

Identifying Opportunities and Constraints of Beekeeping: The Case of Gambella Zuria and Godere Weredas, Gambella Regional State, Ethiopia

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Abstract

The study was aimed at identifying opportunities and constraints of beekeeping in Gambella zuria (Abol) and Godere weredas, South West Ethiopia. Formal and informal survey methods were used to collect information of secondary data and response on structured questionnaires from May 2014 to July 2014. One hundred twenty households were selected, 60 from Abol and 60 from Godere weredas. Principle of sample proportionality were used to select sample respondents from each selected kebeles in the weredas, in which from Pukong (Abol) area 19 (15.8%), Koben (Bonga) area 41 (34.2%), Gelesha (Godere) area 29 (24.2%) and Chemi (Godere) area 31 (25.8%) respondents were sampled. All the interviewed household heads were male headed. Almost 52.5% of respondents attended primary and junior school level education. The major opportunities to engage on honeybee beekeeping were high existence of honeybee colony (19.2%), Socio economic value (17.7%), availability of honey bee flora (17.2%), enough water sources for bees (16.6%), market demand of honey & bee products (15.2%) and Experience of beekeeping (14.07%). Among respondents, nearly 95.8% of them sold their honey immediately after harvest whereas remaining 4.2% store for home consumptions, for beverage making and sell few weeks later after harvesting. The identified major constraints of honeybee beekeeping in the districts were insufficient visit to apiary and bee management skills (51.1%), bee enemies (14.3%), drought and wild burning (13.1%), absconding and migration of bee colony (12.3%), poison plant in the area (4.9%) and poison chemical spraying (4.3%). Generally, the high potential is manifested with abundance of honeybee swarm, availability of honeybee flora, socio economic value of honeybee, demand of honeybee product in market and experience of honey beekeeper in the areas. These potentials were under exploited due to existence of constraints requiring immediate intervention, particularly on improved technology introduction and frequent upgrading of knowledge and skill of beekeeper.

Keywords: Honeybee; Constraints; Arsham sample; Opportunity

Introduction

Ethiopia is one of the countries in the African continent, which own huge honey production potential. Owing to its varied ecological and climatic conditions, it is also home to some of the most diverse flora and fauna in Africa. Its forests and woodlands contain diverse plant species that provide surplus nectar and pollen to foraging bees [1]. The ideal climatic conditions and diversity of floral resources allow the country to sustain around 10 million honeybee colonies, of which seven million are kept in local beehives by farmers and the remaining exist in the forests as wild colonies. This makes the country to have the highest bee density in Africa [2,3]. Ethiopia, having the highest number of bee colonies and surplus honey sources of flora, is the leading producer of honey and beeswax in Africa. It produces about 43,373 metric tons of crude honey per year, thus shares 23.5% of Africa and 2.35% of world's honey production. Beekeeping is an important agricultural sector that utilize natural nectar and pollen for production of honey, wax and other hive products that have a great contribution for the income of smallholder farmers [4].

Nowadays more than 7000 species of flowering plants estimated to be found in the country, of which most of them are honeybee plants [4]. The sub-sector share in the GDP has never been commensurate with the huge numbers of honeybee colonies and the country's potentiality for beekeeping. Productivity has always been low, leading

to low utilization of hive products and relatively low export earnings. Thus, the beekeepers in particular and the country in general are not benefiting from the sub sector [3].

This sector, is not so far a popular business venture, despite, the country potential, investors were not involved. On the other hand most of the rural beekeepers cannot afford to invest on inputs, process, pack and transport their products to market to maximize profit [4]. The products obtained from this sub sector are still low as compared to the potential of the country. Similarly, Gambella is one of the regional states estimated to have 86,300 colonies of bee [5], which can play great role in increment of production and productivity of this sector for the region and as a whole for country development. Therefore, this study was done with the objective to identify the major constraints and potential opportunities of beekeeping in study areas.

Materials and Methods

Description of study area

The study was carried out at Gambella Zuria (Abol) and Godere districts of the Gambella People's Regional State (GPNRS). Gambella Zuria (Abol) district is one of the districts in Anuak zones of Gambella Regional State, where the study was under taken in its Pukong and Koben Kebele. The district is found at an elevation of 400 masl to 600 masl and bordered on the South by Abobo and on the west by Itang districts and on the north and east by Oromia Regional State [5].

Godere is one of the districts in Mejeng Zone of Gambella Regional State, where the study undertaken in its Gelesha and Chemi Kebele. Mejeng zone is located at about 620 km away from Addis Ababa in South Western Ethiopia in between 7°10' 0"-7°40' 0" N latitude and 35°0' 2"-35°20' 2" E longitude.

Sampling Techniques

The study was conducted in beekeeping potential area of Gambella regional state. For this study, two weredas were selected based on the history of honey bee keeping and its representativeness to the weredas. The weredas were Gambella zuria (Abol) and Godere. Prior to the actual survey, informations were gathered from secondary data and informally from key informants. Based on the information obtained from secondary data and informal survey, structured questionnaires were developed and pre-tested for its reliability and applicability to the objectives of the study.

Sample size was determined according to Arsham [6] with the formula of $N=0.25/SE^2$, where $SE=4.56\%$ and at confidence interval of 5%. Accordingly, one hundred twenty (120) households were selected. Sixty (60) from Abol and 60 from Godere weredas. The kebeles (i.e., smallest administrative unit) in the weredas were selected based on the principle of sample proportionality. These were from Pukong (abol) area 19 (15.8%), Koben (Bonga) area 41 (34.2%), Gelesha kebele (Godere) areas 29(24.2%) and Chemi kebele (Godere) areas 31 (25.8%). The sampling frame comprised only of those households with beekeeping experience.

Data collection

Data's were collected in between May 2014 to July 2014. The data collections were through interview and direct observation particularly emphasizing on the parameters of potential opportunities and constraints of honey beekeeping. Quantitative data were generated using single-visit-multiple-subject formal survey methodology, which include the following major data groups: Household socio-economic characteristics, Honey production and marketing systems, Farmers' indigenous knowledge and practices of honey beekeeping, Potential constraints and opportunities of beekeeping in the areas.

Statistical analysis

The collected data were coded and tabulated for analysis. Descriptive statistics (i.e., mean, percentage, ranking and standard deviation) using SPSS version 16.0 was used to analyse the collected data's.

Results

Household Characterization

Gender and education level of Honey beekeeper in study areas: One hundred twenty respondents were interviewed in this study. All the interviewed household heads (N=120), were male headed.

With regard to educational level of the household heads above 90% had gone through the formal primary and above primary level of education, while 9.1% of members were not (Table 1).

Variables	Abol	Godere	Overall (N=120)
Gender of household head (%)			
Male	100	100	100
Educational level of household head (%)			
Illiterate	5	13.3	9.1
Primary & junior school level (1-8)	40	65	52.5
Secondary school level (9-12)	33.3	21.7	27.5
Certificate, diploma level and above	21.7	0	10.8
Total	100	100	100
N=Number of households having honey bees			

Table 1: Gender and educational status of households the study Weredas.

Family size and age distribution of beekeeper in study area: The average family size of the beekeepers was 5.4 persons, with maximum and minimum family size of 10 and 1 person, respectively. The beekeepers had an average experience of 16.5 years ranging from 1 year to 80 years. The mean age of the respondents were 33.4 years (with standard deviation of 13.7 years) ranging from 1 year to 80 years (Table 2).

Socio-economic indicators	Minimum	Maximum	Mean	S.D
Age of household (yrs.)	15	80	33.4	13.7
Experience (yrs.)	1	80	22.2	16.5
Family size	1	10	5.4	2.5

Table 2: Family size and age distribution of interviewed households of Gambella.

Beekeeping activities in the surveyed area can also be practiced by aged persons with >65 years old as the age range indicates (Table 2).

Opportunities and potential for beekeeping in Abol and Godere Wereda areas: According to the respondents, the major opportunities for beekeeping in study areas are shown in Table 3.

Opportunity	%beekeepers observing opportunities	Rank
Abundance of honey bee (swarming frequency)	19.2	1
Socio economic value	17.7	2
Available flowering plants (harvesting frequency)	17.2	3
Water availability	16.6	4
Market demand of honey bee products	15.2	5
Experience (engagement period) of beekeeping	14.07	6

Table 3: Potential opportunities of honeybee keeping in the area.

The existence and abundance of honeybee (19.2%), socio-economic value of honey (17.7%), availability of potential flowering plants (17.2%), water resources availability (16.6%), market demand of honey bee products (15.2%) and experience (engagement period) of beekeeping (14.07%) as shown in Table 3 from the highest to lowest rank respectively.

Market demand of honey bee product: Though it is cheaper beekeepers have no problems of honey disposal market in the areas, they consider the market as an opportunity for their honey bee products (Table 4).

Market trend of Honey bee products	Wereda		
	Abol	Godere	Overall
Marketing places and price/kg (%)			
·At Village (30 birr/kg)	66.6	61.7	64.15
·Nearby market (45 birr/kg)	33.4	38.3	35.85
Time of selling (%)			
·Immediately after harvest	91.6	100	95.8
·Store for increase of price	8.4	0	4.2

Table 4: Market trends of honey in the Weredas.

In fact, honey produced in the area sold mainly at their village level and the rest is sold at nearby market like Bonga and Meti (Godere wereda main town) towns at much higher price than at the village level in Abol and Godere Weredas respectively.

The average price of crude honey in the village level is ETB 30/kg and at Bonga and at Meti town is ETB 45/kg. Nearly 95.8% of respondents sold their honey immediately after harvest where as the remaining 4.2%, store for home consumptions, for local beverage making and sold few weeks later after harvesting time (Table 4).

Constraints of Beekeeping in Abol and Godere Wereda areas: As depicted in Table 5, the major constraints of beekeeping in the areas include Insufficient visit and bee management skills (22.4%), Bee enemies in the area (14.3%), Drought and Wild burning (13.1%), Absconding and Migration of bee colony (12.3%), Poison plant in the area (4.9%) and Poison chemical spraying (4.3%).

Apiculture Constraints	Respondents	% experience of constraints
Insufficient visit and bee management skills	-	51.1
· Problem of Inspection & apiary cleaning	22.4	-
·Low level of technology used	14.8	-
·Lack of training & extension service	13.9	-
Bee enemies in the area	-	14.3
Drought and Wild burning	-	13.1
Absconding and migration of bee colony	-	12.3

Poison plant in the area	-	4.9
Poison chemical spraying	-	4.3
Total	-	100

Table 5: Constraints of beekeeping in Abol and Godere weredas of Gambella regional state.

Container type (name)	% respondents using it
Plastic bucket	75.8%
Pot and Buke	21.7%
Others types of cans containers	2.5%

Table 6: Common containers used for storing honey in Abol and Godere weredas of Gambella regional state.

Discussion

Beekeeping is the well-practiced farming activities in the area. Large family size have a better chance for labour shares in farm activities and hence for beekeeping activities too. It is found a dominant percentage of male-headed households in this study area, which demand climbing of tree branches for hanging hives and harvesting honey, were accepted normally as the duty of male. Similar studies by Kebede [7] and Tessega [8] indicated that about 98.3% were male headed beekeeper and the rest 1.7% were female headed in their reported study conducted in Amhara Regional State of Ethiopia. Another study by Tesfa et al. [9] reported that all the interviewed beekeepers in western Amhara regional State of Ethiopia was found male. Inagreement with this study beekeeping were also reported as an activity of men in Bale highlands of Southeast Ethiopia [10]. Outside Ethiopia a similar result showing beekeeping is the main activity done by men obtained by Baltazar et al. [11] in Tanania.

In a study done by Ayele [12] in Ada'a district indicated that 22.8% of the beekeepers had not received any formal or informal education opposite to this study which is 9.1%, the remaining were at different levels of literacy ranging from basic education to secondary school level. Gichor [13] noted that for more advanced beekeeping and for better colony management, beekeeper should have a good grasp of honey bee biology and behavior. Moreover, illiterate beekeepers need intensive and frequent training before distributing modern hives. Baltazar et al. [11] found high respondents educated formally or informally which is similar to the result of this study. The high level of literacy (90%) in the districts can be taken as an advantage for setting training programs and simplifies ways of practical demonstration of essential concepts of improved beekeeping. In another way exposure to education will increase ability of the keepers to obtain, process, and use information relevant to the adoption of improved innovations of beekeeping at their disposal. Therefore education will boost the possibility that a beekeeper will adopt improved beekeeping for increment in productivity of honey bee products. This is due to the fact that beekeeping is a self-employment opportunity available in the study area and elsewhere in the country.

The level of beekeepers' experience was taken to be the number of years that an individual was continuously engaged in beekeeping. This is what one would expect in a situation where people are actively engaged starting from an early age in helping older beekeepers to

undertake basic tasks. Based on this exposure, young people gradually move on to become independent beekeepers as soon as they obtain their own hives, which also stated by Gichora [13]. They continue accumulating experience by seeking technical advice from fellow beekeepers whenever necessary. This result showed that beekeeping was performed by active age groups and hence in most cases people at adult age is actively engaged in beekeeping activities. Related results was reported by Alemu et al. [14] in Sekota district, that majority of the respondents (57.7%) have an experience of 11-40 years in traditional beekeeping. Family size of beekeeper might be associated with the labour requirement for various farm activities in the area hence this family size may not cause problem on labour requirement of beekeeping activities.

As indicated in Table 3, 17.2% respondents reported that there is a good potential of honey production due to conducive environments, which enables them to harvest honey frequently because of high honeybee flora. The honeybee population and their productivities in general are mainly influenced by the nature of honeybee flora of an area as indicated by Nuru [3]. Similar studies in Gomma district of Ethiopia indicated that the honeybee flora compositions of Gomma district are perennial crops, annual herbs, and some natural trees having significant contribution for beekeeping [15]. These authors also indicated that variation in vegetation characteristics of the area could be potentially suitable for effective distribution of honey production at various seasons, which is similar to the present study. The high feed and water availability for honeybee is in agreement with [4,15-18]. In agreement with this Malede et al. [19] reported that Among the major opportunities of bee keeping in and around Gonder area were the existence of flowering plants and ample source of water, availability of honey bee colonies.

As nearly 95.8% of respondents sold their honey immediately after harvest while the remaining 4.2%, store for home consumptions. According to Legesse [20] the whole domestic honey market of Ethiopia lacks proper structure and legality where there is lengthy chain of actors that widens the access of producers to bigger and better paying markets. This may not give them an opportunity to benefit from the rise in price of honey in off-seasons. Similar study in Bure, indicated that 69.1% of the harvested honey was used for income generating, 12.4% home consumption, 7.8% cultural ceremonies, 5.8% as a medicine and 4.9% as a beverage [21]. Most of the honey were marketed locally in the study area; village level marketing is also similar practice by most beekeepers as stated by Kaiser and Ernest [22]. In agreement with this Legesse [20], and Belie [8] in his review papers that, domestic honey market starts at the smallholder beekeepers level, who majorly sell crude honey to collectors in the nearest town/village markets. As Monga and Manoch [23] reported 46.7% respondents of panchkula district of india was faced marketing of honey and other bee products as a constraints , this was due to absence of any cooperatives and institutional support for cleaning, packing and marketing in the nearby area.

The present study revealed that there are a number of beekeeping constraints in the area with different degrees as shown in Table 5. The existing production constraints in the beekeeping development of the country are complex and largely vary between agro-ecological zones and production systems as mentioned by EARO [13]. Variations of production constraints also extend in socio-economic conditions, cultural practices, climate (seasons of the year) and behaviours of the bees [24]. The present constraints showed that there is a shortage of appropriate technical assistance for beekeepers. Phokedi [25] reported

about apiculture and its problems in Botswana noted that the shortage of qualified personnel to extend and consolidate beekeeping among farmers was a major constraint.

Similar with present study the major problems of beekeeping identified and prioritized in Ethiopia Tigray region, Astbi-wenberta wereda were; drought, pests and diseases of honey bees, lack of beekeeping materials, death of colony, lack of adequate extension support, marketing problem, shortage of bee forage, lack of adequate bee keeping skill & reduction of honey bee colonies [26]. In another study done in Ada'a Liben woreda of Ethiopia, different results were reported about constraints of beekeeping thus includes, lack of institutional linkage and information gaps [4]. Similar study by Ebojei et al. [26] in Kaduna State of Nigeria reported that constraints of beekeeping mentioned by bee farmers as pest attack, lack of finance, poor storage, deforestation, inadequate beekeeping equipment and theft.

Practice of using improved technology in honey beekeeping in the area is the second (14.8%) most serious constraints. According to this study over 90.9% of the beekeepers are producing honey using traditional hives while it is possible to produce two to three folds using intermediate and modern hives. Most (above 90%) of the local beekeepers responded that beside the modern hives un-affordability lack of the basic tool that would be needed for private work like bee veil, hand gloves, smoker, chisel, and overall(beekeepers suit) was the main problem. Honey harvesting and storage systems are also too traditional, processing and value adding is nearly non-existent. This is an indication for low-level technology used in the area demanding participatory extension and research needs to be promoted to stimulate local innovation. Moreover an introduction of improved beekeeping technologies to the rural communities facing problems because it is beyond the buying capacity of farmers and even not easily available for those who can afford it.

As indicated in Table 5, among the constraints hive inspection and apiary cleaning were one of the major problems (14.3%) identified in the area. Since their hives were traditional type, there was no internal hive inspection, but there were beekeepers sometimes doing external hive inspection for observing bee's activities on the hive entrance, which is an accumulation of swarm on hive entrance due to either for swarm preparation, ants or other enemies attack or indicating ripening of honey. Few Beekeepers (3%) also reported that presence of dead bees found on the entrance of the hive as an indication of starvation or poisonous by different chemicals. Study in Ada'a district indicated that 86.0% of the respondents took a look externally into the hives, 3.0% inspect internally and 11% both eternally and internally [12].

As indicated in Table 5, wild burning and drought (13.1%) is a constraints majorly affecting honey beekeeping. Similarly, Workneh [27] reported in his study that drought is the primary constraint in beekeeping sub sector in Atsibe wenberta district. It affects their feed sources (bee forage and water). Therefore, the honeybee colony absconds to areas where resources are available for their survival.

Honeybee colonies abandoned their hives at any season of the year for different reasons. According to the response of the respondents (Table 5) 12.3% of constraints were due to absconding of honeybee colonies. The reported reasons for absconding of bee colonies by respondents were due to lack of bee forage or due to drought, incidence of pests and predators, bee poisoning, poor management and wild burning. In Abol wereda absconding happen mostly in between February and April. Except few colonies that have got enough

honey combs (stored food) which enable them to survive the dearth period and colonies that got adequate additional food, others were absconded and/or migrated to highlands, (i.e., particular to koben area) or towards lake area in search of water and food. The possible reasons indicated for absconding and/or migration were shortage of food, shortage of water, pests and predators of honeybee, poor bee management practice and lack of protection against bad weather. About 40% of the respondents of koben area indicated that shortage of food, water and forest burning were the serious problem than others, which are mainly responsible for absconding, or migration of honeybees occurred in the area. Similar Study reported that in the main causes of absconding from the hives were lack of feed, which accounts 42.2%, Honeybee enemies, honeybee disease and indiscriminate agrochemical application accounts for 34.3%, 7.8%, and 15.7%, respectively [28]. Related problem were identified by Tolera and Dejene [29] that colonies absconding (56.6%), poor honeybee pests (43.7%), harvesting unripe honey (30.3%) and pricing fluctuation of honey (40.6%)

According to this study 14.3% of respondents responded that honeybee enemies and pest were the constraints challenging the beekeeping sector in the region. Ethiopia, as one of the sub-tropical countries, the land is not only favourable to bees, but also for different kinds of honeybee pest and predators that are interacting with the life of honeybees [30]. The existence of pests and predators are nuisances to the honeybees and beekeepers. Similar findings were reported, by Chala et al. [11] that ants, wax moth (*Galleria mellonella*), bee-eater birds, spider, bee lice (*Braula coecal*), honey badger (*Mellivora capensis*), monkey, small hive beetles (*Aethina tumida*) and lizard were the most harmful pests in decreasing order of importance. Pests and predators cause devastating damage on honeybee colonies with in short period of time and even overnight. Kerealem [30] reported that ants, honey badger, bee-eater birds, wax moth, spider and beetles were the most harmful pests and predators in order of two decreasing importance. According to Beyene [31] reports pest and predator were ranked as second problem of Kewet district in which among them ant (33.3%), wax moth (16.7%), honey badger (15%), bee lice (13.3%), birds (10%), lizard (6.7%) and spiders (5%)

The constraints of beekeeping due to poison chemical in the study Wereda is shown in Table 5. Only 4.3% share of constraints was due to poison chemical spraying in Wereda. The use of chemicals and pesticides for Tsetse fly, mosquitoes and household pests control brings in to focus the real possibility of damaging the delicate equilibrium in the colony. Of the various kinds of chemicals only insecticides and herbicides are now major problems to the beekeepers. The chemicals used for crop protection are the main pesticides that kill the bees. But in this study areas more significantly affecting one are insecticides applied to non-crop pests such as mosquitoes and Tsetse flies. Insecticides have a much more dramatic effect on population of bees, thus, the important contribution made by bees to the production of food and human nourishment is being put in danger. The types of chemicals used include Malathion, DDT. As it was seen from the beekeeper point of view, poisoning of honeybees by agrochemical was not as such a serious problem [32].

The majority (95.5%) of the sample households responded that they do not store honey primarily because of high demand for cash and secondly because of lack of storage facilities. Honey is mostly harvested in October to January and April to June of major harvesting periods of Godere and Abol wereda respectively. Some beekeepers that have no pressing problems keep the honey for prolonged period to get better

price in off time. Similar study by Alemu et al. [14] reported that majority of the sample beekeepers (55%) do not store their honey; they sale it immediately to their customers in less than one month time after harvest.

Respondents reported that there was also constraints of container type used for honey storage and transporting to market. 75.8% of respondents use plastic bucket, 21.7% pot and Buke and 2.5% others types of cans containers (Table 6). However, these are technically not appropriate storage facilities as they result in serious quality deterioration. Study in Bure district revealed that, 46.7% respondent use plastic bucket, 40% plastic sack and 10.8% gourd were used to store honey for short period [8].

Conclusion

Beekeeping in Gambella Zuria (Abol) and Godere Wereda particularly in Pukong, Koben, Gelesha and Chemi kebeles of study sites have indicated their potential in their abundance of honey bee swarm, availability of honey bee flora, socio economic value of honey bee in the society, demand of honey bee product in market and experience of honey beekeeper in the areas. Therefore if the major constraints will be solved, particularly of colony inspection and apiary cleaning problems, low level of technology used, honey bee pests and enemies problems and lack of training and training institutions which were mainly related with skill gaps of managing honey bee, it will be a good reward of honey bee product productions.

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Competing Interests

The authors have no financial or other conflict of interest to declare in relation to this manuscript and declare no financial or other relationships leading to a conflict of interest.

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