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Assessment of Stingless Bee (*Apidae: Meliponini)* Production Practices and Indigenous Knowledge in West Arsi and Bale Zones of South-Eastern Oromia, Ethiopia

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Abstract: The study was proposed to assess the stingless bee production practices, distribution and indigenous knowledge in the Bale and West Arsi Zones of South-eastern Oromia. Three districts were considered within two zones. From each district three Rural Kebeles were selected and a total of 65 stingless bee honey hunters were interviewed and field observations were also added. Across-sectional study with purposive sampling methods was used to conduct the study. According to the study results, the honey hunters were categorized Meliponula species (underground nesting stingless bees) and Trigona species (tree trunk cavity nesting stingless bee). They were used different methods to find the ground-nesting stingless bees and these includes by chance when walking along forest or grazing land or to home land, direct observations of nest entrance or dedicated searching for presence of holes on the ground, use of honey smell to locate the nest site on ground and use of its enemies like ant as indicators. The average amount of honey harvested per nest was 2.88±0.23 Litters and it was differing from place to place depending on availability of flowering plants, age of nests and season of the year. The study indicated harvesting honey in the study area was totally in destructive way. As the respondent report, the collected honey was used for home consumption, treatment of different kinds of diseases and for income generations. About 87.7% of respondents were searching stingless bees at early in the morning and afternoon when sun gets on set. 49.2% of sample respondents were harvested honey twice per year. During the study time the price of stingless bee honey ranges from 250 to 1000 with mean price 507.89 Ethiopian Birr per litter at local market. The study showed that Honey badger, Aardvark, Sugar ant, Ant, Termites and Wasps as the major stingless bee enemies in the study areas. The study revealed there is a deep indigenous knowledge of wild stingless bee honey hunting practices. In addition, the study area has unique and diverse fauna and floras in which dominant flowering plants exist, that makes conducive environment for stingless bees. Hence, adopting stingless bee colony domestication technology is critical for increasing stingless bee production and productivity through sustainable honey production and conservation. In addition to it requires great attention from government, non-government organizations and concerned body should raise awareness about conservation, domestication and sustainable use of these natural resources.

Keywords: Stingless Bee, Ground-Nesting, Indigenous Knowledge, Honey Hunters

1. Introduction

Stingless bees (*Apidae: Meliponini*) are widely distributed in the tropical and subtropical regions of the world [1]. Stingless bees the largest group of eusocial bees in which containing about 56 genera and more than 600 species are known to occur in various nesting ecological areas of the world [2, 3] Stingless bees are mainly associated with tropical dry and humid forests in low and warm areas, although some species can be found in cloud forests and pine-oak forests in the highlands [4]. These bees are reactive all year round and do not sting instead defending by biting if disturbed. Stingless bees usually nest in hollow tree trunks,

tree branches, underground cavities or rock crevices, but they have also been encountered in wall cavities, old rubbish bins water meters and storage drums [5]. Stingless bees are true generalists, collecting nectar and pollen from a vast array of plants [6, 7]. Ethiopia has only six species of stingless bees known to date [8]. These species of stingless bees are commonly found in low to medium highlands of Ethiopia. Stingless bees nest in different habitat types, preferentially nesting in cultivated lands adjoining forest areas, protected forests, grass lands, and woody shrubs along field edges in central and western Oromia [9]. Some of these bees are known for their honey, which has been produced from wild stingless bee colonies by honey hunting. Honey hunting from stingless bee colonies in Ethiopian farming communities has a longstanding tradition, where local hunters search for natural stingless bee nests, which is a common practice all over the country in general and in Oromia in particular. Bale and West Arsi Zone are among the zones in Oromia, where honey hunting has a long tradition of collecting honey from wild stingless bees. In addition to the longstanding tradition of stingless bee honey collection, these zones are known for their abundant Harenna forest covers an area of 3500 to 7000 km^2 in Ethiopia where the second largest Forest is found [10]. The existence of large natural forest coverage in the area may create a good potential for stingless bee honey production.

Stingless bees play an important role in the ecology, economy, and culture of human beings. They act as the main pollinators for many wild and cultivated tropical plants [11]. Stingless bees' honey has been used as a source of income generation. Moreover, stingless bees are attached to the culture of the local community, with their honey used as traditional medicine for treating different kinds of ailments in different parts of Ethiopia [12]. Like in other parts of Ethiopia, stingless bee honey has played a role in traditional medicine in local communities of Bale and West Arsi Zones.

Despite the ecological, economic and traditional medicinal roles of stingless bees and their products in the rural communities of Bale and Arsi, information on their distribution and indigenous knowledge of stingless bee honey collecting has not been documented yet. Hence, documenting the distribution and traditional production systems of stingless bees in the area is highly important for the development of proper stingless bee management practices and conservation. Therefore, this study aimed to identifying their distribution, production practices and indigenous knowledge of stingless bees in the Bale and West Arsi Zones of South-eastern Ethiopia.

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted in Dellomenna and Harenna Bulluk Districts of Bale Zone, and Nensabo District of West Arsi Zone which were located in South-eastern of part of Ethiopia (Figure 1). The study area ranges from lowland to highlands, representing different agro-ecologies in the Bale and West Arsi Zones. There are two rainy seasons in the area, the first, the main rainy season, extends from August to December with a rainfall of 270 to 560 mm, and the second, the short rainy season, goes from April to July with rainfall of 250 to 560 mm. The dry season covers the months of December through March [13]. Honeybee floral diversity are found from lowland to highland, which provides an appropriate conducive environment for regulating and, with year-round forages to stingless bees in the study area.

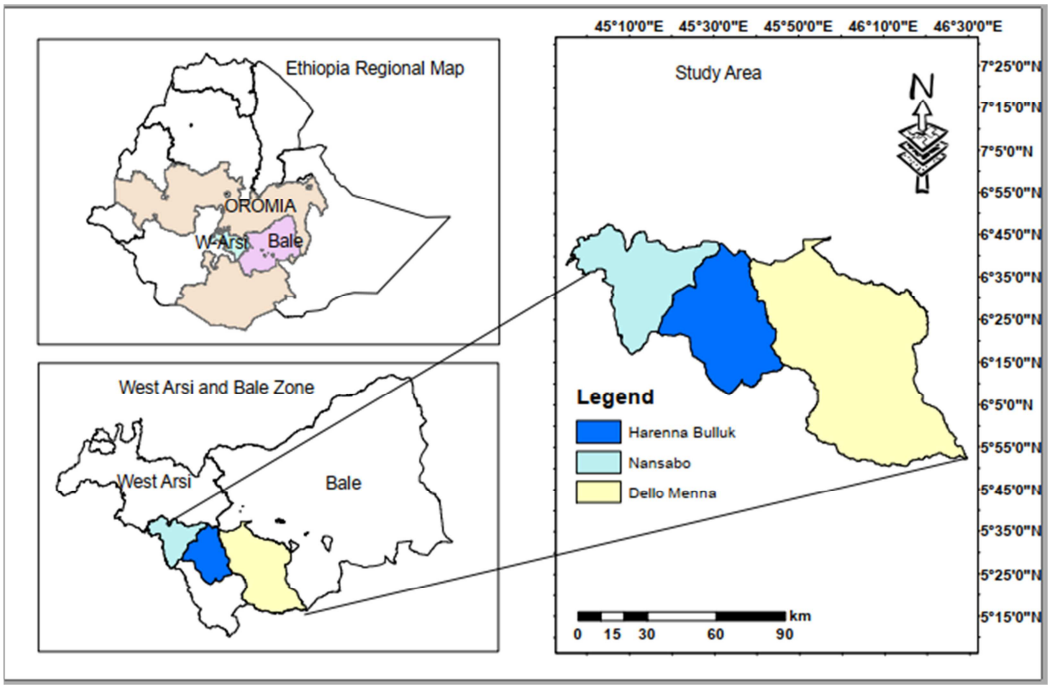

Figure 1. *Map of the study area.*

2.2. Study Design, Methods and Sample Size

A cross-sectional study design was employed to document the indigenous knowledge of the Bale and West Arsi communities on stingless bees 'honey hunters'. The study was conducted in 2021 and 2022 in Dellomenna, Harenna and Nensabo Districts. From each district, we selected three Peasant Association (PAs) based on prior information obtained from district experts, development agents, and elder community members on the potential areas for stingless bee honey production. A total of 65 male farmers were participated in the study that had hunting practices of stingless bee honey. We then held informal discussions with elders and local administrators in each Peasant Association (PAs) to identify those individuals who were knowledgeable about stingless bee hunting practices. Thereafter, we clarified the purpose of the study and received consent to interview the 65 honey hunters individually. In the meantime, we collected secondary data/ information from the Zonal and District of Agriculture offices before conducting the actual survey. Lastly, during the study time, focused group discussions (FGD) were also held with experts, community groups (elders), development agents, and stingless bee honey hunters to generate relevant information on stingless bee honey collecting practices in the study areas.

2.3. Method of Data Collections

The core points of the questionnaires focused on indigenous knowledge of stingless bee practices in the study area. Focus points included how to search or locate the nest, when to search the nest, the number of nests harvested per year, the amount of honey harvested per nest, honey production/collecting practices, the honey flow season, major challenges of stingless bees, and their distribution, and marketing of honey. A semi-structured questionnaire was developed, pre-tested with a few farmers, and reframed in such a way that it could be used to collect reliable data/information. Moreover, ranking index (RI) was calculated by using formula described by [14]) followed:

$$\text{Rank index} = \sum W/A*N$$

Where, W: Weighting is given to each factor by the respondent

A: the highest weight in the research

N: Total number of respondents

2.4. Data Management and Statistical Analysis

All collected data were entered into MS-Excel spreadsheets after the completion of data collection work in the study areas. Then, statistical analysis was conducted using logistic regression, ranking index (RI) and descriptive (means, standard errors, and percentages) procedures of Statistical Package for the Social Sciences (SPSS) software version 20.

3. Results and Discussion

3.1. Socio-Economic Characteristics of the Respondents

Using a semi-structured questionnaire and field observations, we characterized the traditional knowledge of stingless bee honey hunting in Bale and the West Arsi Zone of the Oromia Region as follows: All respondents who participated on interviewed to generate information about stingless bees honey hunting was male headed households. This arises from the traditional believe that stingless bee honey collecting is a men's activity and thus women are not allowed to collect honey from stingless bees in the study areas. It is a cultural taboo that restricts women from collecting honey from stingless bees. Similarly, 15] reported that nest hunting, just like the placement of hollow wooden logs for the honeybee *Apis mellifera* into large trees, is generally considered the work of men.

The survey result showed that the stingless bee honey hunter respondents' ages range from 22 to 96 years old, with a mean age of 43.91 years. This result showed that stingless bee honey collection can be performed by all age groups reasonably without any difficulties and is more actively performed by the younger age groups.

The results revealed that there were significant differences ($P<0.05$) in stingless bee honey collecting experience between districts, with the total mean of the three locations being 20.22 years' experience with a range of 1 to 81 years. Furthermore, the correlation between the age of stingless bee honey hunters and their experience indicated strong positive and highly significant relationship ($r = 0.74$, $N = 65$, $P = 0.00$), showing engagement in stingless bee honey collecting from an early age. Similarly, [16] reported that beekeepers in Bale started beekeeping at their early age.

3.2. Indigenous Knowledge of Stingless Bee Honey Hunters

The stingless bees and their products represent one of the main natural resources known to the community of Bale and West Arsi. Their bee honey is one of the most appreciated natural products in this area. The current study showed that there is a deep and diverse indigenous knowledge of the local community on stingless bee nest location, honey collection, and the use of its products. This practice has long been an integral part of the community's culture and their way of life in the study area. However, the method of harvesting the honey is completely destructive. Similarly, [17] stated that meliponiculture is relatively uncommon in Africa and that harvesting of meliponine honey is mostly destructive.

The majority of respondents (47.7%) said that the knowledge of stingless bee honey collection and use of their products is obtained orally from their parents and elders, about 32.3% only from their parents and 20% said it is only gained from elders. It is in this way that knowledge of stingless bee hunting/collection passed from generation to generation and honey from ground-nesting stingless bee has

been collected by their ancestors for many years in the study area.

In the area, stingless bees were traditionally classified as *daamu* (underground nesting stingless bees*)*, which are *Meliponula spp.* and *bookee* (tree trunk cavity nesting stingless bees), which are known *Trigona spp.* In addition, whenever the respondents were asked which stingless bee they knew in their locality, underground nesting or tree trunk cavity nesting, the majority of the respondents (83.1%) said underground nesting is the most common; only 16.9% said both underground nesting and tree trunk cavity nesting are the most common; and none said only tree trunk cavity nesting. Likewise, from the species recorded in Ethiopia so far, only *Meliponula beccarii* is known to build its nests underground [8, 9].

According to respondents' reports, the age of stingless bee nests was determined by the number of guard bees on the nest entrances. For instance, if four bees sit on the nest entrance, the nest has a four- year age, and the amount of honey it produces is proportional to its age; as they had reported, the amount of honey the nest produces increases as the age of the nest increases. However, the number of guard bees at the entrance varies due to several factors, including time of day, weather condition, presence of pests and predators, colony strength [18]. A large number of guard bees on the nest entrance, particularly during the mid-day, are attributed to the activities of enemies and intruders around the stingless bee nests [19]. Therefore, the traditional method of estimating age and honey yield of a given nest based on the number of guard bees around the nest entrance doesn't produce real information about the age and yield of the nest.

3.3. Practices of Stingless Bees Honey Harvesting

It is known that stingless bee honey is a non-timber forest product that is highly appreciated by local communities in the study area. Whenever the respondents requested an answer, could you mention the materials you used when harvesting stingless bee honey? The respondents mentioned different kinds of materials like a *spade*, a *knife*, an *axe*, *sefed* or collection plate and small plastic or glass bottles. After preparing all these materials, the process of collecting honey is carried out starting by placing an indicator at the entrance of the nest and cleaning the ground surface up to 30 to 50 cm around the nest entrance. Next, they excavated around the nest until they reached the bottom of the nest, which has height of 30 to 60 cm. The entire nest was then removed and placed on a *sefed* or other materials such broad leaves or large tree barks. Lastly, they cut the brood nest to separate it from the honey and pollen pots. The honey is then strained as the majority of the respondents stated that 82.3% crushed and squeezed the honey pots and then they were used clean clothes to retain any impurities and allow liquid honey to pass through it. Only a few respondents (17.7%) made a hole in each individual honey pot to run the pure honey runs directly into the honey container they prepared.

3.4. The Use of Stingless Bee Honey in Communities

The sampled respondents mentioned that the use of stingless bee honey throughout study the area was similar. According to the responses of the farmers interviewed, about 78.5% used stingless bee honey for several purposes (for home consumption, treatment of different kinds of diseases and sale). From the total of 65 sampled respondents, about 18.5% mentioned that they were used for treatment of different kinds of diseases like asthma, coughing, tuberculosis, diabetes, cancer, malaria and tonsillitis. Few respondents (3.1%) stated that they were only used for home consumption because of its medicinal and nutritional value. This could be due to a traditional belief passed down from their parents and elders in the communities. Stingless honey has also similar function in other countries. For instance, stingless bee honey is believed to have medicinal value and has a higher market demand in India, where it is 20 times more expensive than *Apis* honey [5].

3.5. Methods of Searching Stingless Bee Nests and Harvesting Season

According to the responses of the sample respondents, there were several methods of searching for the nests of ground nesting wild stingless bee in the studied districts. The first method is by chance when farmer walks along forest or grazing land or its home range looking for nest holes on the ground. In the second method, hunters looking for the presence of stingless bees carefully, and then conducting dedicated searches on ground nests or holes on the ground when they observe any bee activity in the areas. They also keep silent sit down on the ground and look for forager stingless bees returning to or leaving their nest. The third method was the use of the honey smell to locate the nest sites on the ground during the active season. The fourth method was the use of stingless bee enemies like ants as indicators to locate stingless bee nests on the ground. If they were attacked by enemies like ants, they were said the bees make a buzzing sound and then be able to carefully find for the nest entrance. These practices are consistent with [15] who described Sheka community practices from Southwestern Ethiopia.

Regarding time of stingless bee nest searching, about 87.7% of searches for stingless bees were performed in the morning and late in the morning (8:00 to 11:00 AM) and late in the afternoon (4:00 to 5:30 PM) when the bees are active, while only 10.8% were performed in the morning (8:00 to 11:00 AM) and 1.5% only in the afternoon (4:00 to 5:30 PM) saying that stingless bees prefer cool weather condition for foraging.

The majority of the respondents (49.2%) were harvesting stingless bee honey twice per year, which extends from December to February and June to August (two seasons). The other respondents stated that they only harvest once per year. Moreover, a few respondents said they harvested throughout the year depending on the availability of forage resources in the area. When they saw stingless bees nest out of harvesting season in the study areas, the respondents were advised to

place their own unique mark around the nest and leave untouched until honey collecting time or to keep the nest in great secret to avid other people spotting it. For this purpose, they used different symbols like stones, sticks, animal dung, and any other materials to mark the place, and allow returning during the harvesting season.

During the study period, the price of stingless bee honey ranged from 250 to 1000 ETB with a mean price of 507.89 ETB per litter at the local market, which was up to three times the price of *Apis* honey, which ranges from 200 to 300 ETB per kilogram. This might be because traditionally, stingless bee honey was used as medicine to cure different kinds of diseases in communities.

3.6. Stingless Bee Distribution and Production Practices

The study area has a high potential for stingless bee keeping, according to the results of focus groups discussion (FGD) with Bale and West Arsi Zone Agriculture Office, apiculture experts. The results revealed that stingless bees were found in twelve districts out of 18 and five districts out of 11 in the Bale and West Arsi Zones, respectively. Similarly, the study results showed that about 35.4% of stingless bees were distributed only along forest areas whereas 7.7% were found only in farmland, 1.5% only in caves, 26.2% in forest area and farmland, 29.2% in forest area, farmland and around home steady. Other similar reports on *Meliponula beccarii* is found habitat in both protected and non-protected areas [15]. *M. beccarii* prefer to open farmlands and non-protected areas [20, 21].

About 98.5% of the respondents reported that the ground nesting stingless bees are distributed in their locality and only 1.5% mentioned that the tree trunk nesting bees are found in their locality. As they had mentioned, the ground nesting types are known for its high honey yield. Similarly, [15] reported that the ground nesting stingless bee is more abundant, and honey hunters frequently collected the ground nesting stingless bee's honey in Sheka, in southwestern Ethiopia. Moreover, this bee has been reported from many localities in Gojjam and Tigray [8]. The greater abundance of ground nesting in the surveys could be related to the altitude addressed during the assessments, as most of the studies were conducted at a medium altitude, where the ground nesting stingless bee is more frequent [22], whereas the smaller stingless bees are rare as they prefer lower altitudes. Furthermore, during a focus group discussion with elders, experts and local administrates, they reported that their local areas were previously found abundant but are now decreasing in population and production for a variety of reason. These reasons were deforestation, overgrazing, expansion of agricultural land and the use of different agro-chemicals in their area.

The amount of honey harvested per nest per year was higher at Harenna Bulluk (2.97 ±0.51 liters) followed by Nensebo (2.96±0.28 liters) and the lowest was from Dellomenna (2.42±48 liters) (Table 1). As the respondent mentioned, the amount of honey yield per nest differ from place to place based on the availability of forages, age of the nest, colony strength and season of the year. The honey yield of the ground nesting bee wild colonies can differs based on nest age and a nest older than one year can produce up to 5 litter's honey [15].

Table 1. *The mean and ranges comparison of honey yields in litters per nest per year.*

Districts	Total sample size (N=65)		
	Minimum	Maximum	Mean ± SE
Dello Menna	1	6	2.63±0.47
Harenna Bulluk	0.5	9	2.97±0.51
Nensebo	1	6	2.96±0.28
Over all mean	0.83	7	2.88±0.23

3.7. Challenges and Threats in Stingless Bee Honey Hunting

The main challenges and difficulties of stingless bee honey hunting reported as importance by respondents were stingless bee enemies, a lack of extension services, and government attention, a poor knowledge sharing culture in the community, a lack of awareness by farmers about meliponiculture and a lack of improved technologies on meliponiculture, according to the information gathered from the sample respondents. A similar finding was reported by [23] from western Oromia. According to respondents' reports 49.6% honey badger (*Mellivora capensis*), 33.9% aardvark (*Orycteropus afer*), 28.9% sugar ant, 27.6% ant (*Dorylus fulvus*), 24.7% wasp (*Vespula germanica*), 18.6% termites and 16.5% snakes were identified by respondents in the study areas. The major enemies of stingless bees were ranked by respondents according to their relative importance as enemies of stingless bees in the study areas (Table 2). Different scholars [15, 24] reported similar findings, reporting that ground nesting stingless bee colonies was affected by honey badgers, ants, moles, wasps, termites, foxes and snakes.

Table 2. *Rank index for major pests and predators of stingless bee colonies declared by respondents.*

Stingless bees enemies	1	2	3	4	5	6	7	Rank index	Rank
Honey badger	32	36	24	18	32	16	32	0.418	1st
Aardvark	16	22	24	0	22	44	22	0.330	2nd
Sugar ant	19	26	22	26	19	16	18	0.321	3rd
Ant	36	18	0	18	14	18	9	0.248	4th
Wasps	24	16	16	0	32	0	16	0.229	5th
Termites	12	0	12	24	0	12	12	0.158	6th
Snakes	0	22	11	0	22	0	11	0.145	7th

Index = sum of (7*ranked 1st+ 6* ranked 2nd+5* ranked 3rd+4* ranked 4th+3* ranked 5 th+2* ranked 6th+1* ranked 7th) for individual pests and predators divided by the sum of (7*ranked 1 st+ 6* ranked 2nd+5* ranked 3rd+4* ranked 4th+3* ranked 5th+2*ranked 6th+1* ranked 7 th) for overall pests and predators

Stingless bees are threatened by several of factors under natural conditions. In our results, deforestation took lion's share (48.7%), followed by applications of agro-chemicals (30.2%) and over grazing of range lands 27.8% (Table 3). Reports have shown that stingless bees are threatened by many of anthropogenic factors [25, 26]. The most common threats are frequent fires, honey hunting, logging for timber and livestock overgrazing.

Table 3. *Rank index for major factors threatening stingless bee colony declared by respondents.*

Threatening factors	1	2	3	4	Rank index	Rank
Deforestation	32	8	24	64	0.492	1st
Application of agro-chemical	40	0	20	38	0.377	2nd
Overgrazing rangeland	36	18	27	9	0.346	3rd
Unlimited stingless bee hunting	16	32	8	32	0.338	4th

Index = sum of (4*ranked 1st+ 3* ranked 2nd+3* ranked 3rd+4* ranked 4th+3* ranked 4 th+2* ranked 3th+1* ranked 4th) for individual and threatening factors divided by the sum of (4*ranked 1st t+ 3* ranked 2nd+3* ranked 3rd+2* ranked 2th+3* ranked 3th+2*ranked 3th+1* ranked 4 th) for overall threatening factors

3.8. Opportunities for Meliponiculture in the Study Area

According to respondents and our observation the study areas have unique and diverse and fauna and flora in which dominant flowering plants exists, which makes a conducive environment for stingless bees. In this regards, the major opportunities of stingless bee keeping in the study districts, according to the respondents, include the high medicinal value of stingless bee honey, the high demand and high price of the honey, non-stinging nature, availability of bee forages, drought resistant behaviors of stingless bees and indigenous knowledge of farmers on stingless bee locating (Table 4). The finding of this study is therefore supported by another study [23]. Meliponini species dry spell resistance is less flexible rather than honeybees. Because mated queens are unable to fly colonies would have to leave their queen behind when abandoning the nest [27]. As result, resource inducing absconding is rare in the Meliponini, and they need to adopt alternative strategies to sustain their permanent colonies during the extended dearth periods they experience in tropical dry forests [27].

Table 4. *Rank index for major opportunities of stingless bee colonies declared by respondents.*

Opportunities	1	2	3	4	5	6	Rank index	Rank
High medicinal value of SH honey	30	15	30	60	0	90	0.577	1st
High demand and prices of honey	40	60	20	0	20	20	0.410	2nd
Non-aggressive and no side effect	16	32	0	16	0	48	0.287	3rd
Availability of bee forage	48	12	24	12	12	0	0.277	4th
Drought resistant behaviors	27	0	9	18	27	18	0.254	5th
Indigenous knowledge of farmers	22	11	22	0	0	33	0.226	6th

Index = sum of (6*ranked 1st+ 5* ranked 2nd+4* ranked 3rd+3* ranked 4th+2* ranked 3th+2* ranked 5th+1* ranked 6th) for individual opportunities divided by the sum of (6*ranked 1 st+ 5* ranked 2nd+4* ranked 3rd+3* ranked 4th+2* ranked 5th+1*ranked 6th) for overall opportunities

4. Conclusions and Recommendations

Stingless bees hunting had long traditional practices by communities of Bale and West Arsi zones. There is a good resources available both stingless bees and natural floral diversity in the study areas. Stingless bees honey hunting is the main job of men and honey selling only participated by women. The way of honey collection is traditional employed by hunters is totally destructive. There is no domestication and intervention made for improving production and productivity of stingless bees in the study areas. The knowledge of stingless bees honey hunting and the uses of their products knowledge was gained from their parents and elders. From presented result, stingless bee colonies were categorized these including; *Meliponula* spp (*daamu)* that ground-nesting and *Trigona* spp (*bookee)* above ground-nesting in which the most dominants underground is *Meliponula species* is found in the study areas. The average amount of honey harvested from stingless bee per nest per year was 2.88±0.23 (mean ±SE) however there is different place to place and time to time based on availability of floral resources according to respondents. Moreover, several materials were used during time of harvesting stingless bee honey includes *spade, knife, axes, sefed* or collection plate and small plastic or glass bottles and stingless bees honey were used for treatments of different ailments (asthma, cough, tuberculosis, diabetes, malaria and tonsillitis) and income generation. From current result, several methods of searching stingless bee colonies in their habitat includes walking along forest, grazing land, home steady areas, honey smell and their enemies in the study areas. The time of searching and stingless bee colonies from early in the morning and afternoon when sun gets on sets in the study areas. Stingless bees honey harvesting was employed from December-February and June –August. The current result, the major pests and predators were identified including honey badger, Aardvark, sugar ant, ant, wasp, termite, and snakes

the most serious enemies of stingless bee colonies. Major threatening factors of stingless bee colonies were deforestation, application of agro-chemicals, over grazing of range lands and unlimited wild stingless bee honey hunting. From the present study, the main challenges of stingless bee colonies honey collecting lack of extension services, lack of attention, and lack of improved technologies on meliponiculture. From the present result major opportunities of stingless bee colonies for communities were declared by respondents these, high medicinal value, high demand and prices, non-aggressive and no side effect, availability of floral resources, drought resistance and indigenous knowledge of farmers in the study areas.

Therefore, from the current study, the following points can be forwarded for recommendation:

1) Adopting stingless bee domestication technology is critical for increasing bee production and productivity through sustainable honey production and bee conservation.
2) The government, non-governmental organizations, and other concerned parties must raise awareness about the conservation, domestication, and sustainable use of these natural resources.

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References

[1] Michener C (2007). The Bees of the World. 2nd edition. USA: The Johns Hopkins University Press.

[2] Cortopassii Laurino M, ImpenotrinfonsecaVl. Roubik DW. Dolin A. heard T. Aguilar I, Ventriien GC, Eardley C NogueroNeo. p (2006). Globla meliponine culture challenges and opportunities Apidae 37: 275-292.

[3] Eardley C. (2005). Taxonomic revision of the Africa Stingless bees (Appidea, Appidae: Meliponini) African plant pat 10: 63-96.

[4] Ayala R (1999). Revision de las abejas is sin aguijón de México (Hymenoptera: Apidae: Meliponini). Folia Entomological Mexicana, 106: 1–123.

[5] Kumar, M. S., Singh, A. R. and Alagumuthu, G (2012). Traditional beekeeping of stingless bee (Trigona Sp) by KaniTribes of Western Ghats, Tamil Nadu, India. Indian Journal of Traditional Knowledge 11: 342-345.

[6] Heithaus, E. R (1979). Flower-feeding specialization in wild bee and wasp communities in seasonal neotropical habitats. Oecologia 42: 179-194.

[7] Biesmeijer, J. C., E. J. Slaa, M. Siqueira de Castro, B. F. Viana, A. Kleinert, and I.-F. V. L (2005). Connectance of Brazilian social bee – food plant networks is influenced by habitat, but not by latitude, altitude or network size. Biota Neotrop 5: 1-9.

[8] Pauly, A. and Zewdu Ararso Hora (2013). Apini and Meliponini from Ethiopia (Hymenoptera: Apoidea: Apidae: Apidae). Belgian Journal of Entomology 16: 1-35.

[9] Zewdu Ararso Hora, Taye Negera, Alemayehu Gela and Simu Debela (2021). "Stingless bee species diversity and ecology in Oromia.," in Regional Review Workshop on Completed Research Activities Proceedings of review Workshop on Completed Research Activities of Livestock Research Directorate held at Batu Fisheries and Other Aquatic Resources Research Center, Batu, Ethiopia, 15-20 November, eds. T. A. Aredo, D. Abate, A. Adi, M. Endabu, A. Bezabeh, M. Hailu, et al. (Batu, Ethiopia: Oromia Agricultural Research Institute (IQQO)), 297–311.

[10] Bussmann, Rainer, (1997). The forest vegetation of Harenna escarpment (Bale Province, Ethiopia) syntxommy and phytogeographical affinities. Phytonologia 27, 1-23.

[11] Slaa, E. J., L. A. S. Chaves, K. S. Malagodi-Braga, and F. E. Hofstede (2006). Stingless bees in applied pollination: practice and perspectives. Apidologie 37: 293–315.

[12] Berhanu Andualem (2013). Synergistic Antimicrobial Effect of Tenegn Honey (Trigona iridipennis) and Garlic against Standard and Clinical Pathogenic Bacterial *Isolates Intl. J. Microbiol. Res.*, 4 (1): 16-22. DOI: 10.5829/idosi.ijmr.2013.4.1.66207

[13] Sinana Agricultural Research Center (SARC) (2001). Profile of Sinana Agricultural Research Center (SARC) Oromia Agricultural Research Institute. Working Document Series 1, Addis Ababa, Ethiopia.

[14] Musa L. M. A, Peters K. J and Ahmed M. K. A (2006). On farm characterization of Butana and Kenana cattle breed production systems in Sudan. Livestock research for rural development, 18 (12): 56-61.

[15] Kidane, A. A., Tegegne, F. M., & Tack, A. J. M. (2018.). Indigenous knowledge on ground-nesting stingless bees in southwestern Ethiopia. Int. J. Trop. Insect Sci. 41, 2617–2626.

[16] Bekele Tesfaye, Desaleng Begna and Mitiku Eshetu (2017). Beekeeping practices, trends and constraints in Bale, South-eastern Ethiopia. Journal of Agricultural Extension and Rural Development, 9 (April), 62–73. https://doi.org/10.5897/JAERD2016.0846

[17] Eardley, C. D (2004). Taxonomic revision of the African stingless bees (Apoidea: Apidae: Apinae: Meliponini). African Plant Protection 10: 63–96.

[18] Griuter C. Karcher M. Ratnieks F (2011) The Natural history of nest defence in a stingless bee, Tetragniscaangustula (Latriille) (hymenoptera: Apidae), with two distinict types of entrance guards Neotnop Fntomol 40: 55-61.

[19] Bayeta, A. G., Hora, Z. A. (2021). Evaluation of different hive designs for domestication and conservation of native stingless bee (Apidae: Meliponula beccarii) in Ethiopia. Int J Trop Insect Sci 41, 1791–1798. https://doi.org/10.1007/s42690-020-00392-5

[20] Kajobe, R (2007). Nesting biology of equatorial Afrotropicalstingless bees (Apidae; Meliponini) in BwindiImpenetrableNational Park, Uganda. Journal of Apicultural Research, 46 (4), 245-255. https://doi.org/10.1080/00218839.2007.11101403

[21] Kajobe, R (2008). Foraging behaviour of equatorial afrotropicalstingless bees: Habitat selection and competition for resources. Doctoral dissertation. Utrecht University repository https://mafiadoc.com/download/foraging-behaviour-of-equatorial-afrotropical-stingless-beeshabitat-_5a7804781723dd4a0abf9fae.html. Accessed 10 February 2022. [accessed Dec 05 2022].

[22] Fichtl, R. and Admasu Addi (1994). Honeybee Flora of Ethiopia. Margraf Verlag, Germany, pp 510.

[23] Arega A. and Gudeta T (2021). International Journal of Advanced Research in Biological Sciences Assessment of current status, nesting ecology and potential threats of stingless bees in selected districts of East Wollega. 8, 63–72. https://doi.org/10.22192/ijarbs

[24] Shenkute, A. G., Y. Getachew, D. Assefa, N. Adgaba, G. Ganga, and W. Abebe (2012). Honey production systems (Apis mellifera L.) in Kaffa, Sheka and Bench-Maji zones of Ethiopia. University Library of Munich, Germany.

[25] Coll, M., Piroddi, C., Steenbeek, J., Kaschner, K., Lasram, F. B. R., Aguzzi, J., Ballesteros, E., Bianchi, C. N., Corbera, J., Dailianis, T., Danovaro, D., Estrada, M., Froglia, C., Galil, B. S., Gasol, J. M., Gertwagen, R., Gil, J., Guilhaumon, F., Kesner-, E. (2010). The biodiversity of the Mediterranean Sea: Estimates, Patterns, and Threats. *PloS One*, 5 (8).

[26] Eardley, C. D., Gikungu, M., & Schwarz, M. P. (2009). Bee conservation in Sub-Saharan Africa and Madagascar: diversity, status and threats. *Apidologie*, 40 (3), 355–366.

[27] Michael Hrncir Stefan Jarau · Friedrich G. Barth (2016). Stingless bees (Meliponini): senses and behavior *J Comp Physiol A* DOI 10.1007/s00359-016-1117-9.