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

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ABSTRACT

Among all constraints of beekeeping, natural bee enemies are known to cause great damage on the life and the product of honeybees through causing absconding and migration. A study was conducted in Bale from July, 2010- June, 2012 in six districts with the objective of assessing the effect of natural bee enemies on the life of honeybees and their products. From each district 3 Rural Kebeles (RK's) and 10 beekeepers from each RK's were purposively selected and a total of 180 beekeepers were participated. The selected beekeepers were interviewed using pre-tested structured questionnaires and single-visit-multiple formal survey method to collect the data. The collected data were analyzed using SPSS version 20 software and descriptive analysis method. The majority (96.86%) of the respondents in the study area were followed traditional production system, but only few beekeepers were started transitional (0.88) and modern (2.26) beekeeping production system. In the study area honeybees' enemies, agro-chemicals, lack of knowledge to manage bees and bee products, lack of bee colonies and bees poisoning from plants identified as major beekeeping constraints. Respondents were asked to identify major honeybee pests and predators. Based on the result of this study, the existence of pests and predators were a major challenge to the honeybees and beekeepers in the study area. In all surveyed area the beekeepers were reported that the presence of Honey badger, spider, bee-eating birds, bee lice,

Beetles, wasps, Death Head hawks moth Mice and lizards in order of their decreasing importance. Traditionally, the beekeepers were used their own control mechanisms of protecting these pests and predators like application of ash under the stand of the hive, hanging hives by rope on long trees, cleaning around the apiary site, using dog for large predators like honey badger, fencing their apiary site and mechanical like killing of the predators and pests etc. About 72.6% of the respondents reported that honey production trend in the area were decreasing and 25.1% and 2.2 was said increasing and unchanged trend of production system respectively. Despite the challenges of beekeeping, it is realized that there is potential of beekeeping in Bale, though the production system is traditional and there is an opportunity of improving the situation since there are plenty of beekeeping resources.

1. Introduction

Ethiopia has a longstanding beekeeping practice and endowed with huge apicultural resources and it has been an integral part of other agricultural activity, where about one million households keep honeybees. More than 5.15 million hived honeybee populations are found in the country (Adgaba et al., 2014). Beekeeping is regarded to be an agricultural venture little or no land except a space to stand or hang hive; very little labor, almost no capital and most of the other inputs are considered to be locally available (Rubio, 2001). However, the success of apicultural activity depends on the biotic and environmental factors proffered by the ecosystem. Honeybee pests have been identified as one of the major biotic factors standing in way of successful beekeeping practice (Oyerinde and Ande, 2009).

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

Among all constraints of beekeeping; natural bee enemies (pests and predators) are known to cause great damage on the life and the products of honeybees through causing absconding and migration especially in Bale. In many parts of the world, research is under way to develop means to combat or prevent honeybee pests and predators. However, bee research in Bale is at its infancy stage and no investigation was made on type of honey predators' distribution in Bale. These enemies include: bees eating birds (*merops species*), honey badgers (*mellivoracapensis*), wasps and ants and due to these enemies the bees have devoted very strong defense behavior. Even after small disturbances thousands of bees will leave the nest to attack everything which moving. If the bees do not succeed in driving away potential predators they could immediately leave the nest and try to settle elsewhere in convenient surroundings/place. The same is true if there is serious scarcity of feed. Beside their aggressiveness, a considerable high reproductive rate is further strategy of survival. Apart from these realities, there is no research information conducted in Bale regarding to honeybee pests and predators, production potential, beekeeping constraints and the exiting opportunities for future. In order to address this problem, it is very important to identify the potential development which is bottle necked of beekeeping in Bale. Therefore, the objectives of this study were: To identify beekeeping constraints and opportunities of beekeeping, to assess effect of natural bee enemies (pest and predators) and to asses' farmer's awareness about the natural enemies and their control method.

2. Materials and methods

2.1. Study area

The study was conducted in Bale zone of Oromia Regional State which is located in Southeastern part of Ethiopia. Bale is located at 7^0, 00'N and 39^0 45'E and 7^0, 30'N and 39^0, 30'E of latitude and longitude respectively (Ethiopian Mapping Authority, 1988). The study area ranges from lowland to highlands which were representing different agro-ecologies of Bale with Altitude range 500- 4377 meters above sea level. The annual minimum and maximum temperature of the area extends from 2^oc to 20^oc for highland (William, 2002) and 26^oc to 40^oc for lowlands respectively (RLDHMO, 2009). In the area there are two rainy seasons, the first and the main season extends from August to December with rainfall 270-560 mm and the second and the short rainy season goes from April to July with rain fall 250-560 mm. The dry season covers from December to March (SARC, 2001). Floral diversity extends from lowland to highland has good potential that provides the most appropriate environment for regulating and providing year-round foraging to honeybee populations except the most extreme highlands and lowland of the area.

2.2. Sampling and sample size

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

2.3. Data collection

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

2.4. Data analysis

All data were entered into MS- Excel spread sheets after the completion of data collection work from the study areas. Then the data was analyzed using *SPSS version 20* software and the data was summarized using descriptive statistics (means, standard errors and percentages).

3. Results and discussion

3.1. Socio-economic characteristics of the households

This section provides an overview of the beekeeping practices of sample respondents in Bale zone based on the questionnaire survey result and the results are presented and discussed more specifically and entirely to the situation of sample respondents.

Table 1 shows that the household surveyed respondents age ranges from 20-90 years with mean age 45.25 ± 14.83 (mean ± SD) out of which more than 67% age was less than 50 years old. This result was agreement with Tessega Belie, 2009 and Chala Kinati, 2010. The result indicated that young people in most productive ages are engaged in beekeeping and most of the respondent about 38.33% had an experience of 11- 20 years old and only 17.78% had less than 10 years experience. The rest had 17.78% (21-30 years), 12.4% (31-40 years), 8.89% (41-50 years) and 5% (more than 50 years) experience of beekeeping. From this one could assume that in Bale zone a condition where people were actively engaged in beekeeping starting from their early age in helping older

beekeepers to undertake basic tasks of beekeeping. Gichora, 2003 stated that young people gradually move on to become independent beekeepers as soon as they can obtain their own hives. They continue accumulating experience by seeking technical advice from fellow beekeepers, development agents (DAs) and experts as necessary.

Concerning religion, in the surveyed area about 71.1% people were Muslim and 28.9 people Orthodox and it indicated that Muslim religion was the dominant religion in the area. The family size of the respondents showed that maximum 19 and minimum 1 with mean averages 7.16 ±4.02. This high family size is most probably because high practice of polygamy in the area. About 53.9% of the respondents had 0.5-2 hectors of farming land, 30.0% had 2-5 hectors, 13.3% had more than 5 hectors and 2.8% of the respondents didn't posses farming land. Tessega Beile, 2009 and Chala et al. 2012 had reported similar issues. In general the result indicated that most of beekeepers posses less farming lands and this showed that beekeeping does not need large land holding and even possible without of having farming land.

Table 1
Socio-economic characteristics of the respondents.

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

3.2. Sources of honeybee colonies to start beekeeping

The indigenous knowledge of beekeeping differs from beekeepers to beekeepers and also from place to place, depending beekeepers experiences and exposure in beekeeping activities. When beekeepers were asked to explain how they were started beekeeping, about 98.3% replied that they were started beekeeping by catching swarms and only 1.7% started through inheritance from their family. Chala et al. 2012 in Gomma district of Oromia region, reported that about 87.8% of beekeepers are started beekeeping by catching swarm. The result showed that catching swarm was the dominant sources of basis colony in the study area and the beekeeping production system was mostly traditional and this is also most probably because of poor extension services system, poor adoption of improved beekeeping technologies, high costs of beekeeping equipments, lack of Government and Non-government organization dealing with beekeeping in the study area.

Whenever the beekeepers asked "where do you place your Honeybees (bee hives)? They were replied that as 50% of them place at backyard and the remaining 41.7%, 7.8% and 0.6% were hanging on tree in forest, under the roof of house and both at backyard and hanging in forest respectively (Table 2).

Table 2
Arrangement of beehives.

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

3.3. Trends of beekeeping in Bale

Beekeeping is not a new idea in Bale; it is an ancient farming activity which is practiced as a sideline with other farm activities. Yet in Bale there are three types of beekeeping which include: traditional, transitional and modern based on the types of beehives used. The data showed that the majorities (96.86%) of the respondents in Bale were followed traditional production system, but only few beekeepers were started transitional (0.88%) and modern (2.26%) beekeeping production system. Shunkute et al. (2012) reported in Kaffa, Sheka and Bench-Maji zones of Ethiopia traditional beekeeping practice is the dominant system accounting for more than 99% of the total, while intermediate and modern hives are less used (<1%). In Bale still traditional production practiced in two forms, traditional forest beekeeping which is practiced in forest by hanging beehives on long trees and with no management care given for bees and it is the dominant way of traditional production system in Bale up to yet (Fig.1) and the second form is traditional backyard beekeeping which is practiced around homestead and little management was given to this type beekeeping production system.

Fig. 1. Forest beekeeping at left lowland area and at right highland area.

Data showed that beekeeping production system in the study area from 2010-2012 was slightly showed improvement in the trends of beekeeping, traditional production system was decreasing but transitional and modern beekeeping production system started slightly improvement (Fig. 2) which mean that using of improved beekeeping technologies under way which showed green light for beekeepers to get improved quality and quantity of honey and other hive products in the area.

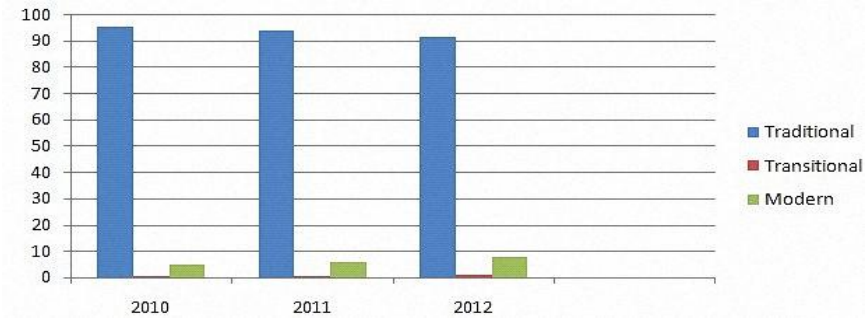

Fig. 2. Status of beekeeping production system in Bale (2010-2012).

Table 3 indicated that about 72.6% of the respondent said trend of beekeeping production were decreasing in the yields of hives and the number of honeybees population this is because of climate change from time to time as they said flowering plants found in the area previously was diminished and only 25.1% and 2.2% were said increasing and stable production system respectively in the area. As their responses, the main reasons of decreasing production were: deforestation, un-wise use of pesticides and herbicides, presence of pests and predators in the area, absconding and migration problem, lack of honeybee's forages, and bee colonies death were

mentioned as the most problems for the deteriorations of product and productivity of honeybees and this result similar with report of Tessega (2009) and Haftu and Gezu (2014).

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

Trends of beekeeping	Frequency	Percentage (%)
Increasing	45	25.1
Decreasing	130	72.6
Stable	4	2.2

3.4. Honey harvesting periods, production and management practices

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

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

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

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

Table 5
Frequency inspections/visiting of apiary site.

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

3.5. Beekeeping constraints

Based on the results of the present study, the major constraints of beekeeping come from environmental condition which includes: honeybees’ enemies, bee poisoning due to agro-chemicals, lack of knowledge to manage

bees and bee products, lack of bee colonies and bees poisoning from plants (Table 6). All of the beekeeper participated in the study was requested to rank in order of their importance. Accordingly, un-wise use of pesticides and herbicides were stood on the first line that challenged beekeeping in the area and followed by honeybees' enemies (pests and predators) the detailed result was shown in Table 6. As they had mentioned these constraints directly affected honeybees and hive products and had great impact on the economy of the beekeepers. Shunkute et al. (2012) reported in Kaffa, Sheka and Bench-Maji zones of Ethiopia reported the same issues.

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

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

3.6. Honeybees pests and predators and controlling mechanisms

3.6.1. Honeybees pests and predators

According to the result of current study, the existence of pests and predators were a major challenge to the honeybees and beekeepers in the study area. The beekeepers reported that presence of the most harmful pests and predators in their area which consists: Honey badger (*Mellivoracapensis*), spider (*Latrodectusmactan*), bee-eater birds, bee lice (*Braulacoecal.*), beetles (*Aethinatumida*), wax moth (*Galleria mellonella*), wasps (*Polistesfuscatus*), Death head hawk moth (*Acherontiaatropos*) / (*irbaataibiddaa in afanoromo*), mice, lizards, snake, praymantis, and monkey were the most dangerous pests and predators in order of their importance (Table 7). Similar findings were reported by Desalegn (2001), Kebede T and Lemma T, 2007; Tessega Belie (2009), Chala et al. (2012), Shunkute et al. (2012) in the central, eastern mid rift valley, Bure district Amhara region and Gomma district Oromia region, Kaffa, Sheka and Bench-Maji zones of Ethiopia respectively. This survey revealed that 50.3% of respondents had observed honey badger in and around their apiary sites. As the respondent said the honey badger attack was a serious problem and stand on the first line in the area in causing hive product deterioration and absconding of honeybee colonies and this was because most of the beekeepers about 96.86% followed traditional production system which is easily attached by badger. As a result of this predator attack a considerable amount of honey and other hive products lost and absconding was occurred. As the respondents reported that spider and bee-eating birds with 31.5% and 17.8% took the second and the third most serious bee enemies present in the area and table 8 showed the most top ten frequently found pests and predators in the study area, but some rarely found pests and predators in specific area were also mentioned by few farmers like ants (of two type sugar ant (xuxi) and ants (goondaa) which reported, snake, pray mantis, existence were also reported by some of interviewed beekeepers.

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

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

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

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

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

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

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

3.7. Beekeeping opportunities

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

4. Conclusion

It is known that Bale has adequate natural resources and a long tradition and culture of beekeeping. However, because of many beekeeping constraints beekeepers did not fully benefited from Apiculture subsector. Among these constraints honeybee enemies (pests and predators) were mentioned as bottle neck of beekeeping in Bale. These pests and predators include: Honey Badger, Spider, Bee-eating birds, Bee lice, Beetles, Wax moth, Wasps, Death head Hawks moth, Mice, Lizards in order of their importance. Despite this problem there is also a good opportunity to enhance the production, productivity and quality of products in Bale zone.

Based on this conclusion the following points can be forwarded and recommended. Appropriate scientifically proved means of controlling and management of pests and predators should be addressed in order to minimize the effects of these pests and predators. Since most of the beekeepers in Bale followed traditional way of production system which is highly affected by these pests and predators, emphasis should be given to training programs for the community focusing on the practical aspects of beekeeping and modern beekeeping technologies. There should be introducing affordable and appropriate beekeeping technologies with all accessories, to enhance the beekeeping production, productivity and quality products in order to fully benefit the beekeepers from this sub-sector.

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