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HONEY PRODUCTION IN HARENNA FOREST OF SOUTHERN BALE MOUNTAINS NATIONAL PARK, ETHIOPIA: ECONOMIC AND CONSERVATION PERSPECTIVES

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ABSTRACT: The economic and conservation perspectives of traditional, forest-based honey production in the Harenna forest of southern Bale Mountains National Park (BMNP), Ethiopia, were studied mainly focusing on the Rira community. Data on the number of beehives per household, amount of honey produced per hive and price of one kg of honey were gathered through semi-structured interviews and focus group discussion. Annual need of food consumption, the price of wheat /barley, traditional techniques of hive preparation and management and trends of production were also investigated. The study results showed that on average, a household owned 50 ± 13 functional hives, and harvested 7 ± 0.6 kg of honey from each hive per year. The mean price of honey per kg was 7±0.8 Birr (current exchange rate $1USD=8.5 Birr). Out of the honey produced about 88 ± 1% is delivered for sale. The potential annual income earned from honey can reach 2027 ± 77 Birr per household. This level of income can purchase about 13 ± 0.5 quintals of barley /wheat or roughly about 50-65% (6-8 months) of a household's annual food requirements. The beekeepers use hives constructed predominantly from three tree species; namely, *Erythrina brucei*, *Hagenia abyssinica* and *Polyscias fulva*. Despite some critical constraints such as marketing and lack of trainings on improvement of beekeeping techniques, the economic value of honey for the Rira community is so important that it could be considered as one of the conservation promotion options for the Harenna Forest. All the beekeepers of the area have their own territory in the forest area, which is managed by traditional bylaws, where only the head of the household and his family hang their hives. Therefore, strengthening their traditional beekeeping management, introduction of non-timber materials for hive construction and halting of the present constraints would mutually and sustainably enhance both the livelihood of the community and conservation of the forest resources.

Key words/phrases: Conservation, Economics, Harenna forest, Honey production, Traditional hives, Rira.

INTRODUCTION

Of all the countries in the world, perhaps, none has a longer tradition of beekeeping than Ethiopia; it has been practiced throughout the country for thousands of years (Fichtl and Admasu Adi, 1994). Wide climatic and

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edaphic variabilities have endowed Ethiopia with diverse and unique flowering plants. This makes the country highly suitable for bees and beekeeping (Fichtl and Admasu Adi, 1994). Apiculture is one of the options that help to promote forest conservation. Several studies showed that forest management and beekeeping have had strong interdependence because beekeeping contributes for ecosystem functioning, biodiversity conservation, honey production and plant pollination (LeFevre, 2007). However, the potential of apicultural sector in Ethiopia has been underutilized because traditional beekeeping methods have been deployed (Tadesse Woldemariam, 2007).

The Crucible II Group (2000) estimated that tropical forests are decreasing in area at a rate of 1% per annum with 34, 000 species of plants, 12.5% of the world flora, facing extinction. In a similar fashion, the Harenna forest in the southern slope of the Bale massif, one of the richest centres of biodiversity in Ethiopia, is vanishing rapidly, losing its conservation values and ability to provide ecosystem services owing to clearance for agriculture and degradation associated with unsustainable use (Lisanework Nigatu and Mesfin Tadesse, 1989; B and M Development Consultants, 2001)**.** This is due to the almost total dependency of the forest dwellers on the natural resource base of the forest for all subsistence and development activities such as agricultural expansion, grazing and logging. Yet, there is still room for hope if we are able to assign an economic value to the forest itself, and, thus provide incentives to the community for conserving the forest. Thus, it is now timely to identify the solutions that could mitigate the current biodiversity loss occurring in the Harenna forest.

Despite the variety, importance and richness of foods from forests in Africa, progress has been slow in designing and implementing measures to increase the contribution of wild plants and animals to food production and food security (Vivero Pol, 2001-2002). Forest products, like honey and beeswax from beekeeping, play an important role in household consumption and income diversification of rural communities in Ethiopia. One of these producers at present is the Rira community in the Harenna forest of southern Bale Mountains National Park (BMNP).

Among the options suggested (BMNP, 2004) for ensuring the harmonious coexistence of the Rira community and the Harenna forest was to diversify household economies by promoting the utilization of non-timber forest products, for example, improving the quality and quantity of honey production through improved techniques. Improving honey production in

the area requires developing the knowledge of the traditional beekeeping techniques and understanding the economic and ecological feasibilities of the production in the area. Some socio-cultural and economic studies on apiculture have been conducted in parts of Ethiopia (Vivero Pol, 2001-2002). However, as traditional hive preparation and management techniques vary across cultures (Fichtl and Admasu Adi, 1994) and honey quality varies among forests, more work is needed to understand the economic potential and the compatibility of traditional beekeeping practices with conservation objectives of the forest resources. However, despite the presence of high potential of honey production in the Harenna forest, information on apicultural practices is lacking. Therefore, the present study is aimed to document the indigenous knowledge and traditional techniques of honey production, to assess household earnings from honey and to identify trends and problems with honey production in the area.

MATERIALS AND METHODS

Study area and people

Rira is situated in northern part of the Harenna forest, at about 480 km southeast of Addis Ababa. The village is administered under Goba Wereda (District) of the Bale Zone in the Oromia National Regional State. The vegetation of the Harenna forest ($6^{o}40'$ to $7^{o}10'$ north and $39^{o}30'$ to 40^{o} east) has been well documented by different authors (Hillman, 1986; Lisanework Nigatu and Mesfin Tadesse, 1989; Miehe and Miehe, 1994; NH, 2004). The forest is known for its floral and faunal diversity and endemicity (Hillman, 1986; Lisanework Nigatu and Mesfin Tadesse, 1989). The area is characterized by eight months of rainy season (March-October), mean annual rainfall of 987 mm, and four months of dry season (November to February). The mean maximum and minimum temperature of the area is 24^{o}C and 19.9^{o}C, respectively (Getachew Tesfaye *et al.,* 2002).

The Harenna forest has extra-ordinary values of NTFPs, including wild coffee (*Coffea arabic*), beekeeping and bamboo products. The presence of high floral diversity makes the Harenna forest suitable for beekeeping. Various reports (e.g. Mooney, 1963; B and M Development Consultants, 2003) indicated that prior to 1960s, the sole economic activities of the people inhabiting the forest were livestock husbandry and honey gathering. The present study has focused only on the Rira village of six large settlements found in the forest. The community at Rira is typical of a Muslim subgroup of the Oromo people. A total population of 1,495 and 180 households inhabit the peasant association (B and M Development

Consultants, 2001; Per.comm. with Rira DA). Their present livelihood is based on mixed farming, rearing of livestock (cattle, sheep and horses), the cultivation of barley and wheat, and beekeeping.

Methods

A semi-structured interview and focus group discussions were used to collect the data. Interview items focused on personal information, socio-economic information, and honey production including trees for hive construction, number of hives, amount of honey produced, income from honey and its domestic use. Since honey production is solely a male pursuit in Rira (Per.comm. with the local community), only male households were used for the study. A systematic random sampling technique, systematically choosing the villages and randomly choosing interviewees, was used to select the samples. The majority of the people were acquainted with the interviewers, who were recruited from among candidates who had completed high school education in the area and were involved in related field of studies. Thus, we visited interviewees randomly chosen on the basis of whom we first met as we walked through the peasant association, visiting each village turn by turn and based on their willingness to be asked regardless of their involvement in honey production. A total of 63 (35.5%) of the households in Rira were interviewed. The interview was administered in the local language (Afan Oromo) under the close supervision of the investigator. One-day training was given to the enumerators on interview techniques and filling semi-structured questions. During the interview, an introduction was provided at the beginning of the survey to explain the purpose of the study and to assure the respondent that all the information generated would be treated anonymously. A series of questions, like age, marital status, family size, annual need of food consumption for the family and the price of one quintal of wheat or barley, were included in the interview to gather personal and socio-economic information at the level of the respondent. Concerning honey, information on the number of beehives each possesses, kilogram of honey harvested per hive and price of one kilogram of honey was gathered. Then, information on the local materials used for hive preparation, trees/shrubs used for beehive hanging and/or bees forage and trends of honey production and problems pertaining to it in the area were recorded. A focus group discussion was held with 10 key informants to investigate why they prefer one species to others and to rank the most commonly used ones as reported during the survey. Following the methods used by Kebu Balemie *et al.* (2004), direct matrix ranking was employed where interviewee and key informants ranked the tree species

based on the degree of their preferences subjected to different factors for hive preparation. Each rank was given an integer value of 1, 2, 3, 4 and 5 with the most preferred one receiving the highest value (5), while the least important was assigned a value of 1. Finally, these numbers were summed up for all respondents, giving an overall rank for the species. By ordering according to choice, it was considered that the most favoured species was usually the most preferred, in the context of the users.

An initial analysis was made using descriptive statistics. Subsequent analyses were made using correlation tests to examine the associations between respondents' socio-economic characteristics and their responses concerning honey production. The results were presented using tables and a graph.

RESULTS

Socio-economic characteristics

Socio-economic characteristics of the respondents are indicated on Table 1. The survey included different age groups; 10 people (16.1%) were under 25; 22 (35.5%) were 25-45 and 30 (48.4%) were older than 45. The majority of the interviewee 36 (68.1%) were monogamous and the rest 26 (31.9%) were polygamous. On the average, every household interviewed has a family size of 9.3 ± 5 people ranging from 3 to 20. The predominant economic activities of the people were small-scale agriculture on 1.4 ± 0.4 ha of land, livestock rearing and honey production. Wheat and barley were the two commonly cultivated crops in the area. About 14.3 ± 12 quintals of wheat and/or barley were harvested in each cropping season out of the land they possess. However, the mean annual food consumption of every household interviewed was 23 ± 3 quintals of wheat/barley and the price of one quintal was estimated to be 160 ± 0.8 Birr. The mean total number of livestock heads of each type (cattle, sheep and horses) that a household owns was 31.3 ± 23. Based on the responses of the respondents, hive hanging was practiced throughout the year (24.2% of the interviewee) with the highest peak in October-January (56.3% of the interviewee). While honey harvesting was mainly done from December-April (71.4% of respondents' response), the highest peak was in January-March with a frequency of 61.2% responses. They also added that the mean time required to reach their hive hanging site was three hours.

Table 1. Socio-economic characteristics of the respondents.

Socio-economic indicator		Mean
Family size		9.3 ± 5
Livestock		31.3 ± 23
Size of farmland		1.4 ± .4
Annual crop production in quintal per hectare		14.3 ± 12
		Percent (%)
Age structure	<25	16.1
	25-45	35.5
	>45	48.4
Marital status	monogamous	68.1
	polygamous	31.9

Relationship of respondents' socio-economic status and honey production

Honey production was a widespread activity in the area and 95% of the male household interviewed were found engaged in the practice. The study result showed that all of the socio-economic categories of the respondents considered have no significant influence on their responses about the number of beehives they have, amount of honey production and price (Table 2).

Table 2. Correlation coefficient values for the association between the respondents' socio-economic characteristics and their responses

Socio-economic character	No. of hives	Honey production/hive in kg	Price of honey/kg
Age	-0.23	-0.03	-0.22
Family size	-1.2	0.03	-0.26
Amount of crop production	0.22	0.05	-0.22
No. of livestock	-0.01	-1.5	-0.23
Site distance	-0.01	0.06	0.03
Size of farmland	0.06	0.03	-0.02
Marital status	-0.11	-0.11	-0.32

Local materials used and traditional hive preparation and management in the study area

Local materials used

The main hive type used in Rira was log hives made of hollowed logs of

different tree species. Eleven tree species were commonly used for hive preparation in which some were widely used than others (Table 3). Accordingly, *Hagenia abyssinica*, *Arundinaria alpina* and *Allophylus abyssinicus* were the most commonly used species in the area.

Table 3. Ranking of the most commonly used plant species for hive preparation in the study area (Species and botanical family names are according to Fichtl and Admasu Adi, 1994).

Name of plant species	Family	Local name (in Afaan Oromoo)	Frequency of report	Percent	Rank
Allophylus abyssinicus	Sapindaceae	Abbara	32	52	3
Arundinaria alpina	Poaceae	lemana	45	73	2
Croton macrostachyus	Euphorbiaceae	Makkanisa	23	37	6
Dombeya torrida	Sterculaceae	Dannisa	11	18	10
Erica arborea	Ericaceae	Sato	22	36	7
Erythrina brucei	Fabaceae	Walena	28	45	4
Hagenia abyssinica	Rosaceae	Heto	46	74	1
Hypericum revolutum	Hypericaceae	Garamba	17	27	9
Polyscias fulva	Araliaceae	Koriba	27	44	5
Myrsine melanophloeos	Myrsinaceae	Tulla	21	34	8
Schefflera volkensii	Araliaceae	Ansha	4	7	11

Preference ranking

The study result showed that there were at least six main factors that determined the species preference for hives. The capacity to keep the bees warm, durability, the tendency to attract bees, cost of preparation, portability and amount of honey produced were the main factors that influenced a choice. As indicated in Table 4, of the six most preferred woody species, *Erythrina brucei* was ranked first, while *Hagenia abyssinica* and *Polyscias fulva* were the second and third preferred, respectively.

Table 4. Average score for direct matrix ranking of six plant species commonly used for hive preparation (Based on preference criteria 5=best; 4= very good; 3=good; 2=less preferred; and 0=not preferred; Species names are according to Fichtl and Admasu Adi, 1994).

Reason of preference	Plant species					
	Allophylus abyssinicus	*Arundinaria alpina*	*Croton macrostachyus*	*Erythrina brucei*	*Hagenia abyssinica*	*Polyscias fulva*
Keeps bees warm	2	2	4	5	5	3
Long lasting	4	0	1	1	5	3
Attracts bees	1	3	1	5	4	5
High honey production	3	4	1	4		1
Easy to make	5	1	5	5	2	3
Light to carry	3	5	4	5	3	4
Total	18	15	16	25	23	19
Rank	4	6	5	1	2	3

Methods of preparation and management

To prepare the hives, a dried tree trunk (log) was first split into two equal halves. After hollowing the insides of both splits they were re-fixed together by a strong and durable material, mostly lianas. The beehives were made in a cylindrical shape. A small hole was made on the side of the hive near one end for bees' entrance and exit. Parallel to this hole near the opposite end a large hole was made through which honey will be cropped. Then, the outer surface of the hive was covered with bamboo sheath for insulation and rain proofing. Only hives made up of bamboo were smeared inside with a thin layer of cattle dung.

When the hives were ready, the beekeepers fixed the log hives in the upper branches of trees selected based on the abundance of flowers they bear to attract wild bee swarms and provide them forage. Based on the frequency of answers reported by the respondents, of the twelve tree species usually used for hive hanging, *Schefflera volkensii* and *Dombeya torrida* were ranked as the first and second species, respectively, while *Allophylus abyssinicus* and *Erythrina brucei were ranked* as the third and fourth frequently used species. On the other hand, *Schefflera volkensii, Hypericum revolutum, Erica arborea* and *Erythrina brucei* were, respectively, reported as the first four major tree/shrub species that provided a valuable source of pollen and nectar for honey bees in the study area (Table 5). Unlike other places of the country where hives are fumigated with some aromatic herbs before hanging, the informants did not practice it. A sheet of thin plate is usually

fixed around the middle of the tree trunk to disable climbing up of honeybee predators, commonly Honey badger *(Mellivora capensis)*. During harvesting, the smoke of glowing lichens was carefully blown towards the bees to drive them away from the combs. Every harvester has a territory in the forest where only he can hang his hives.

Table 5. Ranking the major tree and/or shrub species used for hive hanging and/or honeybee flora in the Harenna forest in Rira village as reported by the interviewees (N=62; Species and botanical family names and habit are according to Fichtl and Admasu Adi, 1994).

Species	Local name	Family	Growth habit	Use for hive hanging		Use for honeybee forage	
				Frequency of report (%)	Rank	Frequency of report (%)	Rank
Schefflera volkensii	Gatame	Araliaceae	Tree	83	1	92	1
Polyscias fulva	Koriba	Araliaceae	Tree	70	5	54	7
Erica arborea	Sato	Ericaceae	Shrub/Tree	5	12	80	3
Croton macrostachyus	Makkanisa	Euphorbiaceae	Tree	61	6	23	12
Erythrina brucei	Walena	Fabaceae	Tree	79	3	71	4
Hypericum revolutum	Garamba	Hypericaceae	Shrub/Tree	21	11	82	2
Syzigium guineense	Baddessa	Myrtaceae	Tree	33	10	30	11
Prunus africana	Suqqe	Rosaceae	Tree	60	7	36	10
Hagenia abyssinica	Hexo	Rosaceae	Tree	34	9	43	8
Allophylus abyssinicus	Abbara	Sapindaceae	Tree	82	2	65	5
Pouteria adolfi-friederici	Guduba	Sapotaceae	Tree	48	8	42	9
Dombeya torrida	Danisa	Sterculaceae	Tree	74	4	62	6

Economic values of honey in the study area

On the average, each household possessed 50 ± 13 bee colonies in traditional hives. Though yields vary from year to year depending on the abundance and availability of forage flowers, during the study period weather condition, an average, 7 ± 0.6 kg of honey was harvested from a hive. The price of honey also varied from season to season and increased with time till the next early harvesting season. Nevertheless, the mean price per kg was 7 ± 0.8 Birr. On the average, a beekeeper household of the area annually produced approximately about 350 kg of honey and supplied 308

kg (88% of the total production) for marketing. Therefore, the potential annual income earned from honey can reach about 2,027 ± 77 Birr. per household. During the harvesting season, when the price of a quintal of barley was about 160 ± 0.8 Birr, sales from honey can purchase about 13 ± 0.5 quintals of barley or roughly about 50-65% (6 to 8 months) of households annual food needs, given the mean annual food needs of a household is about 23 ± 3 quintals.

Table 6. Mean number of hives per household, kg. of honey harvest per one hive, price per kg. of honey, mean percent of honey for sale and domestic use, annual mean kg. of honey for sale and annual income from honey sale its contribution of household annual food need (N=62).

Items	Mean ± SD
Mean no. of hives each household possesses	50 ± 13
Kg. of harvest per hive	7 ± 0.6
Price of honey per kg	7 ± 0.8
Mean percent of honey for sale	88 ± 1
Mean percent of honey for domestic use	12 ± .5
Annual mean kg. of honey for sale per harvester	308
Annual income from honey sale (in Birr) per harvester	2027 ± 77
Quintals of grain sales from honey buys	13 ± .5
Annual food need (in quintal) per household	23 ± 3
Proportion of annual food need covered by honey sale	50 ± 65%

Trends and problems of production

The great majority of the respondents, 54 (73%) reported that honey production in the Harenna forest has been decreasing over the last decade, while 4 (7%) and 5 (8%) of the respondents reported that it has remained the same and was increasing, respectively. However, 6 (10%) of the respondents suggested that it has been fluctuating (Fig.1). Based on the opinion of the local elders and/or key informants, the main factors that contributed to the decline in honey production in the area were destruction of natural vegetation for agriculture and overgrazing, heavy and/or erratic rainfall and frost that led to the scarcity of flower that provided the sources of nectar for bees. Reduction in the number of bees in a colony and honeybee predators, e.g., honey badger, were also reported as additional factors contributing to the reduction in the honey production next to the aforementioned factors. However, the informants stated that there was no problem of honey production due to pesticides as they do not use them for

crop protection. Further reported constraints of honey production in the area were lack of training on the techniques of improved beekeeping management, lack of honey and wax processing equipment and lack of a suitable marketing system.

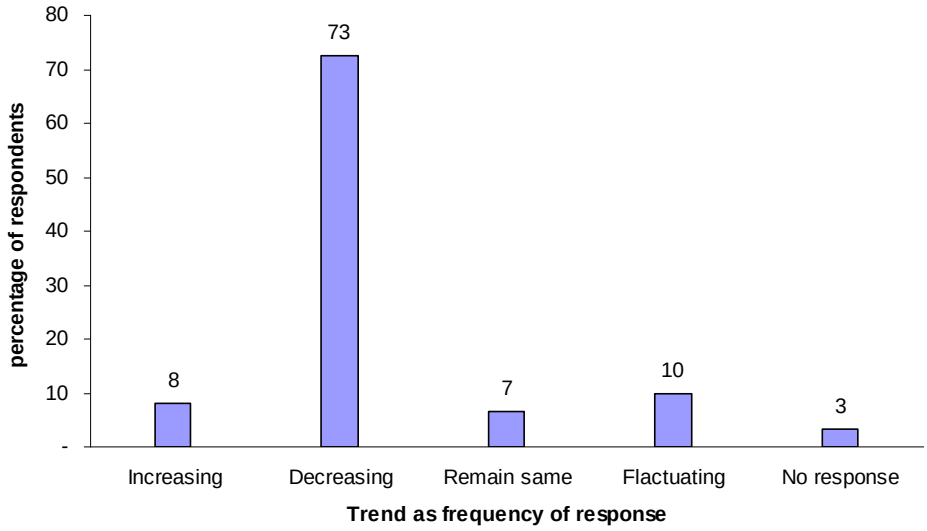

Fig. 1. Trends of honey production in Rira village in the Harenna forest based on opinions of respondents.

DISCUSSION

Absence of any significant correlation between the respondents' socio-economic characteristics and their responses on honey production practices indicated that the practice of honey production in the area was irrespective of their socio-economic status (Tables 1 and 2). This might imply that the practice was so lucrative that every male household was involved, because beekeeping can be undertaken regardless of age and other economic status; and also can be practiced as a part-time activity. The seasonality of hive hanging and honey harvesting usually follows that of the weather pattern. Hive hanging was mainly practiced at the end of the rainy season and harvesting in the dry season. In favour of this finding, Fichtl and Admasu Adi (1994) also noted that there has been a seasonal partitioning of hive hanging and honey harvesting across the country, which is related to the movement of bee swarms and abundance of flower.

Traditional beekeepers in Ethiopia include many varieties of hives (Fichtl and Admasu Adi, 1994) depending on the availability of local material and equipment. Beehives at Rira village were mostly prepared out of logs of selected tree species. The fact that tree logs were used for hive preparation indicated the possibility that the practice may have negative consequences for the forest, for example, over harvesting or reductions in regeneration of selected species. Though the informants indicated that log hives were made from dead trees, evidence suggested otherwise. For example, debarked or ringed standing trees of the priority hive species were found in the forest and a number of log hives observed in the forest were clearly made from fresh tree trunks.

Relating the use matrix value (Table 3) and preference ranking value (Table 4), it might be possible to understand that all woody species with high use value are not necessarily the ones most preferred. For instance, *Arundinaria alpina* was ranked as the second most commonly used material for hive preparation but was the least preferred among the six predominantly preferred. This could be due to limited availability of the most preferred species. Despite being a legally protected tree species, the majority of the people interviewed favoured *Hagenia abyssinica* of the six mostly used tree species for hive preparation. From preference ranking (Table 4), it could be understood that the most favoured species were usually the most important raw material, at least in the context of the people who use them. However, such selective removal of canopy tree species has been one of the most serious problems affecting the regeneration status of various tree species in the Harenna Forest (Lisanework Nigatu and Mesfin Tadesse, 1989; Getachew Tesfaye *et al*., 2002; Getachew Tesfaye and Demel Teketay, 2005). Tree felling for this purpose creates human-induced canopy gaps, which could favour the seed germination, seedling establishment and recruitment of light-demanding plant species thereby unnaturally shaping the forest's dynamics.

The ranking values of tree species used for bee forage shown on Table 5 was in line with the work of Fichtl and Admasu Adi (1994), who reported that the three top species indicated in the present study have high significant sources of pollen and nectar for honey production. In their work they have recommended to the honey producers to plant *Schefflera volkensii* and *Hypericum revolutum* in order to increase their production. By comparing the importance of *Erica arborea* for honey production and agriculture, it was also suggested that higher monetary returns per hectare could be obtained by honey production than by clearing *Erica* forests for agricultural

purposes (Fichtl and Admasu Adi, 1994). On the other hand, the opinion of the respondents that tree species for hive hanging were selected based on the abundance of flower they bear seemed to be misleading to draw a generalized conclusion, because there were some tree species providing better sources of pollen and nectar for bees than those which were reported as more frequently used for hive hanging and vice-versa. For instance, *Hypericum revolutum* and *Erica arborea* were reported as the second and third important sources of bees forage, respectively, among the twelve major tree species used for both hive hanging and bees forage. However, they were ranked as the least frequently used species for hive hanging. Similarly, *Dombeya torrida* and *Allophylus abyssinicus*, which were reported as the second and third tree species used for hive hanging, were ranked as the fifth and sixth most important honeybees forage, respectively (Table 5). Therefore, there might be some other additional selection/preference criteria to select trees for hive hanging in the study area. In the lower altitude of the Harenna Forest (not covered in this study) people usually use tall trees with narrow trunk in order to protect the bees from honey badgers (LeFevre, 2007). It is thus possible that, apart from the abundance of flowers a tree bears, such tree parameters like height and architecture may also influence the choice of trees for hive hanging.

Though the construction of beehives from tree logs is assumed to have a negative ecological impact on the Harenna Forest, there are positive aspects of honey in this traditional beekeeping practice for the conservation of the Forest. Key informants had pointed out that all the beekeepers have their own territory in the Forest area where only he and his family hang their hives on. Thus, the collection of any plant material by other people in a hive territory is strictly forbidden. They have traditional bylaws through which hive and/or honey thefts are made punishable, which is in terms of livestock. The occupancy of a new hive hanging site is demonstrated by randomly making a small debark-marking on the bole of a few dominant tree species found in the site of interest. People of the same family usually use the same area or adjacent areas. Such traditional practices have a paramount importance for the forest's conservation as it helps the beekeepers develop the ownership feelings for the forest resources so that they protect them from unsustainable extraction. Similar traditional resources management practice is very common in southwest Ethiopia and locally called ''*Kobo*'' (Zewdie Jotte, 2007). He suggested that resources managed through this traditional laws are often more sustainable than that imposed systems for controlling access. This is based on the fact that communities' tenurial rights

serve as an incentive for local communities to protect and utilize forest resources in more sustainable and equitable ways (Zewdie Jotte, 2007).

As can be seen from Table 6, the importance of beekeeping in food security and livelihood improvement of the forest-based beekeepers is so significant that it covers about half of their annual food requirements. It was hoped that the income would be higher if there were a package on better beehive management, processing, storage and transporting system of honey. Studies reveal that non-farming earnings in African households are substantial and range from 22-93% depending on the country (Reardon, 1997). In Ethiopia, for 1989-1990, it was around 36-40%, of which honey was one of the sources. Ethiopia produces some 24,000 MT of honey, which could be about a quarter of the total honey production in Africa. This high production is attributed to the presence of high bee colonies and high ecological and floral diversity in the country (Fichtl and Admasu Adi, 1994). According to Vivero Pol (2001-2002), of the total domestic honey production in Ethiopia, about 20% is used as table honey in rural areas, 55-60% is used in the production of *'Tej'* and the remaining portion is sold in Addis Ababa. However, among the Rira community, only about 12.4% of honey is available for home consumption. The great majority is sold in Goba (north of Rira village at ca. 55 km) and the remaining portion is sold on the Goba-Dollo Mana road**.** Unlike people of other parts of Ethiopia, the use of honey for the preparation of local beverage *'Tej'* on wedding and holiday ceremonies is not practiced among the Rira community. According to the opinion of the respondents this avoidance was due to religious taboo on consumption of alcoholic drinks.

The present agricultural proliferation, overgrazing, timber exploitation and other problems in the forest meant that, inevitably, there can be decrease in the quantity and quality of honey produced in the forest. This, on the other hand, may lead to loss of the tradition whereby the young generation would be forced to intensify the aforementioned detrimental practices.

CONCLUSION AND RECOMMENDATIONS

The ecological, biological and socio-economic significance of the Harenna forest is incalculable. However, the present trend of forest destruction due to the shift in economic practices of the local community from honey production and livestock rearing (Mooney, 1963) to intensive agriculture and timber production is alarming. Even immigration of people into the forest from Arsi, North Shewa and East Harerge is growing in an unprecedented way (BMNP, 2006). Therefore, conservation of the forest

sustainably entails the involvement of multidiscipline stakeholders, like NGOs, scientists and relevant government agents in identifying and implementing ecologically sound, economically viable and socially accepted alternative livelihoods. Sustainable utilization of non-woody forest products, like better honey production, sustainable medicinal plant collection and non-destructive harvesting of other genetic resources could provide alternative income that reduces reliance on livestock and barely cultivation. Despite the critical constraints of transportation to supply their produce to the market and lack of honey quality and quantity improvement techniques, the economic value of honey for the Rira community is so viable (it covers up to 50-65% of a household's annual food needs) that it could be considered as one of the conservation promotion options to reverse the current situation, provided that the production would be in progress. The traditional bylaws of hive management that the people have in possession of territory where to hang their hive and thereby protecting the site from the use of other people, should also be appreciated and strengthened. Paradoxically, there is a situation where honey production in the Harenna Forest could have a negative ecological impact. The preparation of beehives from selected tree plants could have disastrous consequences on the regeneration and maintenance of the forest ecosystem. Therefore, devising alternative means for preparation of beehives from selected tree species need immediate attention if we are to conserve and sustainably use forest resources.

For sustainability of the Harenna Forest, beekeeping should be integrated with forest management programmes. In general, a shift of hive preparation from trees to bamboo, provision of intermediate beehives from non-timber materials and provision of training on the techniques of improved management, equipping the community with honey and wax processing equipment, and facilitating a suitable marketing system should be urgently undertaken in order to enhance the economic income of the community, and to minimize their direct destructive dependence on the forest resources, such as intensive grazing and crop cultivation. Finally, in order to develop effective conservation and livelihood improvement plans, further in-depth apicultural studies, mainly focusing on the biology of the honeybees, constraints and bee forages in all villages found in the forest should be conducted, and awareness raising education on the sustainable use of the forest should also be implemented.

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