

Honey Bee Colony Absconding and Associated Risk Factors Facing Beekeepers in Bure Zuria Woreda, North Western Ethiopia

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Abstract

In Ethiopia, beekeeping is based on traditional hives which accounts for more than 95.5% of the hive types while transitional and frame beehives are about 4.3% and 0.2% respectively. The aim of this study was to assess honeybee colony absconding from traditional hives and associated risk factors in Bure Zuria Woreda, north western Ethiopia. A total of 50 beekeepers were selected randomly for a longitudinal apiary inspection survey to determine honey bee colonies owned by the beekeepers and pattern of honey bee colony absconding. However, a questionnaire was prepared and administered to all the beekeepers to assess the risk factors. Pearson chi-square (χ^2) was used to test association of risk factors for beekeeping at p -value < 0.05 . Results showed that the overall number of honeybee colony positive hives owned by the beekeepers in the Kebele was 52 (81.3%) whereas the overall colony negative hives was 12 (18.7%). The number of bee colony absconding hives rose in February (17.2%) and peaked in April (23.4%) with sharp decline thereafter. Whereas the number of colony owning hives rose in October and peaked in December (96.81%) than the rest of the inspection months. Pesticide and herbicide application, inadequate skill of beekeepers and deforestation were reported as the top risk factors associated with bee colony absconding in the study area. Therefore intervention to change traditional beekeeping practices through training and introducing improved beekeeping technologies that are suitable for local beekeepers are needed for mitigation of colony absconding and enhancing apiculture productivity and production in the study area.

Keywords: Beekeeper, Colony absconding, traditional hives, Wehni Durbete Kebele.

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1. Introduction

Beekeeping is a long time agricultural practices in Ethiopia. It is an important component of agriculture and rural development program in the country. Beekeeping in the country is based on traditional hives. Generally, about 4,601,806 beehives exist in Ethiopia, out of which about 95.5% are traditional, 4.3% transitional, and 0.2% frame beehives (Beyene and David, 2007). The country owns the greatest bee density in Africa (Kassaye, 2001; Adgaba, 2002) and is the leading country in the content in honey and bees wax production and exporting (Adgaba, 2002).

However, the level of beekeeping and bee biodiversity conservation still remains in traditional system (Ejigu *et al.*, 2009). Honey bee biodiversity conservation and beekeeping practices have been threatened by several biotic and abiotic environmental factors (Abebe and Jatema, 2015). As a result the number of honeybee colonies in the country has been decreasing from time to time due to various reasons such as population pressure, vegetation loss and inappropriate usage of agro-chemicals which facilitates bee colony decline and absconding (Belie, 2009; Tesfaye, 2015).

Absconding is the total loss of bee colonies from their hives due to various reasons. It differs from swarming in that the nest colony does not divide into two or more parts but the whole colony migrates to find a new nest site due to various problems. Bee species are subject to many diseases and pests like any other livestock and are exposed to absconding due to plenty of challenges. Absconding results in a loss in honey and wax formation due to a variety of negative issue such as shortage of bee equipment, shortage of pollen and nectar, deforestation, scarcity of water, rain, fire and spray of agro-chemicals (Bees for Development, 2000). The major absconding problems of honey bee colony (*Apis mellifera*) in many countries are not well-known and researched adequately (FAO, 2009). Likewise information on Ethiopian honey bee *Apis mellifera* colony absconding is lacking. Therefore, the aim of this study was to assess honey bee colony absconding and associated risk factors facing traditional beekeepers in Bure Zuria Woreda, north-western Ethiopia. The findings of the study are useful to the beekeepers to get basic information about their honey bee colonies absconding seasons and constraints for effective management of honey production by bee farmers. It provides further information about the underlying risk factors facing beekeepers that must be addressed to improve beekeeping and bee biodiversity conservation in the study

setting.

1.1. Materials and Methods

1.1.1. The Study Area

Bure Zuria Woreda (BZW) is found in West Gojjam Zone of Amhara Region State in Ethiopia (Figure 1). It is located at 149km from Bahirdar, the capital of the regional state and at 411km from Addis Ababa. In Western Gojjam Zone there are 19 Woredas. It is geographically located at 10°17'N latitude and 37°00'E longitude. It has 24 kebeles (the lowest administrative unit). From the 24 Kebeles of BZW one Kebele particularly Wehni Durbete Kebele (WDK) was selected for this study based on accessibility and availability of beekeepers and honey production status. The kebele had a total of 6969 populations among these 3447 were males and 3522 females during the study period in 2019.

The area gets an average annual rainfall ranging from about 1000-1500mm. This is the main source of water for rain fed agriculture. The minimum and maximum daily temperature of the area was 17°C and 27°C respectively. The district has three economic-climate regions namely Lowland (Kola), Midland (Wyina Dega) and Highland (Dega) that make up about 21.77%, 77.23% and 1.0% respectively. Mixed crop and livestock farming system is the mode of agricultural practice in the area. Hence peasants in the study area hold livestock species such as cattle, equines (horses, asses and mules), poultry and bee colonies and others which serve the household as source of meat, milk, honey and beeswax, income and means of transportation. Bee conservation is an integral part of the animal husbandry in the study area.

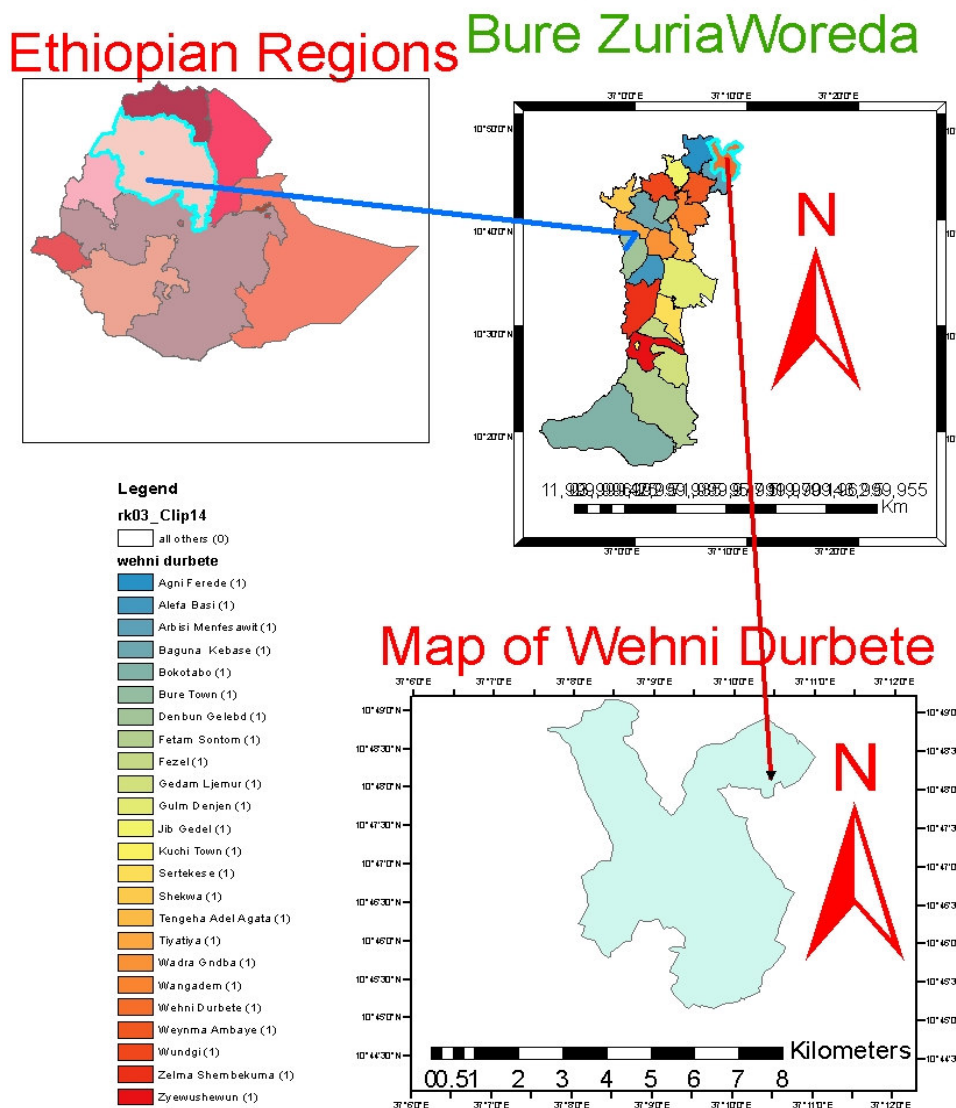


Figure 1: Map of Wehni Durbete Kebele in Bure Zuria Woreda, Western Ethiopia

1.1.2. Research Design

A longitudinal apiary survey that involved both quantitative and qualitative data collections were undertaken from September 2018 up to May 2019 to gather basic information about honey bee colony absconding patterns and associated risk factors facing beekeepers in the selected Kebele and beekeepers' apiaries.

1.1.3. Sampling Design and Determination of Sample Size

To determine the pattern of colony absconding and colony density over honey cropping seasons, from a total of 18 Sub Kebeles in the WDK, five Sub-Kebeles were purposely selected based on accessibility and honey production. Sub Kebele refers to a small village in the administrative structure of the Ethiopian state that consists of a more closely related 35-40 household heads. From the five sub-kebeles, 10 beekeepers were randomly selected. A total of 50 (10x5) beekeepers were selected randomly to determine the number of honey bee colony positive hives owned by the beekeepers during the study period and the patterns of colony absconding. Simple observation was used to determine the number of honey bee colony positive hives owned by the beekeepers and to get information about the pattern of honey bee colony absconding over honey cropping seasons in a year. Observation protocols were prepared and used during field apiary inspection survey.

However, to assess risk factors facing beekeepers for honey production in the study area all the available traditional beekeepers in the Kebele were targeted and questionnaire were prepared and administered to all the beekeepers. The questionnaires prepared in both Amharic and English. The questionnaires were contained both open ended and close ended items.

In addition to the above respondents, eight key informants including two senior beekeepers, two agricultural officer, two Kebele officers, two Development Agents (DAs) were selected purposely for focused group discussion (FGD). In addition to questionnaires', the researcher also prepared a discussion points to discuss with the eight focused group members to gather further information which was not including in questionnaires'. The FGD was open ended. It was done in local language, Amharic.

The specific sample collection activities were taken place consecutively for three seasons (spring, winter and autumn) for 9 months from September 2018 to May 30/2019 fortnightly per month. Honey bee colony absconding inspection survey was undertaken fortnightly in apiary of the selected beekeepers. According to the Kebele agricultural office profile records WDK had a total of 167male traditional and modern beekeepers. From these, 150 were traditional beekeepers and 17 were both traditional and modern beekeepers. Among 18 Sub Kebeles 5 sub-kebeles were selected randomly namely Tarenibora, Fendika, Mehalwehni, Adikuta and Terfamiba.

1.1.4. Data Analysis Technique

Statistical Package for Social Sciences (SPSS) version 20 was used for the analysis of quantitative data. Both qualitative and quantitative results were interpreted by descriptive statistics. The analyzed data were summarized in the form of table and graphs. The data obtained through focus group discussion were analyzed through qualitative techniques. Pearson chi-square (χ^2) was used to test association of risk factors for beekeeping at p-value < 0.05.

1.2. Results

1.2.1. Traditional Apiaries Owned by the Beekeepers

Typical traditional apiaries owned by the beekeepers were shown in Plates 1, 2 and 3 respectively. The traditional beekeepers put their hives on the beds of wood, by hanging under thatched - roofed hut and corrugated sheet around homestead and also on trees near their home or far from their home.



Plate 1: Traditional beehives on wood bed under thatched roof hut at home of a beekeeper (Photo: Yaregal

Shiferaw in 2019)



Plate 2: Traditional hive hanging under corrugated sheet at home of a beekeeper (Photo: by Yaregal Shiferaw in 2019)



Plate 3: Tree apiary at homestead of beekeepers (Photo: Yaregal Shiferaw in 2019)

1.2.3. Honeybee Colonies Owned By the Beekeepers

As shown in Table 1, a nine month apiary inspection survey results showed that the overall number of honeybee colony positive hives owned by the beekeepers in Wehni Durbete Village was 52 (81.3%) whereas the overall colony negative hives observed during the study period was 12 (18.7%). From the sub-kebeles, the highest colony positive hives were observed in Tarenbora (26.9%) followed by Adukita and Terefamba (19.2%). Whereas, the highest colony negative hives were recorded in Adukita (33.3%) followed by Mehalwehni (8.3%).

Table 1: Number of honeybee colony positive and negative hives owned by the beekeepers

Sub-Village	Number of beekeepers	Total Hives N (%)	Total Colony Positive Hives N (%)	Total Colony Negative Hives N (%)
Tarenbora	10	16 (25.0%)	14(26.9%)	2 (16.7%)
Adukita	10	14 (21.8%)	10 (19.2%)	4 (33.3%)
Mehalwehni	10	10 (15.6%)	9 (17.3%)	1 (8.3%)
Terefamba	10	12 (18.8%)	10 (19.2%)	2 (16.7%)
Fendeka	10	12 (18.8%)	9 (17.3%)	3 (25.0%)
Overall	50	64(100.0%)	52 (81.3%)	12 (18.7%)

1.2.3. The Pattern of Honey Bee Colony Owning and Absconding

The number of bee colony absconding hives rose in February (17.2%) and peaked in April (23.43%) with slight decline thereafter (Figure 2). Whereas the number of colony owning hives rose in October (7.8%) and peaked in December (96.8%) than the rest of the inspection months.

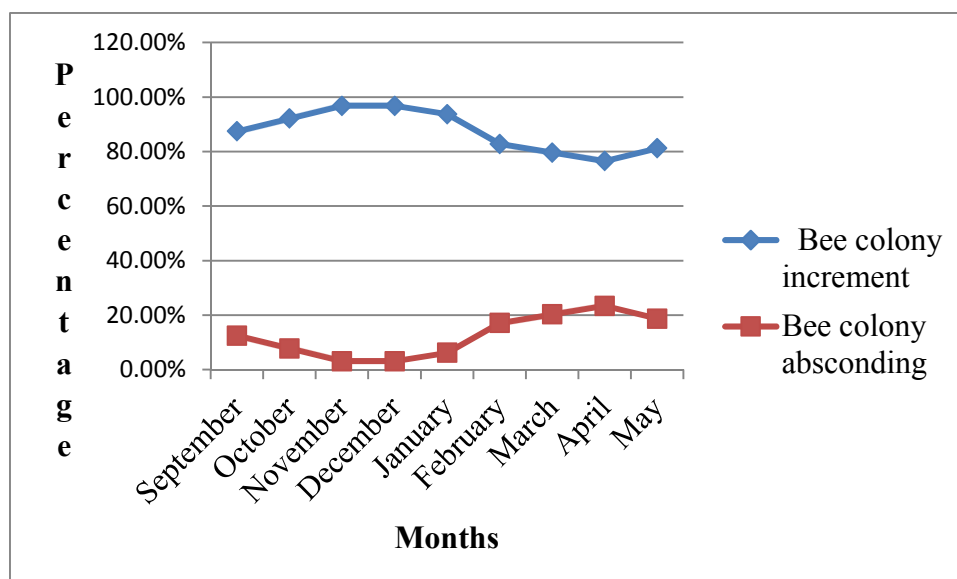


Figure 2: Patterns of honeybee colony owning and absconding from traditional hives in 2019

1.2.4. Other Risk Factors Facing Beekeepers

1.2.4.1. Socio-demographic Profile of Respondents

As shown in Table 2, all (100%) of the beekeepers were males. The majority (56%) of the beekeepers were in the age group between 41-50 years. The majority of the bee farmers (58.0%) undergone elementary education followed by secondary education (26.0%). The majority (54%) of the beekeepers had between 2-4 years of beekeeping experience and a few (14.0%) of them had less than two years of beekeeping experience.

Table 2: Demographic Characteristics of the Respondents (N=50)

Parameters	Categories	Frequency	Percentage (%)
Gender	Male	50	100%
	Female		
Age group	18-20	4	8.0
	21-40	28	56.0
	41-50	12	24.0
	Above 50	6	12.0
Educational Status	Illiterate	8	16.0
	Primary	29	58.0
	Secondary and above	13	26.0
Years of Beekeeping Experience	< 2 years	7	14.0
	2-4years	27	54.0
	> 4 years	16	32.0

1.2.4.2. Risk Factors Enhancing Honeybee Colony Absconding by Season

The respondents reported different challenges which affect the beekeeping activities in WDK such as pesticide and herbicide application that occurred in all seasons with the most occurrences in summer and spring (100%) and the least occurrence in autumn (30%) and winter (6%) respectively (Table 3). A significant association ($P < 0.05$) existed between the challenges of bee colony absconding and season except for pests and predators.

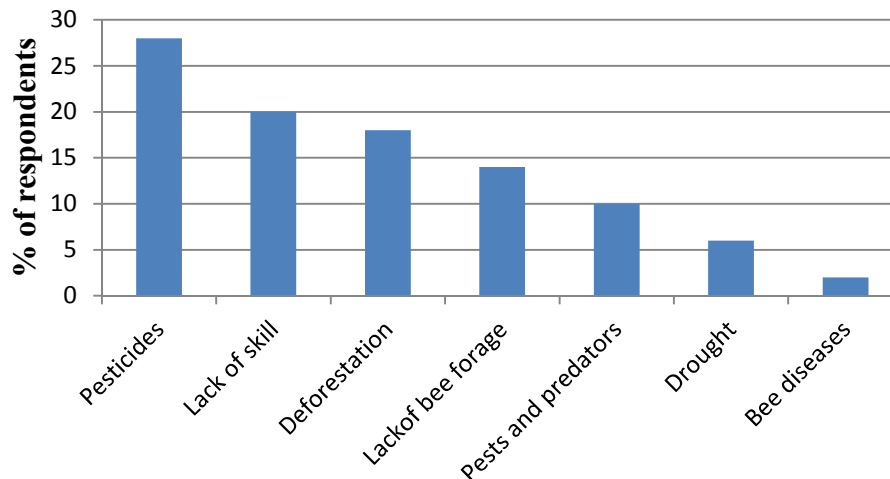
Table 3: Reported causes of honeybee colony absconding by season in WDK in 2019

Causes of Colony Absconding	Season of occurrence																Chi-square (X ²)	P-value
	Winter				Summer				Spring				Autumn					
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No				
Pesticides	3	6	47	94	50	100	0	0	50	100	0	0	15	30	35	70	134.3	0.000
Lack of skill	45	90	5	10	37	74	13	26	8	16	42	84	19	38	31	62	68.4	0.000
Deforestation	46	92	4	8	15	30	35	70	19	38	31	62	50	100	0	0	64.5	0.000
Lack of forage	43	86	7	14	24	48	26	52	0	0	50	100	38	76	12	24	89.2	0.000
Pests, predator	41	82	9	18	39	78	11	22	37	74	13	26	36	72	14	28	1.641	0.650
Bee disease	29	58	21	42	15	30	35	70	3	6	47	94	30	60	20	40	41.6	0.000
Drought	22	44	28	56	0	0	50	100	4	8	46	92	26	52	24	48	51.9	0.000

1.2.4.3. Challenges Causing Honeybee Colony Absconding By Rank

As shown in (Fig 3) constraints were ranked based on its risk factors for beekeeping development such as pesticides

supported by (28%) of the respondents, lack of skills man power supported by (20%) of the respondents, deforestation of trees supported by (18%) of the respondents, lack of bee forage supported by (12%) of the respondents, pests and predators supported by (10%) of the respondents, drought (lack of rainfall) supported by (6%) of the respondents, lack of water (4%) of the respondents, diseases supported by (2%) of the respondents. Pesticides and herbicide application were the top challenges whereas disease was the least one.



Factors causing Honey Bee Absconding

1.3. Discussion

1.3.1. Traditional Apiaries Owned by the Beekeepers

Results of apiary inspection survey showed that the majority of the beekeepers set their bee hives in backyard hanging under corrugated sheet and on beds in separate house constructed only for beekeeping and rarely set beehives on trees far away from their homestead. These observations agree with the works of (Kebede, 2011; Bihonegn, 2017) in Ethiopia. Keeping honeybee colonies under roof and on beds in separate houses in homestead were the common practice of beekeepers in the study setting. These traditional apiary practices of the beekeepers are safer and easily manageable as compared to tree apiaries which are labor intensive for climbing and subject to theft and honey pests.

1.3.2. Honeybee Colonies Owned by the Beekeepers

A nine month apiary inspection survey results showed that the overall number of honeybee colony positive hives owned by the beekeepers in Wehni Durbete Kebele was higher than the number of colony negative hives. These might be due to honey bee management practices of the beekeepers. The bee farmers keep their beehives in homestead and the honey bees were less exposed to theft and pests as explained earlier. Incidence of pests and predators, poor management, and lack of bee forage are the causes of colony absconding (Godifey, 2018). There were some variations among the sub-kebeles in the possession of honey bee colony positive and negative hives. Beekeepers in Tarenbora possessed the highest colony positive hives followed by those in Adukita and Terefamba. Whereas, beekeepers in Adukita owned the highest colony negative hives followed by those in Mehalwehni. This variation in honeybee colony possession among sub-kebeles could be due to beekeeping skill gap among the beekeepers and difference in apiary sites in relation of possession of bee forage. This agrees with the work of Addisu (2017) that reported similar observation from Dessie Zuria district in Ethiopia.

1.3.3. Monthly Pattern of Honey Bee Colony Owning and Absconding

Results showed that the number of bee colony absconding hives rose in February and peaked in April with slight decline thereafter. These would be expected because these months coincide with the dry months of the honey cropping season where there might be shortage of rain and bee flora. These results are supported by several studies who reported that honeybee colony absconding increases from February to May due to shortage of rain and bee flora. The present results were also in line with Godifey (2018) who reported that incidence of pests and predators, poor management, shortage of rain and bee flora are the causes of colony absconding. According to BoA (2004) the peak dearth months of bee colony were during dry period from February to April due to lack of rain and bee forage and during rainy season from June to July because the pollen of flowering plants is diluted and the nectar is washed by rain. The results of this report also agrees with the works of Kebede and his colleagues (2013) who observed that in West Gojjam the months February, March and April were the peak months of shortage of forage and severity for bee colonies.

On the other hand, the number of colony owning hives rose in October and peaked in December than the rest of the honey cropping months. These findings coincide with a previous study from Ethiopia (Belie, 2009) who

reported that most of the Ethiopian highlands are colored with golden-yellow bee flora from September to November and honey production increases because of abundance of local bee flora during this period. The work of Aynalem and Mekuriaw (2017) also assists the present results. The same source indicated that the main honey harvesting period in Amhara Region was October to November due to availability of moisture and peak flowering months of honey plants including pulse and oil crops. Kebede and Taddese (2014) also reported that September, October and November were the main months when colony swarming occurs because of availability of pollen in Ethiopia.

1.3.4. Other Risk Factors Facing Beekeepers

1.3.4.1. Socio-demographic Profile of Respondents

Results show that all of the beekeepers engaged in the traditional beekeeping practice were males. This is in line with the report of Kassa *et al.* (2015) who observed similar results from Jigjiga Zone, in Ethiopia. This shows that beekeeping activities were traditionally male dominated and may be considered as the only work of men in the study area and warrant further study. Beekeeping is a gender friendly activity particularly when it comes to the modern beekeeping and need special attention and action in the study setting. Results also revealed that the majority of the beekeepers were between age group 41-50 years. This survey was not in line with Tesfa (2013) who reported that the majority of the beekeepers were adolescent youths between age group 18-35 years. This implies that the beekeepers were matured youths than either immature youths or older aged adults further pointing the engagement of energetic and productive age group in beekeeping in the study area. With regard to educational status of the beekeepers the majority of them undergone elementary education a result similar to Belie (2009) who reported that majority of beekeepers had elementary education in Bure District of Amhara Region in Ethiopia. But it disagreed with the works of Shimelis (2017) in Ejere district, West Shewa Zone, Oromia Regional State in which most of the beekeepers were reported to be illiterate. When it comes to beekeeping experience, the majority of the beekeepers were reported to have between 2-4 years of beekeeping experience. This report disagrees with the findings of Tsegaye (2015) who observed that the experience of beekeepers in Waghimra and South Wollo Zone Amhara Region was more than five years.

1.3.4.2. Risk Factors Associated with Honeybee Colony Absconding

It was found that honeybee colony absconding was significantly associated with the application of agro-chemicals, lack of skills by the beekeepers, deforestation, shortage of bee forage, drought, and bee diseases. These findings agree with the works of (Belie, 2009; Tesfaye, 2015) who reported similar results from Bure Zuria District in Amhara and Bale Zone of Oromia Regional State respectively. Application of agro-chemicals particularly pesticides and herbicides were higher in summer and spring than winter and autumn. This might be expected because most agricultural activities take place during these seasons and local farmers use the chemicals to control weeds but winter and autumn are off seasons for rain fed agriculture in the study setting. Therefore, chemicals used for crop protection are the main pesticides that kill the honeybees and cause bee colony absconding and decline. Application of pesticides for crop protection accelerates colony decline (Ejigu *et al.* 2009; Tsegaye, 2015).

Deforestation and shortage of bee forage were also reported to be other major risk factors facing the traditional beekeepers. These would be due to over population and existence of basic needs such as fire wood, farmland, building house and charcoal production. This would be expected because “no trees no bees” and local forest resources are degraded and deteriorating due to over utilization and inefficient use of the resource which has negative impact on biodiversity of honeybees (Bedru *et al.* 2006). Population pressure and lack of land use policy were key deriving forces for declining honeybee floras (Tessema, 2016) in Ethiopia. The shortage of bee forage mostly lack occurred from December to April which causes bee colony absconding. This is in line with the work of (Birhan *et al.* 2015) who reported that this period was dearth period for honey bee colonies.

Drought was also reported to be another problem that enhance honey bee colony absconding in the area. In line with this result (Ejigu, 2005; Kebede *et al.* 2008; Kebede and Taddese, 2014) reported that frequent occurrence of drought was a challenge to beekeeping development that usually occurs during January- April in Ethiopia.

Bee diseases were also reported to be another risk factor associated with bee colony absconding. The survey results showed that the diseases were reported to occur during winter and autumn especially from January to April during shortage of bee forage. This would be expected because the bees are vulnerable to various diseases, parasites and pests during dearth period (Begna 2006).

1.3.4.3. Challenges Causing Honeybee Colony Absconding By Rank

Pesticide and herbicide application were the top challenges facing beekeepers in the study area. This finding is in line with Kebede and Taddese (2014) who also reported similar results in Ethiopia. Another top problem of colony absconding in the study area was also inadequate skill of beekeepers. Bee colonies abscond from their hives because of lack of internal and external inspection survey of apiary sites or due to skill gap of beekeepers. These agree with the findings of (Kebede *et al.* 2008; Belie, 2009; Tsegaye 2015) who reported that lack of skill was a cause for colony decline and absconding.

1.4. Conclusions

Results underscore that the local beekeepers own most bee colonies from October to December and lose most of them from January to April from their traditional hives. The top risk factors associated with bee colony absconding in the study setting were application of agro-chemicals, lack of skill by the beekeepers and deforestation respectively. Therefore it needs intervention to change traditional beekeeping practices through training and introducing improved beekeeping technologies that are suitable for local bee types and conditions.

Competing interests

The authors have read the manuscript and declared that no competing interests exist.

Authors' contributions

YN participated to the study design, conducted data collection, analysis and interpretation and drafted and revised the manuscript. OK involved in designing the study, revised the manuscript and has given approval of the version to be published. All authors read and approved the final manuscript.

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