Vol.10(12), pp. 260-271, December 2018
DOI: 10.5897/JAERD2018.0978
Articles Number: 24DE2B359661
ISSN: 2141-2170

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Journal of Agricultural Extension and Rural Development

Full Length Research Paper

Beekeeping management practices and gap analysis of beekeepers at different agro-ecological zones of Tigray region, Northern Ethiopia

Guesh Godifey[1*], Amssalu Bezabeh[2], Hailu Mazengia[3] and Yayneshet Tesfay[4]

[1]Apiculture and Sericulture Research Case Team, Mekelle Agricultural Research Center, Tigray Agricultural Research Institute, P. O. Box 2582, Mekelle, Tigray, Ethiopia.
[2]Holeta Bee Research Center, Ethiopia.
[3]Department of Animal Production and Technology, Bahrdar University, Ethiopia.
[4]ILRI -LIVES Project, Ethiopia.

Received 19 July, 2018; Accepted 18 August, 2018

The study was conducted to assess beekeeping practices, seasonal colony management gaps in eastern, south-east and central zones of Tigray region in northern Ethiopia. About 384 beekeepers were interviewed. The trend of honeybee colonies indicated an increase in the last five years but with variables (72%) in honey production. Majority (77.3%) of beekeepers inspected their apiary and honeybee colonies externally and only 21.7% did such inspection inside the hive. The most common locally available supplement feed included sugar syrup (94.6%), Shiro (peas and beans flour) (89.1%), tihni (barley flour) (87.6%), maize flour (25.5%), honey (14.4%) and fafa (supplementary food for infants) (7.9%). Major colony management gaps observed entailed adding super by guessing (47.9%), reluctance to decreasing super (35.5%), continued use of foundation sheets (40.4%) and queen excluder not removed (37.9%). The frequency of colonization was significantly different ($p<0.05$) in frame beehives but not in traditional hives. The seasonal colony activities included brood rearing in July to September; reproductive colony swarming, August to September; absconding, March to June; dearth periods, January to May; high availability of honeybee plants, July to December; and honey harvesting period, September to November. Therefore, seasonal colony management practices followed by floral cycle should be practiced by empowering beekeepers with skill in modern beekeeping management in order to improve their seasonal bee management practices, thus increasing honey production.

Key words: Agro-ecology, beekeeping, honeybee colony, management, seasonal, Tigray

INTRODUCTION

In Ethiopia, the contributions of beekeeping in poverty reduction, sustainable development and conservation of natural resources have been recognized and well emphasized (Global Development Solutions-GDS, 2009; Gidey and Mokenen, 2010; Gebremedhin et al., 2012). Beekeeping is also considered as one of the income-

*Corresponding author. E-mail: gueshgod@yahoo.com.

generating activities for resource-poor farmers, including women, youth and the unemployed sectors of the community

Ethiopia has about 1.4 to 1.7 million households that are engaged in beekeeping and produce different types of honey that vary regionally as well as in terms of color, consistency and purity (Haftu, 2015). Nowadays, the well known and popular Tigray white honey is brought to the attention of beekeeping service provider partners in the region. Throughout the country, Tigray white honey is mainly sold in bulk to intermediaries and often distributed in big towns (Slow Food, 2009).

Although Ethiopia is recognized as one of the top ten producers of honey globally, the nation's output is still below 10% of its production capacity (Central Statistical Agency - CSA, 2017). Hence, the country in general and the region in particular are not benefiting from the Subsector as its potential would allow. Among the major challenges of beekeeping in Ethiopia, more than 90% of the beekeeping is practiced in traditional ways using traditional hives with low production and productivities of the subsector, lack of technical skill or poor management, the critical shortage of inputs, inadequate extension delivery system and lack of bee forage (Gezahegn, 2012).

Regardless of the beekeeping potential of smallholder farmers, little is done to identify the seasonal cycles of activities in honeybee colonies in Tigray region. Beekeepers lack a basis to undertake their beekeeping activities based on possible information on seasonal floral calendar (Haftom et al., 2013). This would have a negative effect on practicing appropriate hive and apiary management, honeybee feeding, honey harvesting and controlling natural swarming. For this reason, proper seasonal colony management practices would greatly improve colony performance and honey yields (Tolera and Dejene, 2014). The beekeeping practice and the gaps in beekeeping management are the basis for future intervention by professionals, organizations and beekeepers.

Hence, the present study was undertaken to assess beekeeping practices, identify seasonal colony management and determine gaps in colony management as currently applied by smallholder beekeepers.

MATERIALS AND METHODS

Study area

The study was conducted in six districts (Atsbi-Womberta, Kilte-Awlaelo, Degua-Temben, Saharti-Samre, Ahferom and Kolla-Temben) of Tigray Regional State, Northern Ethiopia (Figure 1). The districts were selected based on their potential for beekeeping; representing three agro-ecologies (low altitude, mid altitude lands and high altitude areas). Atsbi-Womberta and Degua-Temben districts represented high altitude areas; Kilte-Awlaelo, Ahferom and Saharti-Samre districts represented mid altitude areas; and Kolla-Temben district represented lowland agro ecologies. The agro-ecology of Tigray contains the three main traditional divisions of arable Ethiopia: the *kolla* – lowlands (1400-1800 m above sea level) with relatively low rainfall and high temperatures; the *woina dega* – middle highlands (1800 - 2400 m.a.s.l.) with medium rainfall and medium temperatures; *dega* – highlands (2400 - 3400 m.a.s.l.) with somewhat higher rainfall and cooler temperatures. Most of the area is arid or semi-arid with annual precipitation of 450 to 980 mm. The annual mean temperature for the most part of the region is between 15 to 21°C (Bureau of Finance and Economic Development - BoFED, 2014).

Data sources and methods of collection

Both primary and secondary sources of data were used in this study. Primary data were collected from sample household beekeepers through semi-structured questionnaire and field observation. Secondary data were obtained from the reports of Office of Agriculture and Rural Development in the respective districts, Regional Bureau, NGOs and other published and unpublished materials.

Sampling technique and sample size determination

A multistage sampling procedure was employed to select beekeepers and honeybee colonies. At the first stage, three administrative zones were selected using purposive sampling based on their potential for beekeeping. In the second stage two districts were selected from each zone purposly based on their relative beekeeping potential and representing the three agro ecologies. In the third stage, three rural peasant associations from each district were sampled using purposive sampling based on their beekeeping potential and transport accessibility. In the fourth stage, beekeepers were sampled from all rural peasant associations using simple random sampling technique. Sample size for beekeepers was calculated based on Cochran (1963) as follows:

$$n_0 = Z^2pq / e^2$$

Where, n_0 is the sample size; Z^2 is the abscissa of the normal curve that cuts off an area α at the tails, which is 1.96; e is the desired level of precision (5%); p is the estimated proportion of an attribute that is present in the population which is 50%; and q is also 50%. Accordingly, a total of 384 beekeepers was used for the study.

Data management and statistical analysis

The collected data were coded, managed and tabulated for analysis. Simple descriptive statistics such as mean, standard deviation, frequency, percentage and one way ANOVA were used to analyze the data using SPSS (Version 20, 2011). Independent sample T-test methods were used to compare honeybee colonization. Tukey HSD was used to separate means and mean differences were considered significant at $p<0.05$.

RESULTS

Beekeeping practices

Types and number of beehives owned by the respondents

The number of traditional and improved frame beehives owned per household vary among agro-ecologies and

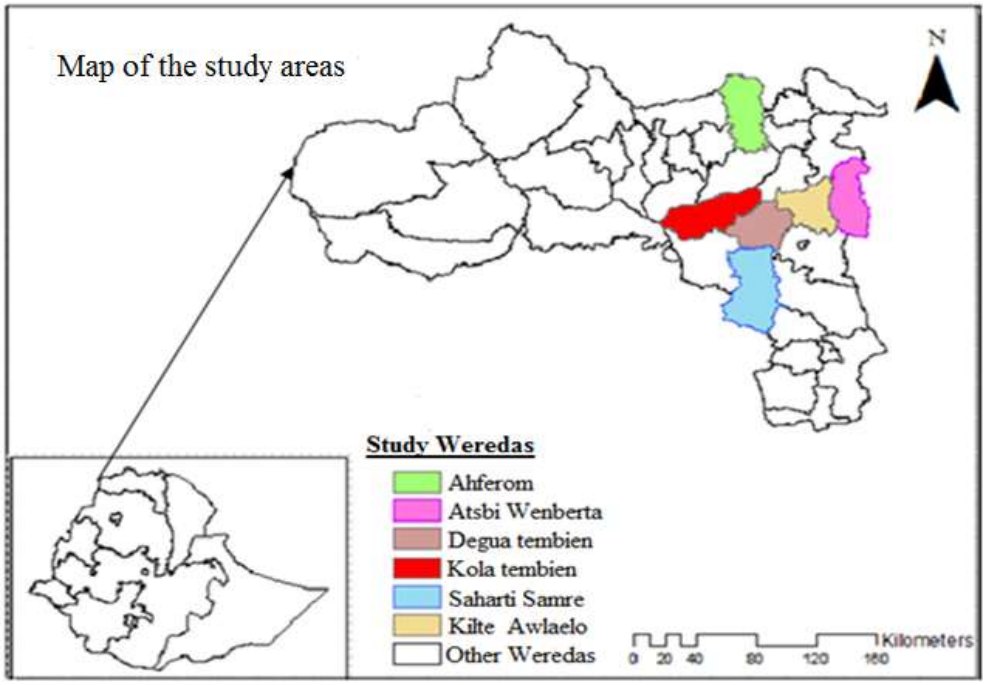

Figure 1. Map showing the study area.
Source: Extracted from Tigray 2012 map.

Table 1. Ownership of colonies managed under traditional and frame hives per household across agro-ecologies.

Agro ecological zone	Number of colonies in traditional hive					Number of colonies in improved frame hive				
	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
Highland	85	1	12	4.6[b]	2.8	110	0	49	7.6[a]	8.1
Midland	120	0	40	6.8[a]	6.1	154	0	47	5.4[ab]	6.6
Lowland	48	2	20	6.8[a]	3.2	58	0	30	5.2[b]	5.0
Overall	253	0	40	6.1	4.8	322	0	49	6.1	6.9

Superscript a, b are significantly different at $p<0.05$.

beekeepers (Table 1). The result revealed that the average number colony ownership per household recorded in traditional and improved frame hives were almost the same for all respondents. It was observed that the mean number of honeybee colonies managed under traditional hive in lowland and midland was significantly ($p<0.05$) higher than that in highland agro-ecological zones. Whereas, significantly ($p<0.05$) large number of bee colonies in improved frame hive were found in highland agro-ecologies.

According to the survey result, the numbers of honeybee colonies in traditional and framed hives increased in the last five years (2010 to 2014) (Figure 1). However, slight decrease was observed in improved frame hives in 2014. Even though the presence of the high demand of honeybee colony, skill of splitting queen rearing technique and frame hive adoption by most beekeepers is assured, lack of appropriate beekeeping equipments affect the increment of improved frame hives (Figure 2).

Apiary types

Majority of the beekeepers in the study areas placed their honeybee colonies in their back yard; while about 12.5% of the beekeepers placed their honeybee colonies in closure areas (protected areas). Some placed the colonies inside a house (10.9%) and others hanged them on trees around the home (0.3%) (Table 2).

Source of bee colony and means of stock increment

The result indicated that majority of the beekeepers obtained their establishing colonies by purchasing them from market places and other beekeepers; while the

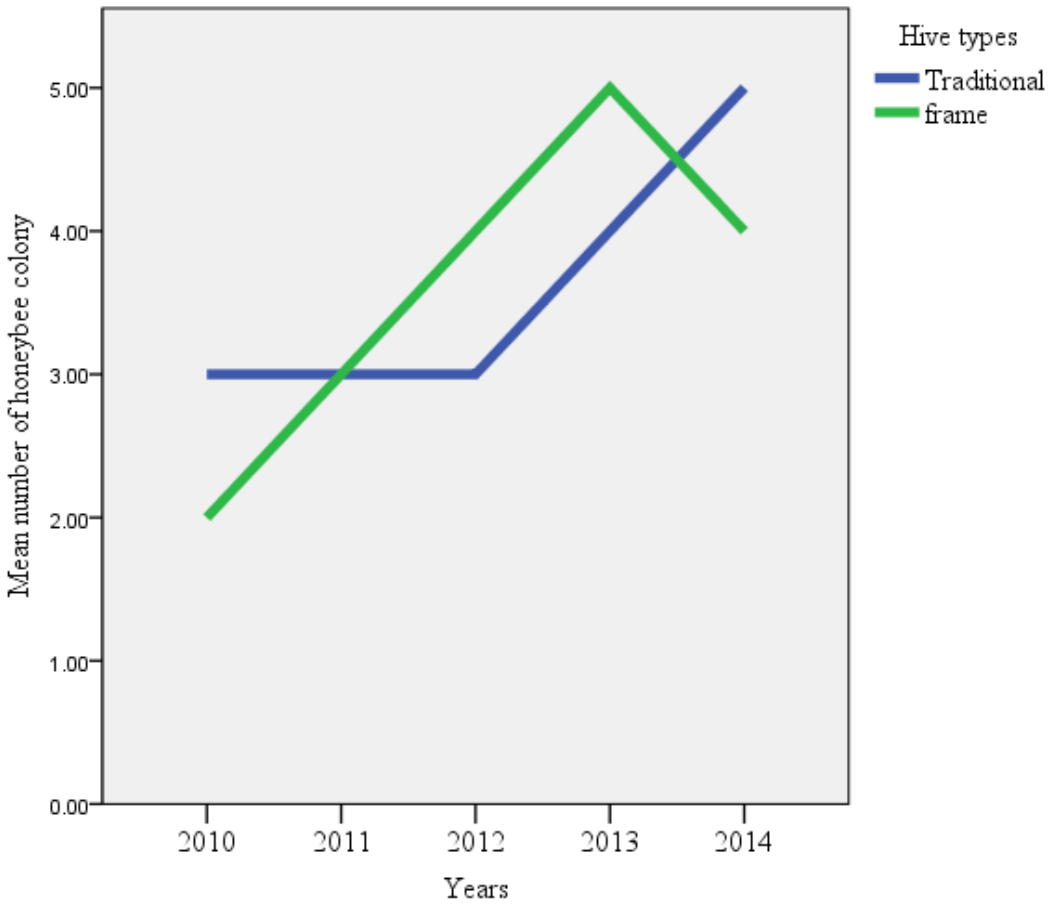

Figure 2. Trend of honeybee colony in the last five years.

Table 2. Placement of honeybee colonies across agro ecologies.

Placement	Agro-ecologies			Overall
	Highland	Midland	Lowland	
Homestead	104 (81.3)	154 (80.3)	35 (54.7)	293 (76.3)
Inside house	7 (5.5)	24 (12.5)	11 (17.2)	42 (10.9)
Closure areas	17 (13.3)	14 (7.3)	17 (26.6)	48 (12.5)
Hang on trees	0	0	1 (1.6)	1 (0.3)

Values in parenthesis are in percentages.

remaining got them as gift from parents and through catching swarms, using hanging bait hives on the apex of trees (Table 3). The proportion of swarm catching was the highest in lowland agro ecological zones and lowest in midlands. On the other hand, majority of the respondents from midlands and highlands got their bee colonies through purchase.

Once the bee colony is established, beekeepers of the respective districts use different means to increase their colony stock number (Table 4). Majority of the beekeeper respondents' indicated that their colony numbers were with no change over time. Additionally, the respondents used splitting, natural reproductive swarming, purchasing and swarm trapping. Splitting and overcrowdings were the major colony sources in the study areas. The main source of colony sizes for highland, midland and lowland was splitting (25%), overcrowding (26.6 %) and splitting (46.95%), respectively.

Honey production and harvesting frequency

According to the survey results, most of the respondents' harvested honey once followed by twice a year. However,

Table 3. Source of colonies.

Colony source	Agro-ecologies {No. (%)}			Overall {No. (%)}
	Highland	Midland	Lowland	
Gift from parents	27 (21.1)	40 (20.8)	19 (29.7)	86 (22.4)
Swarm catching	21 (16.4)	19 (9.9)	21 (32.8)	61 (15.9)
Purchasing	80 (62.5)	133 (69.3)	24 (37.5)	237 (61.7)

Values in parenthesis are in percentages, out of respondents in the same agro ecology.

Table 4. Methods of colony stock increment.

Colony source	Agro-ecologies {No. (%)}			Overall {No. (%)}
	Highland	Midland	Lowland	
Swarm catching	2(1.6)	6(3.1)	6(9.4)	14(3.6)
Purchasing	29(22.7)	13(6.8)	5(7.8)	47(12.2)
Natural swarming (Overcrowding)	27(21.1)	51(26.6)	18(28.1)	96(25)
Splitting	32(25)	35(18.2)	30(46.9)	97(25.3)
Constant	38(29.7)	87(45.5)	5(7.8)	130(33.9)

Values in parenthesis are percentages out of respondents in the same agro ecology.

Table 5. Honey harvesting frequency.

Frequency	Agro-ecologies {No. (%)}			Overall {No. (%)}
	Highland	Midland	Lowland	
Once	46 (35.9)	138 (71.9)	47 (73.4)	231 (60.2)
twice	64 (50)	45 (23.4)	17 (26.6)	126 (32.8)
Three times	15 (17.7)	9 (4.7)	0 (0)	24 (6.3)
Four times	3 (2.3)	0 (0)	0 (0)	3 (0.8)

Values in parenthesis are percentages out of respondents in the same agro ecology.

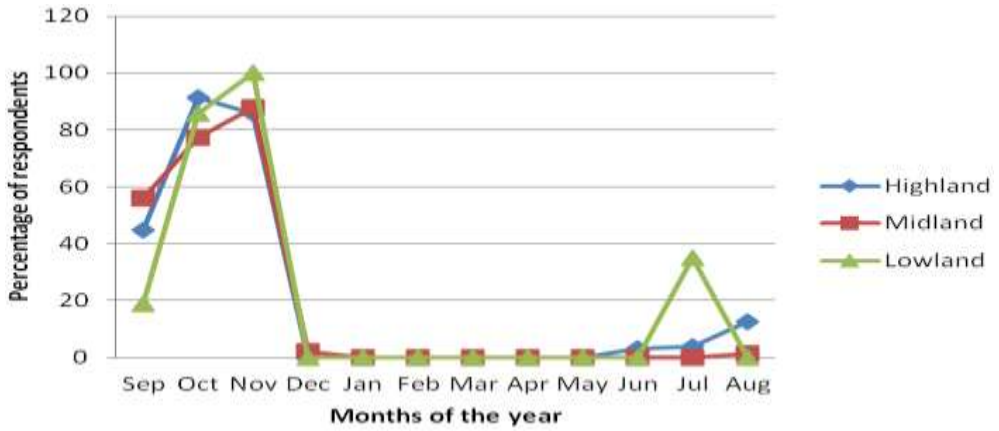

Figure 3. Honey harvesting months by agro-ecological zones.

few respondents explained that they could harvest three to four times per a year (Table 5). The highest honey harvesting frequency was observed in highlands as compared to midland and lowlands. The major honey harvesting months were September to November (Figure 3) in all agroecological zones. Whereas, the minor honey harvesting months were June to August. In the major honey harvesting months, the beekeepers could harvest

Table 6. Average honey yield (kg/hive/year) from traditional and improved frame beehives.

Agro ecology	Traditional beehive		Improved frame beehive	
	N	Mean ±SEM	N	Mean ± SEM
Highland	65	9.5±4.5[a]	100	27.5±8.5[a]
Midland	103	9.9±3.4[a]	138	25.7±9.1[a]
Lowland	45	12.7±5.6[b]	48	26.8±8.5[a]
Overall mean	213	10.4±4.4	286	26.5±8.7

Superscript a, b are significantly different at p<0.05.

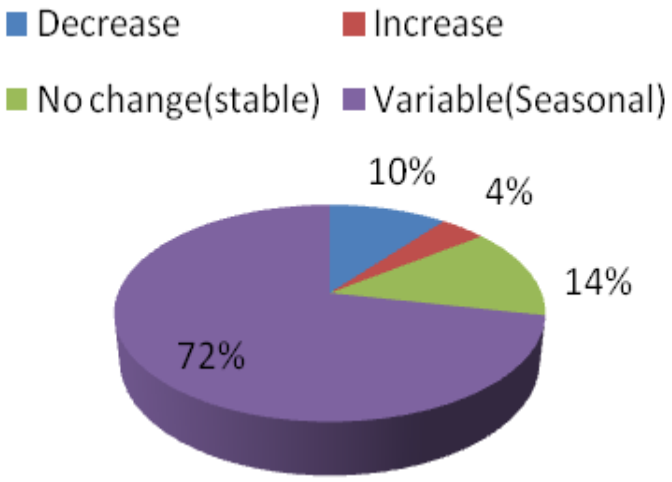

Figure 4. Trends of honey production.

honey twice in a month if the season is with well rained.

As could be indicated in Table 6, the amount of honey harvested from traditional and improved frame hives were 10.4±4.4 and 26.5±8.7 kg per year, respectively. The result indicated that there was a significant difference (p<0.05) in honey yield, using traditional bee hive among agro-ecologies. However, there was no significant difference in honey yield (p>0.15) using frame hive. The highest honey yield obtained from traditional hive was recorded in lowlands compared to highland and midland.

However, majority (72%) of the beekeepers declared that honey production varies among the years. The others, 14, 10 and 4% of the beekeepers responded as the production of honey remainsstable, decreased and increased, respectively (Figure 4).

Seasonal colony management

Colony inspection

Beekeepers inspect their honeybee colonies at different times (Table 7). Majority of the respondents mentioned that they frequently (daily to weekly) inspect their apiary and honeybee colonies externally. The result indicated that an external inspection of apiaries and honeybee colonies is done by most of the respondents. In the external inspection, beekeepers visit their hives and apiary to safeguard honeybee colonies from different natural disasters and various hazards and to observr their flight movement. However, only 13 and 27.9% of the respondents do undertake internal inspection of their bee colonies frequently for traditional and frame hives, respectively. Majority of the beekeepers internally inspected their honey bee colonies by chance at their convenient time. For the external honeybee colony inspection, there was no signinificant difference (χ^2= 2.625, p>0.05) done on tradional and frame hives by the beekeepers. However, there was significant difference (χ^2= 49.180, p<0.01) in the internal inspection undertaken for frame hives than tradional beehives.

Feeding management

Honeybees store honey for their own consumption during dearth periods. Beekeepers harvest honey, which the honeybees stored for themselves. As a result, honeybees face starvation due to lack of feed. To overcome the problem, supplementary feed is required for the

Table 7. Percent distribution of frequency for inspection of apiary by respondents.

Types of Inspection	Frequency of inspection	Hive types		X^2	P-value
		Traditional	Frame		
External	Daily to weekly	74	77.1	2.625	0.453
	At convenient	19.5	20		
	Yearly	5.2	2.9		
	No inspection	1.3	0		
Internal	Daily to weekly	13	27.9	49.180	0.001
	At convenient time	37.7	57.1		
	Yearly	9.1	11.4		
	No inspection	40.3	3.6		

Table 8. Locally available feed types for honeybee colony supplementation used by the beekeepers in the study districts (%).

Types of feed	Agro-ecological zones			Overall
	Highland	Midland	Lowland	
Sugar syrup	93.2	93.9	100	94.6
Shiro	93.2	88.9	79.3	89.1
Tihni	94.6	84.8	35.9	87.6
Maize flour	32.4	24.2	10.3	25.2
Honey	1.4	21.4	24.1	14.4
Fafa	0	8.1	27.6	7.9

honeybees. The most common locally available feed types used for colony supplements identified were sugar syrup (94.6%), Shiro (peas and bean flour) (89.1%), tihni (barley flour) (87.6%), maize flour (25.5%), honey (14.4%), and fafa (supplementary food for infants) (7.9%) in their order of utilization (Table 8). In all agro-ecological zones of the study areas, beekeepers offer supplementary foods for their honeybee colonies.

Manipulation of hive supers, foundation sheet and queen excluders

Movable frame beehives allow common bee management practices such as migratory beekeeping, supers adding or reducing, regular inspection, quality honey harvest, swarm control, feeding during dearth periods, stimulating early colony growth, and pest and disease control. Table 8 indicates the common practice for seasonal colony management. The result reveal that 52.1% of respondents put additional hive supers by inspecting the internal condition of the colonies and the rest of them put without inspection (47.9%). Even though majority of the respondents (64.5%) reduce the super during the dearth period; still, 35.5% of them keep their colonies without reducing during the dearth period.These finding also suggest that some beekeepers replace very old brood combs from their colonies every year (41%), every 2 to 3 years (18.6%), and some forever (40.4%). Most of the respondents explained that 62.1% of them remove the queen excluder immediately after honey was harvested. However, in some beekeepers, queen excluders were left on top of the base hive or without reducing the supers (37.9%) even during the dearth period (Table 9).

Absconding and swarming of honeybee colonies

According to the survey result, the trend of honeybee colony absconding in the study districts increased from 6 to 242 and 25 to 441 in traditional and framebeehives respectively between year 2010 and 2014 (Figure 4). Within the last five years, a total of 441 traditional and 854 frame beehives were absconded in the study areas.

An average number of modern beehive enumerated during survey in beekeepers apiary were 3.03 of which 1.15 were colonized and the other 1.88 without bees due to colony absconding at different time for different reasons. The average number of traditional beehive colonized were 3.25 whereas 3.85 were without bees. The frequency of colonization was significantly different ($p<0.05$) in frame beehives but not in traditional hives (Table 10).

There was a financial loss due to absconding of honeybees from frame and traditional hives. A total of441 traditional and 854 frame beehives without honeybee

Table 9. Percent distribution of improved honeybee colony manipulation in the study areas.

Manipulation variable	Category	Frequency	%
Super adding	Through inspection	162	52.1
	Through guessing	149	47.9
Super reducing	Yes	198	64.5
	No	109	35.5
Foundation sheet change	Every years	126	41.0
	Every 2-3 years	57	18.6
	No change	124	40.4
Queen excluder removal	Yes	190	62.1
	No	116	37.9

Table 10. Mean number of honeybee colonies with and without bees in traditional and frame beehives.

Hive type	Colonization		Significant
	With bees	Without bees	
Traditional	3.25	3.58	NS
Frame	1.15	1.88	**

NS=Not significant difference, ** Significantly different at P<0.01.

Table 11. Average number of swarms produced and used for next generation (N=241).

Agro ecological zone	Number of swarms produced per colony (Mean ±SD)	Number of swarms used for next generation
Highland	8.77±2.38[a]	1.44
Midland	9.12±3.06[a]	1.71
Lowland	8.64±2.80[a]	1.90

Superscript ‘a’ indicates significant difference at p<0.05.

colonies represented a minimum loss of about 661,500 ETB and 3,996,720 ETB, respectively. From the existing total 1295 empty beehives, it would be possible to earn 4,658,220 from the sale of honey.

Some beekeepers consider swarming as a good thing because beekeepers are able to naturally increase the number of colonies by capturing swarms. However, in more recent times, swarming is considered a nuisance because it instantly reduces honey production. The mean reproductive swarming incidence per colony was 8.77, 9.12 and 8.64 in highland, midland and lowland agro ecologicalzones respectively and insignificant difference (p>0.05) was observed (Table 11). However, the average number of incidental swarms caught by the respondents was 1.44, 1.71 and 1.90 in highland, midland and lowland agro ecological zones respectively and the swarmed return to their original hive.

Seasonal colony activities

Brood rearing, reproductive swarming and absconding are a common phenomenon in honeybee colonies. Honeybees perform their normal activities based on seasons, normally during honey flow and dearth period seasons.

The respondents replied that there was an incidence of major brood rearing in the months of May (25.8%), July (99%), August (99.7%), September (100%) and October (63%) in their increasing order. As regards season of reproductive colony swarming, beekeepers of the survey area indicate that September (99.7%), August (92.4%),

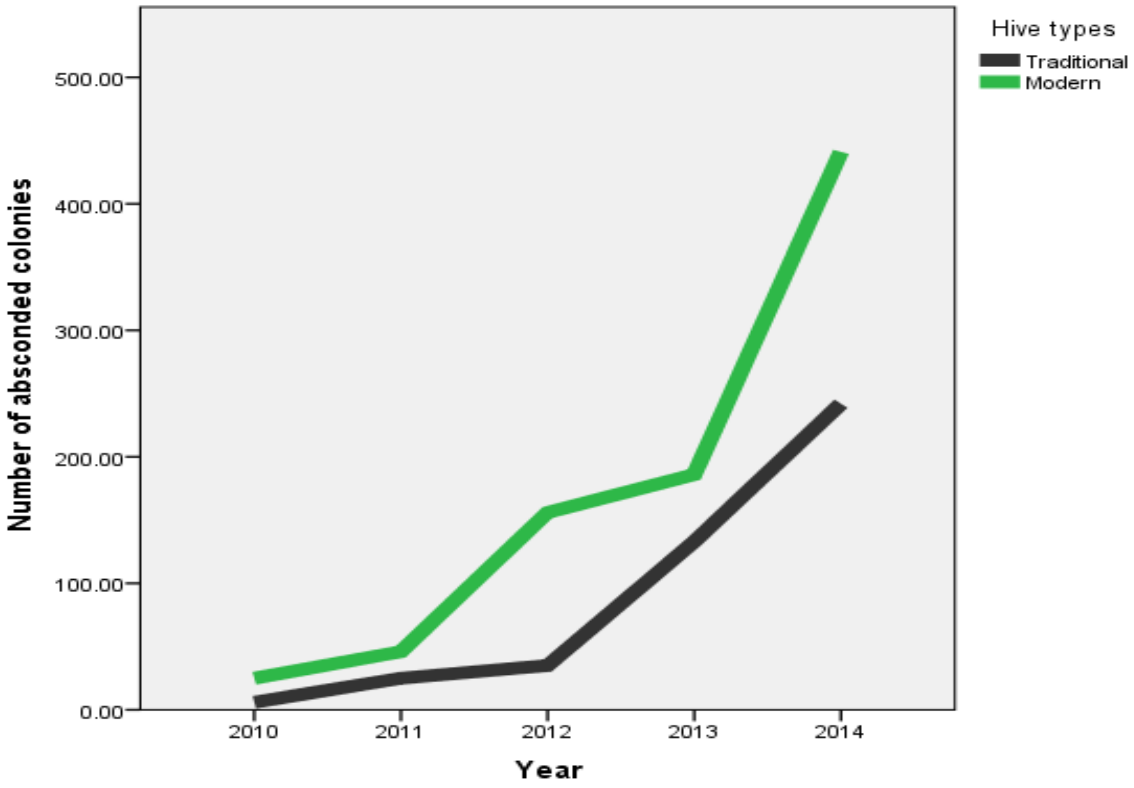

Figure 5. Trend of honeybee colony absconding.

July (33.1%) and October (20.6%%) are the main months in which colony swarming occurs owing to availability of pollen, vegetation coverage and instinct behavior of bees; while, November, December, January, February, March, April and May are months in which there are no record of incidence (Figure 5).

Honeybee colonies abandoned their hives at any season of the year for different reasons. The beekeepers indicate that March (50.3%), April (54.4%), May (63.3%) are June (59%) as the first four main colony absconding months in their locality. As indicated by the beekeepers, incidence of pests and predators, poor management, and excessive weather conditions (sun, wind and rain) are the causes of colony absconding. According to beekeepers, the peak dearth periods of the year are dry season period (March to May) as there is no flowering plant as a source of pollen and nectar; and during rainy season (June to July), as the pollen of the flowering plants is diluted and the nectar is washed by the rain and is referred to as dearth period and agro-chemical applications.

Similarly, high availability of honeybee plants, from July to December, was recorded. September to November are regarded as the main honey harvesting period of the year as this period is the main flowering season of the year; while, June is regarded as the second honey flow season/ harvesting period of the year. Dearth period of honeybees occur between January and June (Figure 6).

DISCUSSION

The number of colonies owned per household were significantly ($p<0.05$) different across the agro ecologies. Improved frame hives and traditional beekeeping practices are found to co-exist in all the areas, which is similar with the finding of Workneh (2011a, b). The sample households in highland had significantly larger number of bee colonies in improved frame hives but lower in traditional hives compared to the sample households in low land and midlands. However, the number of improved frame hives owned by the sampled respondents in highland and midland were insignificantly difference. The greater number of honeybee colonies in improved hives in highland and midland is probably because of strong intervention on beekeeping by Government and non-government organizations in the areas. According to Workneh (2011), improved box hive was introduced into the highland districts of Tigray region in 1998 for the first time. Contrary to this, Alemayehu Abebe et al. (2016) reported that highlands with dense forest and lack of access to modern box hives would have greater number of honeybee colonies in traditional hives.

Majority of the respondents kept their honeybee colonies in their backyard and traditional hives inside the house. This finding is in line with the reports of Tessega

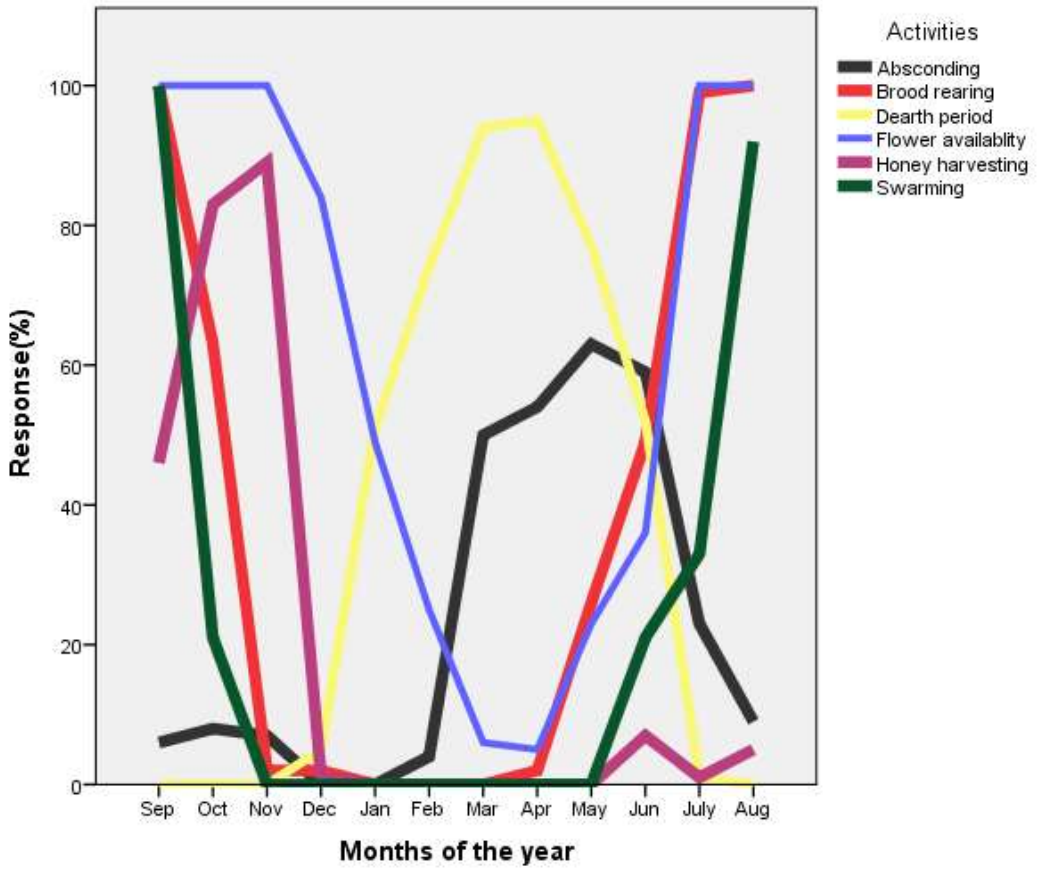

Figure 6. Seasonal activities of honeybees.

(2009), Gidey et al. (2012), Nebiyu and Messele (2013), and Niguse (2015). Placing hive around homestead and in house apiary sites is appropriate for daily follow up of beekeeping activities (Berhanu, 2016). However, Kidane (2014) reported that majority of the traditional hives are hung in the dense forest, which are mostly far from residential areas and are visited only one or two times until harvest among Gambella people in the national regional state.

The honey yield obtained in the current study was similar to the result of Gidey and Mekonen (2010), who reported 8-15 kg and 20-30 kg of honey from traditional and improved movable frame beehives in the region respectively. According to CSA (2017), the amount of honey obtained from traditional and improved movable frame beehives was higher than the national average honey yields of 9.2 and 19.1 kg. Honey yield fluctuates from year to year and varies between colonies.The difference may be due to climatic condition, beekeeping management and extension support offered to beekeepers.The frequency of harvesting honey per hive in the same area and year is also different among beekeepers. Kajobe et al. (2009) stated that the frequency and amount of honey harvested varies depending on, seasonal colony management practices (skill of beekeepers); flowering condition of major bee forage (rainfall) and type of beehive (Belets and Gebremedhin, 2014).

Most beekeepers visit and inspect their beehives externally. However, internal hive inspection was limited. Beekeepers inspect colonies when colonies become weak and during honey harvesting seasons. This is apparently because of the absence of personal protective cloths and tools, fear of being stung, the risk of colony absconding and lack of awareness of the value of doing so. Moreover, almost all beekeepers in the study area perform external inspection and also clean their apiary to prevent ant and other insect pests from getting access to hives. This result is consistent with other findings (Kerealem et al., 2009; Nuru, 2007; Kebede and Lemma, 2007; Teklu, 2016) which report that farmers in Ethiopia do not commonly practice internal hive inspection. However, Yetimwork et al. (2015) reported that 53.5% of respondents (beekeepers) visit their honeybee colonies frequently.

In the present study, beekeepers were adding supers by guessing and continued to keep constant number of supers during the dearth period. This is due to low awareness of the beekeepers. Similar result was reported by Gidey and Mekonen (2010) who indicated that lack of

proper bee management is one of the problems facing the honey sub sector in the region. Similar result was reported by Tolera and Dejene (2014). Furthermore, there are beekeepers that do not change the old comb for many years.

During the shortage of bee forage, most of the beekeepers supplement their honeybee colonies from locally available feed types to survive dearth periods in the region. This finding is in line with that of Yetimwork (2015), Tessega (2009), and Solomon (2009); stating that majority of the beekeepers in Ethiopia practice dry season supplementary feeding. Providing supplemental feed to honey bee colonies increase their performance through improving colony maintenance, buildup, and production during shortage of natural pollen (Lumturi et al., 2012).

Absconding due to inappropriate colony management is the major constraint in the districts and beekeepers fail to produce sufficient amount of honey, regardless of apiculture potential in study the areas. Proper bee management practices enhance colony performance, such as reduced absconding, improved colony strength and higher hive yields (Wilson, 2006; Tolera and Dejene, 2014). Such loss is partially compensated by the high rate of swarming of colonies.

Conclusions

Beekeepers of the study areas own both traditional and frame hives. Even though absconding of honeybee colonies was the most phenomena in the study areas, the number of bee colonies showed an increase in the last five years. Some beekeepers have not considered absconding as the major problem because there is high swarming tendency to substitute the absconded colonies.

Despite feeding management was practiced during the dearth period, management gaps on super adding or reducing and old comb replacement were observed.

The incidence of major brood rearing was in the months of July to September. As regards season of reproductive colony swarming was August to September. Honeybee colonies abandoned their hives at any season of the year for different reasons. March to June was recognized as colony absconding months in most localities. According to beekeepers, the peak dearth periods of the year are dry season period (January to May) as there is no flowering plant as a source of pollen and nectar. Similarly, high availability of honeybee plants from July to December was recorded. September to November were regarded as the main honey harvesting period of the year as this period is the main flowering season of the year; whereas, June was regarded as the second honey flow season/ harvesting period of the year.

Therefore, seasonal colony management practices followed by floral cycle should be practiced by empowering beekeepers with skill in modern beekeeping management in order to improve their seasonal bee management practices; thereby, increasing honey production.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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