies that deal with smallholder farmers' sources of information and information seeking behavior. This underscores the importance of conducting research on the topics in smallholder farmers in the study area. In the study area, productivity of agriculture score in research organization and model farmers is by far more than the productivity of agriculture run by majority of the smallholder farmers. The existing Ethiopian government shows commitment to narrow the productivity gap scored between model and fellow farmers through scaling up and scaling out of best agricultural practices. In the study area, the production and productivity of agriculture is still low.

Information has been identified as an important resource for smallholder farmers. Having acknowledged the importance of information resources, the management of Tanqua Abergelle *Wereda* has invested so much to ensure smallholder farmers' access to timely and relevant agricultural information by employing agricultural development workers, health extension workers, mass media and public leaders found at different levels. However, in Tigray in general and Tanqua Abergelle district in particular, there are no previous studies carried out on the analysis of sources of information and information seeking behavior of smallholder farmers. Therefore, the overall objectives of the study were to: identify and analyze sources of information and the information seeking behavior of the smallholder farmers; and to explore the challenges that the smallholder farmers experienced when they sought information in the study area.

MATERIALS AND METHODS

Tanqua Abergelle woreda is located in Central zone of Tigray

Regional State. The study area is located about 120 km west of Mekele, the capital city of Tigray region, and at a distance of 900 km far away from Addis Ababa, the capital city of Ethiopia. According to the current administrative division, the woreda is sub divided into 19 rural kebele and one urban kebele administrations. The bordering areas of the woreda are kola-Tembien woreda in the north, Saharti-Samre woreda in the south, Degua-Tembien woreda in the east and Nadier-Adiet woreda and Amara Region to the west. The topography location of Tanqua Abergelle woreda is found in kola (below 1, 800 m.a.s.l) and Weina dega (1,800 to 2,400 m.a.s.l). According to this classification, Tanqua Abergelle Woreda is located within two of these topographic regions. That is about 95% of the total land area of the Woreda is estimated to be in the Kola topographic region whereas, the remaining 5% lies in the Weina Dega. According to OoFED (2014) projected estimation, the population of the woreda is about 110,499 of which about 56,339 (50.99%) are male and the remaining 54,160 (49.01%) are female. The wereda has about 24,661 household. In sex ratio, 19,337 (78.41%) are male headed household and 5,324 (21.59%) are female headed household.

The predominant economic activity in Tanqua Abergelle is agriculture. The agriculture system is a mixed farming, which includes both crop production and livestock rearing. Out of the 144,864 ha land area about 31,417.5 ha is cultivable (OoARD, 2014). Smallholder farmers of the study area get information from agricultural information sources. The individual agricultural information sources are DA, extension experts, model farmer, elders, neighbors, friends, relative, agricultural researchers and different level of public leaders. And, the respondents get agricultural information from organizations like wereda OoARD, agricultural research, university and NGOs.

The sample size was specified based on Yamane (1967) simplified formula. The formula adopted 95% confidence interval to the determination of representative sample. When the formula is applied, the sample size of the study was specified into 151.764 and when it rounded up to 152. To select representative sample, the study adopted two stage sampling technique. In the first stage, out of 19 rural kebeles in the study wereda, five rural kebele were selected randomly. In the second stage, a total sample of 152 small households were selected randomly by using probability proportionate to size from each of the sampled kebele. Looking at the uniformity of the response of the focus group discussions, the researcher limits the number of focus group discussion into ten.

The study used both quantitative and qualitative types of data, through primary and secondary data sources. The collection of primary data was carried out on 2016 by interviewing sample household heads and focus group discussion. The study used well reviewed semi-structured questionnaire and checklist. Secondary data were collected from relevant published and unpublished documents. This study employed descriptive statistical analysis methods; mainly frequency, ranking and percentages were employed. The statistical analysis for the study was carried out by using stata version 12.1.

RESULTS AND DISCUSSION

Information seeking behavior of smallholder farmers

This section focuses on analysis of sources of information and information seeking behavior of smallholder farmers. Table 1 demonstrates the information need of farmers on agricultural tools. Smallholder farmers seek information from personal extension workers (78.9%), woreda agricultural extension experts (57.2%), family (51.3%), farmers development group members (45.9%), friends and neighbors (37.5%), cell phone (26.3%), conference and meeting (21.7%), radio (29.6%), printed materials (22.4%), cooperatives (17.1%), different level of administrative members (19.7%), agricultural researchers (7.2%), demonstration and field days (10.5%) and agricultural input suppliers (5.3%). Such dependency of farmers on many information sources is similar to that of Ekoja (2010) who concluded that it is difficult to find common sources of information for all people in developing regions of the world.

The result of this study indicated that smallholder farmers use information seeking behavior to make decision whether to intensify their farming and use agricultural technologies. Most of the rural farming households were highly dependent on non-formal information sources like personal experience, family, village meetings, friends and neighbors, farmer groups and model farmers in their day to day decision making process. These findings are similar to those of other studies on agricultural information seeking behavior (Lwoga et al., 2011; Boz and Ozcatalbas, 2010). In the second level, farmers seek information from agricultural workers like DA, subject matter specialist (SMS) and agricultural researchers. In the third level, they also use traditional and modern information and communication technologies (ICTs), mostly radio and mobile phone (Balarane and Oladele, 2012).

Table 2 also indicated that the results of the focus group discussion conducted with men and women based groups. Men focus group discussants also ranked agricultural professionals as the first and most important sources of information to smallholder farmers, whereas the women based focus group ranked neighbors and friends as the first source of information to farmers. Men and women focus group discussants had also differ in ranking their sources of information where the former group ranked neighbors/friends, development groups of farmers, family, model farmers, radio, cell phone, government administrative bodies, conference and meetings, printed materials, cooperatives and television in their order of importance.

The experiences of extension demonstrate that television and cooperative organizations play important role in transfer of information from the source to the end users. Yet, they have contributed little to inform the smallholder farmers in the study area. This little contribution might be due to low access to rural electrification and farmers who head the cooperative organizations might also have low level of understanding of information about modern technologies, like ICTs. On the other hand, women focus group discussants ranked neighbor, development group of farmers, health extension workers as their main sources of information in

Table 1. Source of information for smallholder farmers.

Sources of information used for accessing agricultural information by smallholder farmers	Household heads searched	
	No.	%
Extension agents	120	78.9
Agriculture extension officers	87	57.2
Family	78	51.3
Farmer development groups	69	45.4
Neighbors and or friends	57	37.5
Model farmers	56	36.8
Radio	45	29.6
Cell phones	40	26.3
Printed materials	34	22.4
Conference and meeting	33	21.7
Training	30	19.7
Different level of administrative members	30	19.7
Cooperatives	26	17.1
Demonstration	16	10.5
Television	11	7.2
Agricultural researchers	11	7.2
Health extension workers	11	7.2
Input suppliers	8	5.3
Farmers research group	7	4.6

Multiple responses were allowed.

Table 2. Result of FGDs ranking information sources searched by rural farmers.

Information sources	Rank	
	Men's group	Women's group
Extension experts (DA, SMS, and age researchers)	1st	4th
Neighbors and or friends	2nd	1st
Farmer development groups	3rd	2nd
Family	4th	5th
Model farmers	5th	9th
Radio	6th	8th
Cell phones	7th	7th
Different level of administrative members	8th	5th
Conference and meeting	9th	6th
Printed materials	10th	-
Cooperatives	11th	10th
Television	12th	11th
Health extension workers	-	3rd

descending order. They also mentioned that health extension workers have played important role to inform women farmers in the area. The women discussants ranked government administrative bodies, conferences and meetings; cell phone, radio, model farmers, cooperative organizations and television in order of their importance to inform women farmers in particular and the local society in general.

Purpose of information seeking

The result in Table 3 revealed that, as smallholder farmers usually seek information from different

Table 3. The purpose of information seeking among the smallholder farmers.

	Response		Rank
	No.	%	
Get advisory on how to use improved technologies	99	81.15	1
Accessing reliable and more timely information	16	13.11	2
Improve the quality of decision making	7	5.74	3
Total	122	100.00	

Multiple responses were allowed.

agricultural information sources. They used it to bridge the information gap they face to overcome agricultural production constraints. The sampled smallholder farmers showed that the information they gathered from multiple sources has been used to get advisory on modern agricultural technologies usage (65.1%), search reliable and more timely on current issue (10.5%) and help them make decision on which technology (or crop variety and livestock breeds) to use for agricultural production and productivity improvement (4.6%).

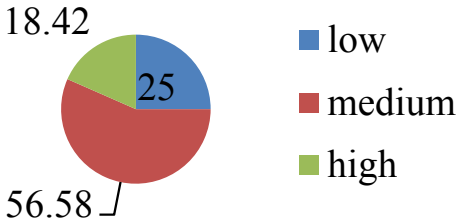

Figure 1. Farmer's satisfaction with information source.

Farmers' satisfaction level with the available information sources

Figure 1 shows that smallholder farmer's satisfaction level with the available agricultural information sources. The fact that information determines success or failure of any business entity in the 21st century, is very important to transfer useful agricultural information to end users (or smallholder farmers) in order to enable them improve their agricultural productivity. Likewise, users should have good information seeking behavior to fulfill their information needs. The farmers were asked if they are satisfied with information sources in supplying demand driven, timely and accurate information. This finding is in line with Meitei and Devi (2009) who reported that rural farmers are not getting the right information at the right time, leading to slow development of agricultural activities. The rural farmers responded to the question in three different levels namely, highly (25), medium (56.58) and low (18.42) satisfied level.

Challenges smallholder farmers faced when they seek information

Table 4 summarized all the challenges experienced while smallholder farmers search relevant information. The sampled smallholder farmers responded to the main problems they countered to gather important information. The result demonstrates that smallholder farmers were facing infrastructure shortage (power), lack of money to buy mobile phone, radio and service fee, lack of interest, incompatible format where the information is packed, and maintenance problem. Similarly, the findings revealed that there is lack of timely and locally specified information, users' inadequate knowledge and skills on how and where to access the required information and distance of information source (Table 4). The results are also supported by Chachhar and Hassan (2013), Mohammed (2014) and Miwanda et al. (2014) research findings showing that many developing countries face lack of infrastructure and service delivery from government.

Conclusions and recommendations

Information contributes a key role in enhancing agricultural production and productivity in the study area. Identifying sources of information and information seeking behavior of smallholder farmers is helpful to inform information service providers on what strategies to adopt for agricultural information dissemination and the improvement of agricultural productivity by applying relevant information. The smallholder farmers seek information mostly from non-formal information sources, extension workers, and administrative bodies found at different levels, and ICTs. The information seeking behavior of farmers were challenged by low rural electrification, lack of money to buy ICTs apparatus and pay service fees, poor information packaging and low

Table 4. Challenges facing smallholder farmers in seeking agricultural information.

Challenges	Households affected		Rank
	No.	Percentage	
Infrastructure shortage(power)	81	53.29	1
Shortage of money	64	42.11	2
Shortage of interest	30	18.73	3
Format in which the information is packaged	19	12.5	4
Maintenance problem	19	12.5	4
Shortage of locally specified information	19	11.85	4
Inadequate users knowledge	18	11.85	7
Distance to the information sources	15	9.87	8
Maintenance problem	7	4.61	10
Shortage of timely delivered information	4	2.63	11
Low capacity of the information sources	3	1.97	12
resources of the model farmers and ours is imbalance	2	1.32	13
Work overload	1	0.66	14

Multiple responses were allowed.

level of smallholder farmers' skill in using modern ICTs tools for searching agricultural information purpose.

Based on the conclusions drawn, the study recommends that government and nongovernmental institutions have to work to effectively and efficiently to enhance rural electrification. Moreover, repackaging of agricultural information into simple and understandable language and promoting modern ICTs makes a difference in overcoming barriers that smallholder farmers are facing in seeking relevant agricultural information in the study area.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interest.

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Full Length Research Paper

Assessment of honeybee enemies (pests and predators) in Bale zone, southeastern Ethiopia

Bekele Tesfaye*, Genet Dadi and Temaro Gelgelu

Oromia Agricultural Research Institute (OARI), Sinana Agricultural Research Center (SARC), P. O. Box: 208, Bales-Robe, Ethiopia.

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Among all constraints of beekeeping, natural bee enemies are known to cause great damage to the life and product of honeybees by causing disappearance and migration. A study was conducted in Bale from July, 2010 to June, 2012 in six districts with the objective of assessing the effect of natural bee enemies on the life of honeybees and their products. From each districts, 3 rural kebeles (RKs) and 10 beekeepers from each RKs were purposively selected and a total of 180 beekeeper participated. The selected beekeepers were interviewed using pre-tested structured questioners and single-visit-multiple formal survey method to collect the data. The collected data were analyzed using SPSS version 20 software and descriptive analysis method. Majority (96.86%) of the respondents in the study area followed traditional production system but only few beekeepers started transitional (0.88) and modern (2.26) beekeeping production system. In the study area, honeybees' enemies, agro-chemicals, lack of knowledge to manage bees and bee products, lack of bee colonies and bees poisoning from plants were identified as major beekeeping constraints. Respondents were asked to identify major honeybee pests and predators. Based on the result of this study, the existence of pests and predators were a major challenge to the honeybees and beekeepers in the study area. In all surveyed areas, the beekeepers reported the presence of Honey badger, spider, bee-eating birds, bee lice, beetles, wasps, Death Head hawks moth Mice and lizards in order of their decreasing importance. Traditionally, the beekeepers used their own control mechanisms of protecting these pests and predators like application of ash under the stand of the hive, hanging hives by rope on long trees, cleaning around the apiary site, using dog for large predators like honey badger, fencing their apiary site and mechanical like killing of the predators and pests, etc. About 72.6% of the respondents reported that honey production trend in the area decreased and 25.1 and 2.2% reported increasing and unchanged trend of production system, respectively. Despite the challenges of beekeeping, it is realized that there is potential of beekeeping in Bale, though the production system is traditional and there is an opportunity of improving the situation since there is plenty of beekeeping resources.

Key words: Enemies, honeybee, pests and predators, Bale zone.

INTRODUCTION

Ethiopia has a longstanding beekeeping practice and 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). Beekeeping is regarded to

be an agricultural venture with little or no land except a space to stand or hang hive; very little labor, almost no capital and most of the other inputs are considered to be locally available (Rubio, 2001). However, the success of apicultural activity depends on the biotic and environmental factors proffered by the ecosystem. Honeybee pests have been identified as one of the major biotic factors affecting the successful beekeeping practice (Oyerinde and Ande, 2009).

Like other living organisms, the life and products of honeybees are affected by harmful diseases, pests and toxic materials. Successful beekeeping requires regular and on time monitoring of any factor that endangers honeybee life and threaten their products (Desalegn, 2015). Honeybee colonies existing in the wild away from man's control produce small surplus honey above their requirements, signifying beekeeping is much more productive and profitable if they are only managed properly (Moeller, 1982). To this reality, protecting them from disease and pests have been recognized many centuries back and now a days became a key activity of beekeepers is to make the beekeeping more profitable (Crane, 1990).

Among all constraints of beekeeping; natural bee enemies (pests and predators) are known to cause great damage to the life and the products of honeybees by causing disappearance and migration, especially in Bale. In many parts of the world, research is under way to develop means to combat or prevent honeybee pests and predators. However, bee research in Bale is at its infancy and no investigation has been made on type of honey predators' distribution in Bale. These enemies includes: bees eating birds (*Merops species*), honey badgers (*Mellivora capensis*), wasps, ants which are the major problems hindering beekeeping activity in the zone. Even after small disturbances, thousands of bees will leave the nest to attack everything moving. If the bees do not succeed in driving away potential predators, they would immediately leave the nest and try to settle elsewhere in convenient surroundings/place. Beside their aggressiveness, a considerable high reproductive rate is another strategy of survival. Apart from these realities, there is no research information in Bale regarding honeybee pests and predators, production potential, beekeeping constraints and the existing opportunities for future. In order to address this problem, it is very important to identify the potential development which is bottleneck of beekeeping in Bale. Therefore, the objectives of this study were to identify beekeeping constraints and opportunities of beekeeping, to assess effect of natural bee enemies (pest and predators) and to assess farmer's awareness of the natural enemies and their control method.

MATERIALS AND METHODS

Description of the study area

The study was conducted in Bale Zone of Oromia Regional State which is located in southeastern part of Ethiopia. Bale is located at 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 area rages from lowland to high lands which represent different agro-ecologies of Bale with altitude range of 500 to 4377 m above sea level. The annual minimum and maximum temperature of the area extends from 2 to 20°C for high land (Williams, 2002) and 26 to 40°C for lowlands (RLDHMO, 2009). In the area, there are two rainy seasons, the first and the main season extends from August to December with rain fall of 270 to 560 mm and the second and the short rainy season goes from April to July with rain fall of 250 to 560 mm. The dry season covers from December to March (SARC, 2001). Floral diversity extends from lowland to high land and has good potential that provides the most appropriate environment for regulating and providing year-round foraging to honeybee populations except the most extreme high lands and lowland of the area.

Sampling methods and sample size

For the study, purposive sampling was employed to identify district(s) and the rural kebele (sites) in which the study was conducted. Six (6) districts (Sinana, Dinsho, Goro, Gindhir, Rayitu and Dellomenna) were selected, considering the different agro-ecologies, accessibility and potentiality of beekeeping. A total of 180 farmers, male and female participated who possess at least three to five bee colonies participated in the study. Secondary information was also gathered from Zonal and Districts Bureau of Livestock Development and Marketing Offices and livestock related sector before conducting the actual survey.

Data collection

The core points of the questionnaires focused on identification of pest and predators of honeybees and the management system practiced by beekeepers in the study area. Focus points included number of honeybee colonies owned, type of hives used, amount of honey harvested per colony, marketing system of honey, pre and post honey harvest management. Semi-structured questionnaires was developed and pre-tested with few farmers and re-framed in such a way that it was used to collect reliable data/information. Single-visit-multiple-subject formal survey method (ILCA, 1992) was employed to collect data on various aspects of beekeeping production, management practices and pests and predators identification.

Statistical analysis

All data were entered into 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 summarized using descriptive statistics (means, standard errors and percentages).

*Corresponding author. E-mail: tbekele2001@gmail.com.

Table 1. Socio-economic characteristics of the respondents.

Variables	Sample size (n = 180)	
	Frequency	Percentages (%)
Ages		
20 - 30	35	19.4
31 – 40	46	25.6
41 - 50	40	22.2
51 - 60	29	16.1
> 60	30	16.7
House hold size		
< 6	63	36
6 – 10	80	45.71
10 – 15	24	13.71
> 15	8	4.44
Farm land hold size		
None	5	2.8
0.5 - 2	97	56.7
2 - 5	54	30
Above 5 heck	24	13.3

RESULTS AND DISCUSSION

Socio-economic characteristics of the households

Table 1 shows that the household surveyed respondents age ranges from 20 to 90 years with mean age of 45.25 ± 14.83 (mean ± SD) out of which more than 67% age was less than 50 years old. This result was agreement with Tessega Belie, 2009 and Chala Kinati et al., 2010. The result indicated that young people in most productive ages are engaged in beekeeping and most of the respondent about 38.33% had an experience of 11 to 20 years old and only 17.78% had less than 10 years' experience. The rest had 17.78 (21 to 30 years), 12.4 (31 to 40 years), 8.89% (41 to 50 years) and 5% (more than 50 years) experience of beekeeping. From this, one could assumed that in Bale Zone, people are actively engaged in beekeeping starting from their early age in helping older beekeepers to undertake basic beekeeping tasks. Gichora (2003) stated that young people gradually move on to become independent beekeepers as soon as they can obtain their own hives. They continue accumulating experience by seeking technical advice from fellow beekeepers, development agents (DAs) and experts as necessary.

Concerning religion, in the surveyed area, about 71.1% of the people were Muslim and 28.9% were Christians and it indicated that Muslim religion was the dominant religion in the area. The family size of the respondents showed that maximum was 19 and minimum was 1 with mean averages of 7.16 ±4.02. This high family size is most probably because of high practice of polygamy in the area.

About 53.9% of the respondents had 0.5 to 2 ha of farmland, 30.0% had 2 to 5 hectares, 13.3% had more than 5 hectares and 2.8% of the respondents did not possess farmland. Tessega (2009) and Chala et al. (2012) reported similar subjects. In general, the result indicated that most of beekeepers benefited from less land and need not large land.

Sources of honeybee colonies to start beekeeping

The indigenous knowledge on beekeeping differs from beekeepers to beekeepers and also from place to place, depending on beekeeping experiences and exposure to beekeeping activities. When beekeepers were asked to explain how they started beekeeping, about 98.3% reported that they started beekeeping by catching swarms and only 1.7% started through inheritance from their family. Chala et al. (2012) reported that about 87.8% of beekeepers started beekeeping by catching swarm in Gomma district. The result showed that catching swarm was the dominant source in the study area and the beekeeping production system was mostly traditional and this is also most probably because of poor extension services system, poor adoption of improved beekeeping technologies, high costs of beekeeping equipment (but stated above possible to start beekeeping with no cost), lack of government and non-government organization dealing with beekeeping in the study area.

Table 2. Arrangement of beehives.

Placement of hives	Total sample sizes (N = 180)	
	Frequency	Percentage
Backyard	90	50
Under the roof of the house	75	41.7
Hanging on trees in forest	14	7.8
Both at backyard & hanging on trees in forest	1	0.6

Figure 1. Forest beekeeping at left lowland area and at right high land area.

Beekeepers replied that as 50% of them place at backyard and the remaining 41.7%, 7.8% and 0.6% were hanging on tree in forest, under the roof of house and both at backyard and hanging in forest respectively (Table 2).

Trends of beekeeping in Bale

Beekeeping is not new idea in Bale; 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 modern based on the types of beehives used. The data showed that the majorities (96.86%) of the respondents in Bale followed traditional production system but only few beekeepers stated transitional (0.88%) and modern (2.26%) beekeeping production system. Shunkute et al. (2012) reported that 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%) (Keffa, Sheka and Bench Maji is forest areas where beekeepers practiced more traditional method by hanging). In Bale, still traditional production practiced two forms, traditional forest beekeeping which is practiced in forest by hanging beehives on long trees and with no management care given for bees and it is the dominant way of traditional production system in Bale up to now (Figure 1) and the second form is traditional back yard beekeeping which is practiced around homestead and little management was given to this type of beekeeping production system.

Data showed that beekeeping production system in the study slightly showed improvement. Traditional production system gradually shifted to transitional and modern beekeeping system (Figure 2) which means that improved beekeeping technologies is practiced to harvest good quality and quantity of honey and other hive products in the area.

Table 3 indicates that about 72.6% of the respondent reported that beekeeping production decreased with regards to the yields of hives and the number of honeybees populations, this is because of climatic change from time to time as they said flowering plants found in the area previously diminished and only 25.1 and 2.2% increased and had stable production system respectively in the area. As their responses, the main

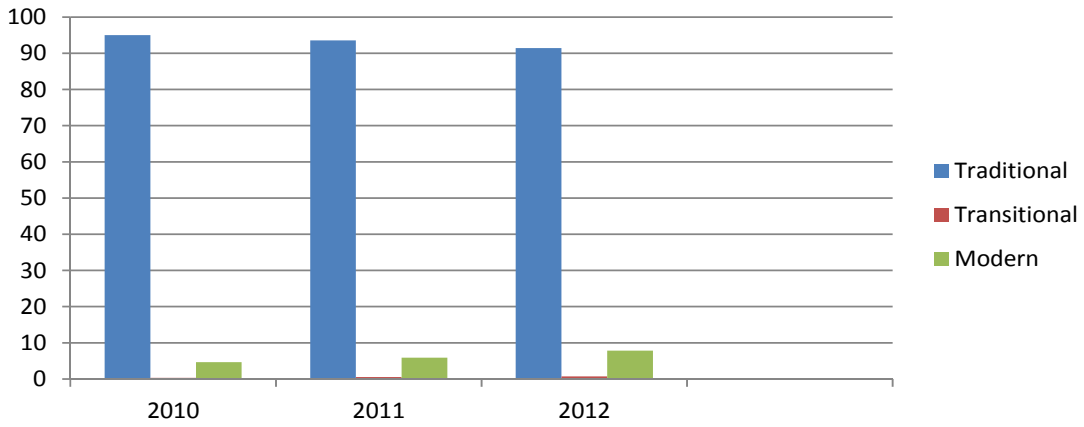

Figure 2. Status of beekeeping production system in Bale (2010 to 2012).

Table 3. Trends of beekeeping production system in the study area.

Trends of beekeeping	Frequency	Percentages
Increasing	45	25.1
Decreasing	130	72.6
Stable	4	2.2

reasons for decrease in production were: deforestation, un-wise use of pesticides and herbicides, presence of pests and predators in the area, absconding and migrations problem, lack of honeybee's forages, and bee colonies death were mentioned as the utmost problems for the deteriorations of product and productivity of honeybees and this result is similar to report of Tessega (2009) and Haftu and Gezu (2014).

Honey harvesting periods, production and management practices

In Bale, there were two honey harvesting period; the first was from November to January (peak periods) the second harvesting time was from May to August (the second peak time). Besides these major harvesting periods, there are many small harvesting periods which depend on the type of flowering plants and rainfall patterns in the study area. Among the total 180 respondents, 82.8% of them harvest honey twice within this period of the year, whereas only 7.2, 5.6 and 4.4% of the sample farmers responded that they harvest once, more than three, three times, respectively in a year. It was reported by the beekeepers that any production obtained in the remaining periods of the year would be left as a source of food for the colony to strengthen it for the next harvesting season. As indicated in Table 4, the annual mean average honey production obtained by sample respondents from traditional hives range from 7.40 to 8.52kg per hives from 2010 to 2012 but transitional and modern hives showed more improvement and there is no significant difference ($P < 0.05$) between transitional and modern bee hives (Table 4) this is because of poor management given to modern bee hives.

For the question, "Do you visit and inspect your beehives and colonies?" 97.2% of the respondents said "YES" and only 2.8% said "NO" and it indicated that most of beekeepers visit and inspect their beehives both externally and internally. About 42% of the respondents visit their bees when necessary, while 36.1% of them visit their bees every day (always) and the rest visit their bees to check if the hive was occupied with bees and at least during honey harvesting seasons. Only few farmers started internal hive inspection and most interviewed farmers practiced external hive inspections (Table 5). About 73.7% of the farmers responded that they clean around their apiary sites, while the rest (26.3%) do not. Only about 36.3% of the interviewed farmers gave additional food during dearth period and the remaining 63.7% did not give any additional feed; this is because of year round availability of flowering plants, except the extreme low areas.

Beekeeping constraints

Based on the results of the present study, the major constraints of beekeeping is the environmental condition

Table 4. Honey harvested in kilogram on different types of bee hives from 2010 to 2012.

Types of hives used	2010		2011		2012	
	Average	SD	Average	SD	Average	SD
Traditional	7.40	5.52	7.42	5.72	8.51	7.47
Transitional	12.00	9.27	11.80	7.08	11.17	8.35
Modern	12.93	7.84	13.84	9.58	15.02	9.69

Table 5. Frequency inspections/visiting of apiary site.

Time of visit	Frequency	Percentages
Always (every days)	61	36.1
Every three days	8	4.7
Every week	17	10.1
Every two week	12	7.1
When necessary	71	42

Table 6. The major constraints of beekeeping in the study area.

Beekeeping constraints	Rank
Un-wise use of pesticides and herbicides	1st
Honeybees enemies	2nd
Lack of knowledge to manages honeybees and bees products	3rd
Lack of bee colonies	4th
Bee poisoning from plants	5th

which includes: honeybees' enemies, bee poisoning due to agro-chemicals, lack of knowledge to manage bees and bee products, lack of bee colonies and bees poisoning from plants (Table 6). All of the beekeepers that participated in the study were requested rank their importance. Accordingly, un-wise use of pesticides and herbicides stand out which challenged beekeeping in the area and followed by honeybees' enemies (pests and predators), the detailed result is shown in Table 6. As mentioned, these constraints directly affected honeybees and hive products and had great impact on the economy of the beekeeping. Shunkute et al. (2012) reported in Kaffa, Sheka and Bench-Maji zones of Ethiopia, the same result.

Honeybees' pests and predators and controlling mechanisms

Honeybees' pests and predators

According to the result of the current study, the existence of pests and predators were a major challenge to the honeybees and beekeepers in the study area. The beekeepers reported the presence of the most harmful pests and predators in their area. Honey badger (*M. capensis*), spider *(Latrodectus mactan)*, bee-eater birds, bee lice (*Braula coeca),* beetles (*Aethina tumida*), wax moth *(Galleria mellonella)*, wasps *(Polistes fuscatus)*, death head hawk moth *(Acherontia atropos)*/(*Irbaataibiddaa in afanoromo*), mice, lizards, snake, praymantis, and monkey were the most dangerous pests and predators in order of importance (Table 7). Similar findings were reported in other areas of the country (Desalegn, 2001; Kebede and Lemma, 2007; Belie, 2009; Chala et al., 2012; Shunkute et al., 2012). This survey revealed that 50.3% of respondents reported honey badger in and around their apiary sites. Honey badger attack was a serious problem and stand out in the area causing disappearance of honeybee colonies. As a result of this predators attack, a considerable amount of honey and other hive products is lost and disappearance occurs. The respondents reported that spider and bee-eating birds with 31.5 and 17.8% were the second and third most serious bee enemies present in the area and Table 8 shows the top ten most frequently found pests and predators in the study area, but some rarely found pests and predators in specific area were also mentioned

Table 7. Pests and predators founds in Bale Zone in order of importance.

Pests and predators	Sample size (n = 180)		
	Frequency	Percentages	Ranks
Honey Badger	90	50.3	1st
Spider	56	31.5	2nd
Bee-Eating Birds	30	17.8	3rd
Bee Lice	18	12.4	4th
Beetles	19	18.8	5th
Wax moth	13	16.9	6th
Wasps	12	22.2	7th
Death Head Hawks Moth	12	31.6	8th
Mice	5	20.8	9th
Lizards	7	43.8	10th

Table 8. Major top ten honeybee enemies (pests and predators) in Bale as ranked by sample respondents and controlling mechanisms total sample (n=180)

Pests and predators	Traditional controlling mechanisms
Honey Badger	Use of chasing dogs, use of “wotmed” to kill, fencing the apiary site with strong fence, hanging hives by rope on long trees
Spider	Cleaning apiary site always, removing the spider webs, putting ash around hive stand
Bee-eating birds	Scaring the bee-eating birds from the area, putting like tallow, mastic, plastic on hive entrance.
Bee Lice	Smoking/fumigating the hive with materials like tobacco, dung, grass, etc, making the colonies strong, giving additional food for weaken colonies.
Small hive beetles	Strengthening the colony or keep strong colonies, remove weak colonies, cleaning apiary site
Wax moth	Making the colonies to be strong, giving additional foods, reduce hive entrance, smoking/fumigating the hive.
Wasps	Cleaning apiary site, remove nests of wasps, narrow the hive entrance
Death head hawks Moth	Cleaning apiary site, reducing hive entrance
Mice	Cleaning apiary site, killing using cats,
Lizards	Lengthening hive stand and fixing smooth iron sheet on hive stand, cleaning apiary site, coating legs of the hives with engine oil.

by few farmers, like ants (two type sugar ant (xuxi) and ants (goondaa)) snake, pray mantis, their existence were also reported by some of interviewed beekeepers.

Indigenous knowledge of beekeepers practiced on pests and predators controlling mechanisms in Bale

Traditionally, beekeepers practiced different prevention mechanisms but are not totally effective in alleviating these pests and predators which need to develop good prevention mechanisms in order to avoid them. Respondents were asked how to traditionally control pests and predators in their locality and most of the respondents reported putting ash around hive for most common pests, fixing smooth iron sheet on the trunks of a tree where hives are hanged, hanging hives on long trees which has very smooth bark which is not suitable for honey badgers to climb on and tying of thorny branches, using dog and killing badger using wotmad (Figure 3). Similar finding was reported by Dabessa and Belay (2015) as beekeepers used different mechanisms to protect their honeybees from pests and predators in Walmara District of Oromia Region. Accordingly, in the study area, the indigenous knowledge of beekeepers used are summarized in Table 8, but this result needs to be proven scientifically by researchers in order for the beekeepers to fully benefits from this apiculture sub-sector.

Beekeeping opportunities

As it was known, Bale has a bimodal rain fall type, due to

Figure 3. Bee hives hanged on trees to protect from pests and predators in Ginnir district.

this fact, there is year round availability of flowering plants. According to the respondents, the major opportunities for beekeeping in the study area include: existence and abundance of honeybee, availability of potential flowering plants, ample sources of water for bees, beekeepers' experience and practices, socio-economic value of honey and marketing situation of bee products. Different researchers had reported similar ideas (Workneh, 2006; Chala et al., 2012; Shunkute et al., 2012).

CONCLUSIONS AND RECOMMENDATIONS

It is known that Bale has adequate natural resources and a long tradition and culture of beekeeping. However, because of many beekeeping constraints, beekeepers did not fully benefit from the apiculture subsector. Among these constraints, honeybee enemies (pests and predators) were mentioned as bottle neck of beekeeping in Bale. These pests and predators includes: honey badger, spider, bee-eating birds, bee lice, beetles, wax moth, wasps, death head hawks moth, mice, lizards in order of importance. Despite this problem, there is also good opportunity to enhance the production, productivity and quality of products in Bale zone. Based on this, the following points can be forwarded and recommended. Appropriate scientifically proved means of controlling and management of pests and predators should be addressed in order to minimize the effects of these pests and predators. Since most of the beekeepers in Bale followed traditional way of production system which is highly affected by these pests and predators, emphasis should be given to training program for the community, focusing on the practical aspects of beekeeping and modern beekeeping technologies. There should be introduction of affordable and appropriate beekeeping technologies with all equipment, to enhance the beekeeping production, productivity and quality products in order to fully profit the beekeepers from this sub-sector.

Conflicts of Interests

The authors have not declared any conflict of interests.

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

Bekele Tesfaye[1]*, Desalegn Begna[2] and Mitiku Eshetu[3]

[1]Sinana Agriculture Research Center (SARC), Oromiya Agriculture Research Institute (OARI), P. O. Box 208, Bale-Robe, Ethiopia.
[2]Holeta Bee Research Center (HBRC), Oromiya Agriculture Research Institute (OARI), P. O. Box 22, Holeta, Ethiopia.
[3]Department of Animal and Range Sciences, Haramay University, P. O. Box 138, Dire-Dawa, 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

*Corresponding author. E-mail: tbekele2001@gmail.com.

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.

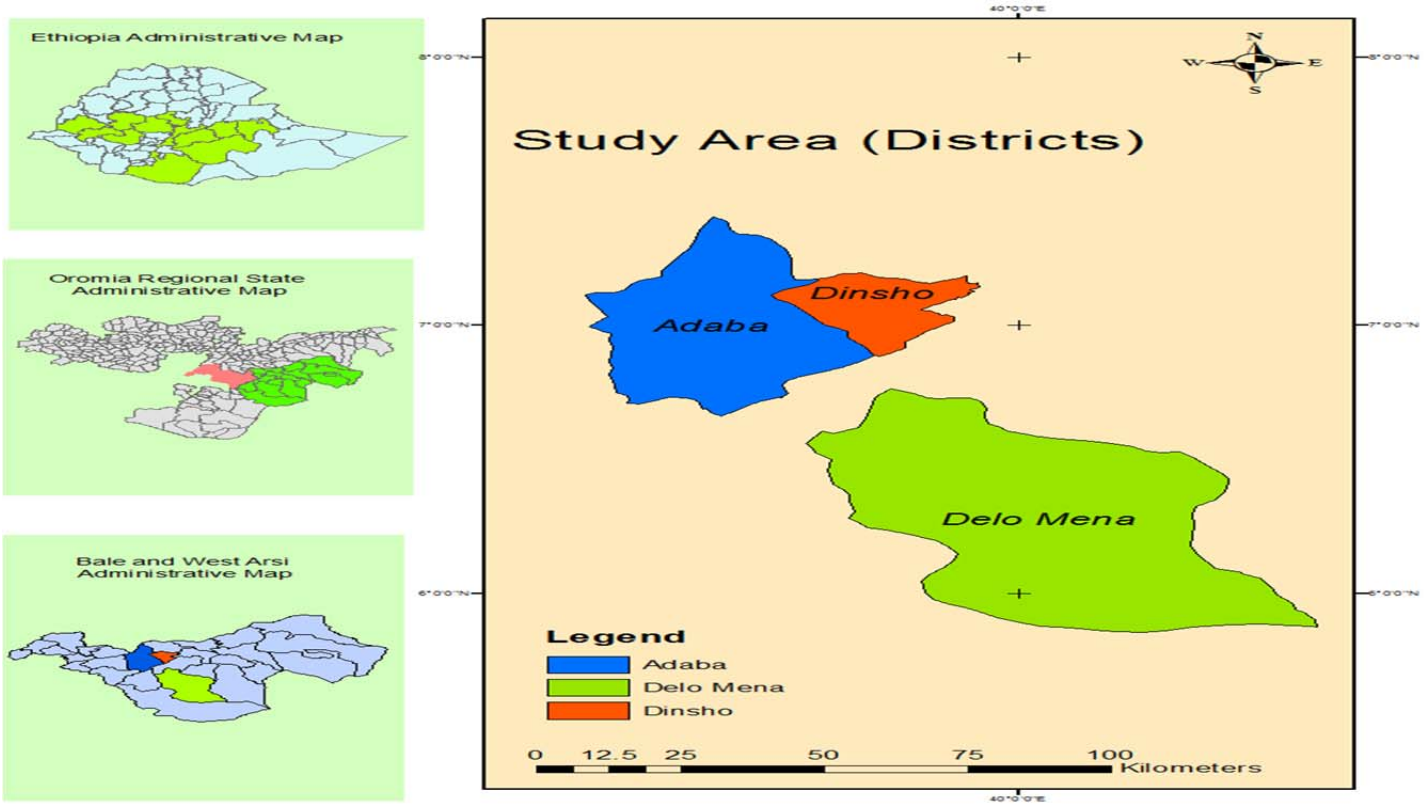

Figure 1. Map of study areas.

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.

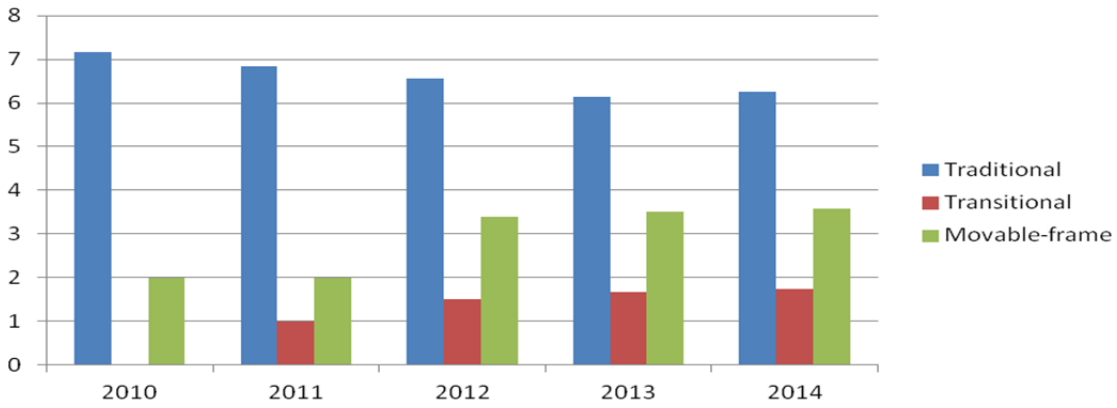

Figure 3. Beekeeping trend in the study area from 2010 to 2014 (source: resurvey result).

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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