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Honeybee pests, predators and diseases in the selected districts of Bench-Maji and Sheka zones, Southwest Ethiopia

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This study evaluates the honeybee pests, predators and diseases in the selected districts of Sheka and Bench Maji zones. A cross sectional study design was used in the study. Four hundred and twenty households were involved in the study and 35 were randomly selected using stratified random sampling techniques from each purposively selected twelve kebeles. Specimens were collected from a hive of 72 households for validation of disease prevalence in the study areas. According to the result of survey, the most common beehives used in the study areas were traditional beehives (39.05, 80.95, 98.10 and 97.14% in Anderacha, Guraferda, Shey Bench and Maji districts, respectively). Most beekeepers from Anderacha (62.86%) and Shey Bench (49.52%) districts placed their hive both in backyards and on trees in the forests; while, most beekeepers in Guraferda (75.24%) and Maji (96.19%) districts hang their hive on trees in the forest. The current study revealed that, the existence of ant, lizards, honey badger, termites, snake, death head hawks moth, spider (*Latrodectus mactans*), wax moth, bee-eater birds, beetles, bee lice and wasps were a serious challenge to the honeybees and beekeepers. Subsequently, the beekeepers were ranked the major pests and predators identified in their areas. Accordingly, ant was ranked first in Anderacha (26.67%), Guraferda (23.81%) and Shey Bench (25.71%) districts that causes disturbance, death and absconding of bee colonies. Overall, there are four different types of honeybee diseases observed in the study areas, namely, nosema, chalk brood, bee paralysis and stone brood disease. It was concluded that the overall pests, predators and diseases were seriously challenging the honeybees and beekeepers in the study areas. Thus, extension agents should alert beekeepers about the features of major pests, predators and diseases in their areas and educate them on controlling mechanisms.

Key words: Bench Maji, diseases, pests, predators, Sheka.

INTRODUCTION

Honeybee produces valuable products including honey, without competing with other activities of agriculture and

forestry. The production is a valued environmental friendly agricultural activity, which efficiently pollinates the flowering plants, vegetables and trees; playing an important role in promoting agricultural activities and forestry (Nakamura et al., 2009). It contributes to peoples' livelihoods in almost every country in the world. Specifically in rural communities where access to income is limited, small-scale honeybees contributes significantly to livelihood security through honey production (FAO, 2009). The sector is also an integral part of agriculture in Ethiopia. It contributes to household food security and enriches national economy through generating foreign currency. Beekeeping is exceptionally sustainable, since the activity has no impact on the environment and it stabilizes fragile areas and help to reclaim degraded lands and increase biodiversity (Adgaba et al., 2014).

Diseases, pests and predators are problems for bee keeping practice in Ethiopian. A numbers of invertebrate pests such as ants, beetle, moths, lice, termites, mites, as well as large vertebrate animals such as amphibians, reptile, lizards, birds, mammals like honey badgers and mice were recognized in the Ethiopian *honeybee*. *Honeybee* diseases in Ethiopia include Chalk brood diseases caused by pathogenic fungi, *Ascosphaera apis*, Nosematosis caused by *Nosema apis* and amoeba caused by a single protozoa *Malpighamoeba mellificae.* These disease-causing pathogenic organisms and various pest animals influence the success of apiculture. Infections of the disease ranging from chronic to highly infectious can result in loss of *honeybee* populations and loss of *honeybee* products such as honey and wax; leading to abscond or death to honey bees (Desalegn, 2000; Amsalu et al., 2010).

Southwest Ethiopia is among the best potential areas for beekeeping in the country. Bench and Sheka Zone, particularly Anderacha, Guraferda, Sheko, Shey Bench and Maji districts are endowed with very diverse and dense natural forests that favor the existence of dense honeybee population. The livelihood of the people is strongly dependent on honey production and used as a major economic activity that generates income and creates job opportunity for the majorities. In addition, honeybees in the Bench and Sheka Zone are exposed to threats from several pests and diseases but not recognized due to lack of measures to establish their significance. The area has hot and humid climate, which is conducive for the development of honeybee disease and pest. The existence of pests and predators are irritants to the honeybees and beekeepers in the country and specifically under local conditions, which causes devastating damage on honeybee colonies. Honeybee colonies may survive the infestation but any extent of severity leads to loss in honey yields and complete honeybee colony absconding due to disturbances. Identifying the major economically important honeybee pests and diseases, assessing their degree of economic importance to prioritize them based on their degree of severity as well as to design appropriate control measures. Hence, it is strongly believed that availing such important information for the study area is relevant for database and development plan of the Districts. Therefore, this study was designed to identify the honeybee pests, predators and diseases in the study areas.

MATERIALS AND METHODS

Description of the study area

The study was conducted in selected districts of Bench Maji and Sheka Zone. They comprise 13 zones of Southern Nations, Nationalities, Peoples and Regions in Ethiopian. Agro-ecologically, Bench Maji Zone consists of 52% lowland (<1500 m above sea level (masl), 43% mid altitude (1500-2300 masl) and 5% highland (>2300 masl). The altitude ranges from 500 to 3,000 masl. Bench Maji Zone is found at 34°45'-36°10' east and 5°40'-7°40' north direction. The annual average temperature range from 15.1 to 27.5°C, while the annual rainfall range from 400 to 2,000 mm. Sheka Zone geographically lies between 7°24‘ and 7°52" N latitude and 35°13‘-35°35‘ E longitude. The farming system is characterized as mixed crop-livestock production system. The total cattle, sheep, goats, horses, mules, donkeys, poultry and beehives population in the Bench Maji Zone is about 334,502, 181,203, 93,952, 9,827, 2,328, 2,381, 704,269 and 110,844, respectively. Similarly, in Shaka Zone, 142,901, 165,249, 20,057, 11,740, 2,550, 2,403, 156,125 and 128,211 number of cattle, sheep, goats, horses, mules, donkeys, poultry and beehives population were found, respectively (CSA, 2016/2017).

Study design

Cross sectional study was carried out for data collection from four different districts through data gathering instruments such as questionnaires, observation, key informant interview, focus group discussion and laboratory investigation.

Sample size and sampling technique

Before the actual survey, information gathered from secondary data and key informants was not included in the data. Based on the information obtained from secondary data and informal survey, a structured questionnaire was developed and pre-tested for its consistency and applicability to the objectives of the study.

Study was conducted in three selected districts of Bench-Maji Zone (Shey-Bench, Guraferda and Maji) and one district of Sheka Zone (Anderacha) was purposively selected based on beekeeping

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potential. Three *kebeles* from each district and twelve *kebeles* were purposively selected from four districts, based on their beekeeping potential and agro-ecology. In each *kebele,* stratification was established based on the agro-ecology and the type of beekeeping they practice. Subsequently, 35 households were selected randomly from each selected *kebele*, with 420 households involved in the study. Specimen was collected from a hive of 72 households for validation of disease prevalence in the study areas. Accordingly, a total of 1440 adult honeybee and 360 brood specimens were collected from the randomly selected households (6 household from each *kebele*). Collected honeybee and brood specimens were transported to Mizan Regional Veterinary Diagnostic Laboratory and each was examined for the existence of diseases according to the procedures of OIE (2008).

Data collection

Two methods of data collection were employed in this study, that is, questionnaire-based and laboratory-based data collection.

Questionnaire based data collection

To attain the objectives, both primary and secondary sources of data were collected. Primary data were collected through questionnaires, observation, focal group discussion and laboratory analysis. Whereas, secondary data were collected from reports of district and Zonal Livestock and Fishery Resource Development offices, as well as other published and unpublished materials.

Laboratory investigation

For laboratory analysis, the team carried mobile laboratory kit composed of stereomicroscope, hand lenses, water bath boiler, scissors, forceps, and reagent chemicals. After sampling, thorough laboratory analysis was carried out according to the procedures of OIE (2008). The major tests conducted were the presence or absence of ecto and endo parasites, chalk brood, nosema and amoeba (where there was suspected symptoms). During the test for each type of examination, standard procedures were followed with OIE (2008) methods. Besides laboratory analysis, field observations were made and pest infestations were observed and recorded.

In addition to observation and laboratory diagnosis, any observed problems related to honeybee management (like absconding of colonies and heavy infestation by disease), have been discussed on the spot with concerned bodies and beekeepers. Finally, the possible ways to minimize the effect has been suggested to the beekeepers and the relevant officers.

Data analysis

All collected data were coded and organized for analysis, using MS excel and the SAS software. The statistical analysis used in the study varied, depending on the type of variables and information required. Descriptive statistics such as means, frequency and percentages were used to analyze the quantitative data, using SAS version 23 software.

RESULTS AND DISCUSSION

Type of beehive used

According to the survey result, the most common beehive used by honeybee producers were traditional hives, amounting to 39.05, 80.95, 98.10 and 97.14% in Anderacha, Guraferda, Shey Bench and Maji districts, respectively. They and are kept at the backyard and hung on long trees in the forest with no management care given for bees.

This is the dominant traditional production system. This might be due to the reduced cost and locally available materials (like bamboo and tree timber) for the construction of traditional beehives. This result is in line with that of Mulubrihan (2014) and Bekele et al. (2017) who reported 90% in Anderacha district and 96.86% in Bale Zone who use traditional beehives respectively. Whereas in the study areas, 1.90, 3.81, 0.95 and 0.95% respondents of Anderacha, Guraferda, Shey Bench and Maji districts, respectively use transitional beehives.

No sampled smallholder beekeeper that use modern hive (frame hive) in Anderacha and Shey bench districts. About 25.71, 12.38, 0.95 and 1.90% of the respondents used both traditional and transitional beehives in Anderacha, Guraferda, Shey Bench and Maji districts, respectively. In this current study, the minimum and maximum percentage of traditional beehives (readings of minimum and maximum percentage) were obtained compared to early findings of Mulubrihan (2014) who reported 10% of respondents that use traditional and transitional beehives. Similarly, Bekele et al. (2017) also reported that a few beekeepers use transitional (0.88%) and modern (2.26%) beekeeping production system in Bale Zone.

Table 1 shows that a few respondents (3.81 and 0.95% in Anderacha and Guraferda districts, respectively) use transitional and movable frame hives. Likewise, some respondents (13.33 and 0.95% in Anderacha and Guraferda districts, respectively) use three types of beehive namely traditional, transitional and movable frame hives. In addition, about 16.19 and 0.95% in Anderacha and Guraferda districts, respectively, use both traditional and Modern hives. Overall, Shenkute 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 Zones are forest areas where beekeepers practiced more method that is traditional by hanging).

Placement of beehives

As indicated in Table 2, there are different types of beehives placement in the study areas. They include keeping beehive in the backyard (homed yard), placing under the roof of the house and hanging on trees in the forest. Survey data showed that, majority of beekeepers of Anderacha (62.86%) and Shey Bench (49.52%) districts placed their hive both in the backyard and

Table 1. Types of beehives used in the study areas (n=420).

Variable	Anderacha district		Guraferda district		Shey Bench district		Maji district	
	n	%	n	%	n	%	n	%
Type of beehives used								
Traditional hive	41	39.05	85	80.95	103	98.10	102	97.14
Transitional hive	2	1.90	4	3.81	1	0.95	1	0.95
Modern hive	-	0.00	1	0.95	-	0.00	-	0.00
Traditional and transitional	27	25.71	13	12.38	1	0.95	2	1.90
Transitional and modern hives	4	3.81	1	0.95	-	0.00	-	0.00
Traditional, transitional and modern hives	14	13.33	-	0.95	-	0.00	-	0.00
Traditional and modern hive	17	16.19	1	0.95	-	0.00	-	0.00

n= Number of respondents.

Table 2. The way of beehives placement in the study areas (n=420).

Variable	Anderacha district		Guraferda district		Shey Bench district		Maji district	
	n	%	n	%	n	%	n	%
Placement of hives								
Backyard	14	13.33	2	1.90	2	1.90	2	1.90
Under the roof of the house	-	0.00	10	9.52	-	0.00	-	0.00
Hanging on trees in forest	25	23.81	79	75.24	51	48.57	101	96.19
Both at backyard and hanging on trees in forest	66	62.86	14	13.33	52	49.52	2	1.90

n= Number of respondents.

hanging on trees in forest whereas, majority of Guraferda (75.24%) and Maji (96.19%) district beekeepers hang theirs on trees in the forest. Similarly, Tesfaye and Tesfaye (2007) reported that about 97.6% of the respondents in Adami Tulu put their hives on a branch of a tree and the others at their backyards. Some the sample respondents (13.33%, Anderacha; 1.90%, Guraferda, Shey Bench and Maji districts) keep their hive in their backyards (homestead) mainly to enable close supervision of honeybee.

This result is lower than early findings of Adebabay et al. (2008) who reported that 94.7% of the respondent beekeepers in Amhara region keep their colonies around the homestead (backyard). Also few others (9.52%), Guraferda district honeybee producers keep their hives under the roof of the house. However, Keralem (2005) and Tessga (2009) reported that majority of the beekeepers at Enebsie and Burie districts kept their colonies under the eaves of their house. Keeping honeybee colonies under the roof of the house and at the backyard make inspection of colonies and other hive management easier compared to free apiaries. The main criteria for beehive placement are: closeness for supervision, availability of flora, orientation to sunlight, free from bee enemies (free from any animals and human disturbances) combinations of criteria and wind direction. Generally, the suitable apiary selection to keep bee colony is far from different factors like the community, road, vehicle sound, machines and animals.

Beekeeping experience and trends of keeping

In the study areas, majority of beekeepers (60.95, 68.57, 68.57 and 60% in Anderacha Guraferda, Shey Bench and Maji districts, respectively) have more than 11 years' experience (Table 3). This result is almost comparable with the findings of Abebe (2008) who reported that in Sekota districts, most respondents had an average experience of 16.5 years in beekeepers. The level of beekeepers experience is the number of years that an individual has continuously engaged in beekeeping. This result could explain that people are actively engaged in beekeeping from an early age and had long time experience. The recently engaged beekeepers that have less than 5 years of experience were 11.54, 18.10, 16.19 and 26.67% of the respondents in Anderacha, Guraferda, Shey Bench and Maji districts, respectively.

Table 3. Beekeeping experience and trends of keeping in the study areas (n=420).

Variable	Anderacha district		Guraferda district		Shey Bench district		Maji district	
	n	%	n	%	n	%	n	%
Beekeeping experience								
1-5 years	12	11.54	19	18.10	17	16.19	28	26.67
6-10 years	29	27.62	14	13.33	16	15.24	14	13.33
>11 years	64	60.95	72	68.57	72	68.57	63	60.00
Trends of beekeeping								
Increasing	30	28.57	35	33.33	25	23.81	37	35.24
Decreasing	75	71.43	67	63.81	65	61.90	56	53.33
Stable	-	0.00	3	2.86	15	14.29	12	11.43

n= Number of respondents.

The intermediate engaged beekeepers that have 6 to 10 years of experience were 27.62, 13.33%, 15.24 and 13.33% of the respondents in Anderacha, Guraferda, Shey Bench and Maji districts, respectively. Most of the respondents have confirmed that their children even at an early age, were also engaged in beekeeping to help their parents. Based on this exposure, young people gradually move on to become independent beekeepers as soon as they obtain their own hives. They continue to accumulate experience by seeking technical advice from corresponding beekeepers whenever necessary. Furthermore, the observations made during the study period by those beekeepers who have more experience in providing shelter, protect colonies from pest attack, supplementary feeding during dearth period, swarm management, colony multiplication, etc., have confirmed that as experience increases, the quality of colony management also increases.

Table 3 indicated that, about 28.57, 33.33, 23.81 and 35.24% of the respondents reported that beekeeping production increasing concerning the yields of hives and the number of honeybee populations in Anderacha, Guraferda, Shey Bench and Maji districts, respectively. Whereas, 71.43, 63.81, 61.90 and 53.33% of the respondents in Anderacha, Guraferda, Shey Bench and Maji districts, respectively reported that there is a decreasing trend in the number of honeybee colonies and their products from time to time.

This might be due to deforestation, unwise use of pesticides and herbicides, climatic change from time to time, presence of pests and predators, absconding and migration problems, inadequate honeybee forages and the prevalence of honeybee disease. About 2.86, 14.29 and 11.43% honeybee keepers of Guraferda, Shey Bench and Maji districts, respectively had stable honeybee production system. This result is similar to that reported by Tessega (2009) as well as Haftu and Gezu (2014).

Major pests and predators of honeybees

Table 4 shows that the existence of ant, lizards, honey badger (*Merluccius capensis)*, termites, snake, death head hawks moth *(Acherontia atropos)*, spider *(Latrodectus mactans)*, wax moth *(Galleria mellonella)*, bee-eater birds, beetles (*Aethina tumida*), bee lice (*Braula coeca)* and wasps *(Polistes fuscatus)* were major challenge to the honeybees and beekeepers in the study area. Subsequently, the beekeepers ranked the major pests and predators identified in their areas.

Majority of beekeeper in Anderach district reported that ant (26.67%), honey badger (23.81%) and wax moth (18.10%) were the 1st, 2nd and 3rd (a space) most harmful pests and predators, respectively in their area. Likewise, majority of Guraferda and Shey Bench districts reported that ant (23.81 and 25.71%), wax moth (20.00 and 23.81%) and honey badger (18.10 and 14.29%) were the 1st, 2nd and 3rd most harmful pests and predators, respectively in their areas.

However, honey badger (26.67%), death head hawks moth (22.86%) and bee eating birds (15.24%) were reported as the 1st, 2nd and 3rd most harmful pests and predators, respectively in Maji district. Similar findings were reported in different parts of the country (Desalegn, 2001; Workneh, 2007; Tessega, 2009; Chala et al., 2012; Shenkute et al., 2012; Bekele et al., 2017).

Generally, ant, wax moth, death head hawks moth, bee eating birds and honey badger are a serious problem and they stand out in the areas; causing challenges on honeybee colonies and honeybee products. On account of this predators attack, a considerable amount of honey and other hive products is lost and disappearance occurs. Table 4 shows that some pests and predators, which are rarely, found in specific area, like lizards, termites, snake, spiders, beetles, bee lice and wasps were also reported by few farmers; they also earnestly affect the honeybee

Table 4. Major pests and predators of honey bees in the study areas (n=420).

Pests and predators	Anderach district		Guraferda district		Shey Bench district		Maji district	
	n	%	n	%	n	%	n	%
Ant	28	26.67	25	23.81	27	25.71	6	5.71
Lizards	3	2.86	1	0.95	2	1.90	1	0.95
Honey Badger	25	23.81	19	18.10	15	14.29	28	26.67
Termites	4	3.81	6	5.71	11	10.48	7	6.67
Snake	2	1.90	1	0.95	1	0.95	1	0.95
Death head hawks moth	6	5.71	7	6.67	5	4.76	24	22.86
Spider	3	2.86	2	1.90	1	0.95	1	0.95
Wax moth	19	18.10	21	20.00	25	23.81	12	11.43
Bee eating birds	8	7.62	11	10.48	13	12.38	16	15.24
Beetles	3	2.86	5	4.76	3	2.86	1	0.95
Bee lice	4	3.81	7	6.67	2	1.90	3	2.86
Wasps	-	-	-		-		5	4.76
Total	105	100	105	100	105	100	105	100.00
Rank								
1st	Ant		Ant		Ant		Honey Badger	
2nd	Honey Badger		Wax moth		Wax moth		Death head hawks moth	
3rd	Wax moth		Honey Badger		Honey Badger		Bee eating birds	

n= Number of respondents.

production in the areas.

As indicated in the Table 4, ant was ranked 1st in Anderacha (26.67%), Guraferda (23.81%) and Shey Bench (25.71%) districts which cause disturbance, death and absconding of bee colonies. This agrees with the results of Adebabay et al. (2008) and Tessega (2009) who reported ants as the most harmful pest in Amhara Region and Burie districts, respectively and the problem was also considered to cause a major problem in the adoption of improved beekeeping technologies (Workneh, 2007). Similarly, in Tigray, Amhara and SNNP regional states and Gomma district of Jimma Zone beekeepers ranked ants as the first problematic pest in honeybees (Amsalu *et al.*, 2010). According to the respondents, the following controlling mechanisms were used for ants; putting fresh ash around the hive stand, pour hot water in to the ants nest, burn the ant nests with fire, use of white eucalyptus leaves as repellant, putting protective plastic under the hive stand, close the cracks and holes by mud, spray soap solution, keeping weeds away from the base of the hive stand, brushing and cleaning the hive with local plants like “tenadam” and onion and putting tree leaves near the hive stand to control the effect of ant on bee and to restrict the movement of ant from its nest to the honeybee hive.

The other pest in the present study areas is wax moth (*Sembel Til)* (18.10, 20.00, 23.81 and 11.43% in Anderacha, Guraferda, Shey Bench and Maji districts, respectively). Similarly, Tewodros (2010) reported wax moth as the most harmful pest in Sekota district. It results in the destruction of honeybee comb in the hive; the comb is eaten and covered by spider web. This pest mainly occurs in weak colony and during prolonged dry period. This pest has been considered as a sign of poor colony management as observed from its damage caused on honeycombs during its larval growth stage and even to the hive body during its pupae stage. The honeybee producers can control this pest immediately after they observe it with various methods such as reducing empty and dark comb, removing the spider web, melting invaded comb and inspecting their hive regularly during dry season, making the colonies to be strong, giving additional foods, reduce hive entrance, smoking/fumigating the hive. This is in agreement with the findings of Adebabay et al. (2008) and Tessega (2009) who reported wax moth as the second most important problematic pest next to ants in Amhara Region and Burie district, respectively.

Honey badger is widely distributed and they seriously challenge the honeybees and beekeepers in the study areas (1st rank in Maji, 2nd rank in Anderach, 3rd rank in Guraferda and Shey Bench districts). They destroy beehive, eat bees and honey. Beekeepers explained that their colonies could be prevented from honey badger damage by using dogs, hanging hives by rope on long trees, mechanical barriers putting like thorny woods and fencing of apiaries as a safeguard. This is consistent with the findings of Adebabay et al. (2008) who reported that

beekeepers at Amhara region has an experience of protecting honey badger by killing, fencing and chasing with dogs.

According to the response of Maji district beekeepers, death head hawks moth (*Embabra)* was ranked 2nd pest among those that affect honeybee production. The pest enters the hive through wider hive entrances and different openings and can cause colony absconding due to its nuisance from a continuous faster wing vibration. Regarding the control measures to this pest, some respondents have explained that they try to kill the pest at night, using a hand torch or other light sources and decrease the size of hive entrance.

The present result indicate that, honeybee eater birds were the 3rd most economically important predator of the honeybees in Maji district (Table 4). Bee eating birds (7.62, 10.48, 12.38 and 15.24% in Anderacha, Guraferda, Shey Bench and Maji districts, respectively) attack mainly the worker bee during transport water, orientation flight, nectar and water gathering as well as during guard duty. Their effects have been noticed to be more prominent when birds came in large numbers (supported by their seasonal movements) and weaker colonies are the ones more prone to the effect of honeybee eater birds. In most cases, the birds use nearby trees or branches of fences to land prey the forager bees. This is in agreement with the findings of Adebabay et al. (2008) and Tessega (2009) who reported honeybee eater birds as the third most important problematic pest next to ants and wax moth in Amhara Region and Burie district, respectively. In addition, Tewodros (2010) also reported that honeybee eater birds were very common in Sekota districts highland. As a result, farmers controlled them through scaring or chasing, killing honeybee eater using local traps extracted from sticky gums and destroying the birds nest in the ground.

Likewise, Tewodros (2010) has also reported the experience of Sekota beekeepers to prevent honeybee eater birds by placing gums of plants where the birds rest and near the apiary, killing the bird by smoking their nest and by chasing away the birds. In addition, Tessega (2009) also reported the experience of beekeepers at Burie district who prevent them by spinning something (old cloth, plastic sheet, etc.) around the hive and by killing using wochif.

As indicated in Table 4, termite (3.81, 5.71, 10.48 and 6.67% in Anderacha, Guraferda, Shey Bench and Maji districts, respectively) which seems like ant causes the bees to abscond from the hive, and they eat honey and bees. Some of respondents also reported snake and lizards (*Enshilalit*) were considered as one of the factors contributing to colony population decreasing trend (Table 4). It has been revealed that snake and lizards were observed to prey honeybee on the entrance of the hive. Killing of snake and lizards using sticks, use of traps and good apiary management (including cleaning) have been proposed by beekeepers as a possible control mechanism against the pest.

The other predator is spider or *Shererit* (2.86, 1.90, 0.95 and 0.95% in Anderacha, Guraferda, Shey Bench and Maji districts, respectively), which kill and eat honeybee by building their web near the hive or near the forage source; leading to decrease in colony population and honey yield. The occurrence of spiders in the colonies and/or apiaries is considered as a sign of poor apiary management. Cleaning apiary site always, removing the spider webs, putting ash around hive stand are the control mechanism in the study areas.

About 2.86, 4.76, 2.86 and 0.95% of beekeeping respondents have claimed beetles as one of the factors contributing to colony population decline in Anderacha, Guraferda, Shey Bench and Maji districts, respectively. In addition, 3.81, 6.67, 1.90 and 2.86% of bee lice was also reported as the other pests that affect honeybee production in Anderacha, Guraferda, Shey Bench and Maji districts, respectively. A few (4.76%) wasps were also claimed by Maji district beekeepers (Table 4). This pest can be controlled by beekeepers through cleaning apiary site, remove nests of wasps and narrow the hive entrance. However their degree of damage was not considered as serious as that of ants, wax moths, honey badger, death head hawks moth and honeybee eater birds identified in the study areas. Eventually, the keepers suggest that smoking/fumigating the hive with materials like tobacco, dung, grass, making the colonies strong and giving additional food for weaken colonies and cleaning apiary site are control measures.

Honeybee disease

Figure 1 shows the overall honeybee disease in the study areas. About 75 (71.43%), 73 (69.52%), 58 (55.24%) and 49 (a space 46.67%) respondents reported nosema disease in Anderacha, Maji, Guraferda and Shey Bench districts, respectively. This result indicates that the high prevalence of nosema disease was reported in descending order in the study areas. Figure 1 shows that the honeybee producers reported 20 (19.05%), 25 (23.81%), 31 (29.52%) and 21(20%) Chalk brood disease in Anderacha, Guraferda, Shey Bench and Maji districts, respectively. About 5 (4.76%), 15 (a space 14.29%), 20 (19.05) and 4 (3.81%) bee paralysis diseases were reported by honeybee producers of Anderacha, Guraferda, Shey Bench and Maji districts, respectively. As indicated in Figure 1, about 5 (4.76%), 12 (11.43%), 5 (a space 4.76%) and 7 (a space 6.67%) stone brood diseases were reported in Anderacha, Guraferda, Shey Bench and Maji districts, respectively.

Generally, the present study showed an overall prevalence of nosema disease reported by honeybee producers in the study areas. This result is comparable with Aster et al. (2007) who stated that in Ethiopia nosema was reported from different regions with varying

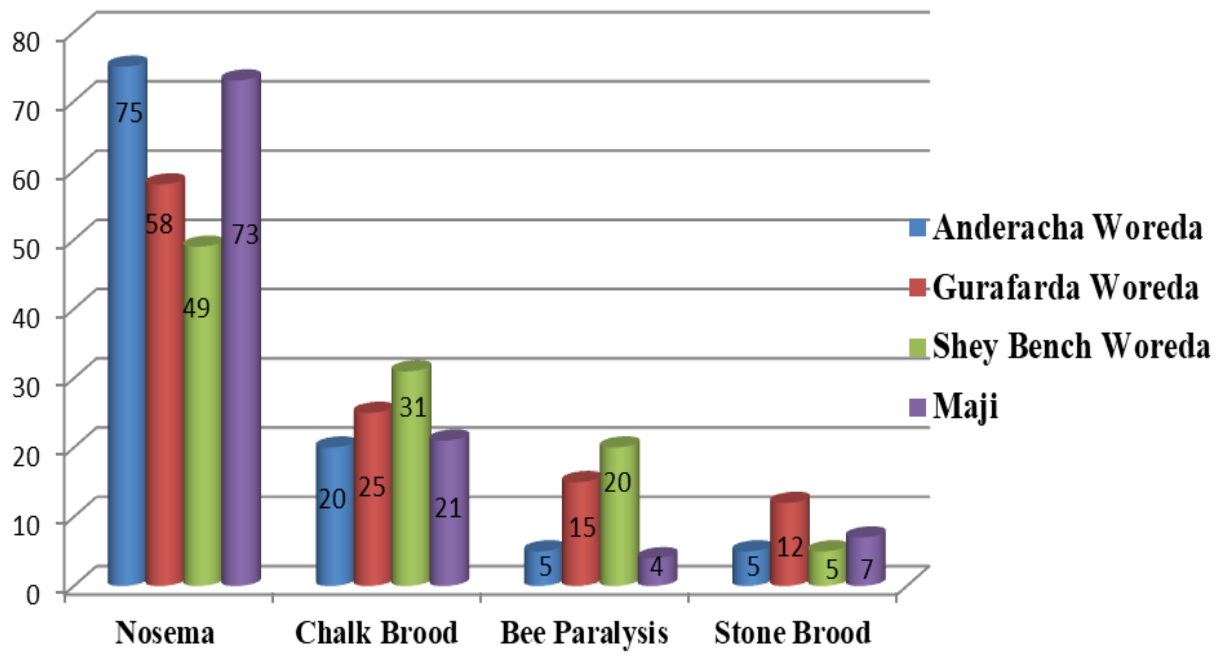

Figure 1. Honeybee diseases in the study areas.

prevalence rate such as 58% in Oromia, 60% Benishangul-Gumuz and 47% in Amhara regions. The second disease next to nosema which occur in the study areas was chalk brood disease caused by pathogenic fungi, Ascosphaera apis that usually attach to workers and drones. Bees that is affected by this disease shows that larvae die early and the larvae look like chalk; thus farmers have to clean the brood nest and burn infected brood comb to control the disease.

The third disease which has less significance influence on honeybee was bee paralysis virus. It affects bees in various ways: fail to fly, trembling of wing and bodies, crowing on the ground and dislocating wing. Although this disease happens rarely when there is scarcity of flora, farmers handle the impact by removing the inflected bees and cleaning the hive. The fourth disease is stone brood disease that is caused by *Aspergillus flavus*, which results in the brood becoming stone and then die early before the pupa stage so farmers clean the apiary and remove infected brood and honeybee. Generally, these diseases mainly occur in traditional beehive because it is difficult to inspect the hive regularly and it eases transmission of disease from infected hive to healthy hive due to the presence of hole and crack.

CONCLUSIONS AND RECOMMENDATIONS

The results of the current study have identified ant, honey badger (*M. capensis)*, wax moth (*G. mellonella)*, death head hawks moth *(A. atropos)*, termites, snake, lizards, spider *(L. mactans)*, bee-eater birds, beetles (*A. tumida*), bee lice (*B. coeca*) and wasps *(P. fuscatus)* as the major honeybee pests and predators that seriously challenge the honeybees and beekeepers in the study areas. This might be due to the poor management practices of apiary site environment, poor site selection and inspection of the beehives. Honeybee colonies and their products decrease from time to time. This could be due to the increment of deforestation, unwise use of pesticides and herbicides, climatic change from time to time, presence of pests and predators, absconding and migration problems, inadequate honeybee forages and the prevalence of honeybee disease. The overall pests, predators and diseases seriously challenge the honeybees and have a significant impact in deteriorating the welfare of the beekeepers in the study areas. Thus, the following recommendations are given to address the problems:

(1) Extension agents should enlighten the beekeepers about the features of major pests, predators and diseases in their areas and educate them on the controlling mechanisms.
(2) Keep cleaning apiary site and strengthen, regular colony inspection and disease diagnosis should be considered and supported by professionals to minimize honeybee death and colony decline due to honeybee pests and diseases.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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