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RESEARCH PAPER

Traditional Forest Beekeeping and Its Challenge in Benishangul Gumuz Regional State, Ethiopia

Alayu Tarekegn[1,*]

[1] Ethiopian Institute of Agricultural Research, Assosa Agricultural Research Center, Assosa, Ethiopia.

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*** Corresponding Author**
Tel.: +251921136027
E-mail: alayutarekegn68@gmail.com

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Abstract

The study was conducted to assess the status of traditional forest beekeeping and related challenge faced by the beekeepers in three representative districts of Benishangul Gumuz. Through the systematic random sampling method, 167 households were selected and data were collected through a semi-structured interview schedule. The collected data were analyzed using descriptive statistics, chi-square test, and T-test of Statistical Packages for Social Sciences (SPSS Version 23). The result shows as compared to the backyard and other beekeeping systems traditional forest beekeeping (71.30%) was still the major type of honey bee colony management in the region. During honey harvesting, 43.71% of beekeepers harvest any hive product by throwing the hive from the long tree and collecting the entire available hive product at night time of the day. Beekeepers' response shows that the factors were no different (P>0.05) across the district to keep honey bee colonies traditionally in the forest area. The result further indicates the participation of females in the beekeeping sector is still very low level in the study area (10.2%). In conclusion, in the study area due to forest beekeeping practice the honey bee population, diversity, and the hive product highly declined and the beekeepers still have not benefited from the sector. So, to decrease traditional forest beekeeping practice further activities must be done by the government and a research center on the integrated improved forest beekeeping, awareness creation, and on reducing honey bee race aggressiveness behavior.

Introduction

Ethiopia has a huge potential for beekeeping production because of its endowment with diversity in climate and vegetation resources for beekeeping (Kidane, 2014). The result of the Central Statistical Agency revealed that a total of about 6.99 million hives are estimated to be found in the rural and pastoral sedentary areas of Ethiopia (CSA, 2013). Of these total hives, 95.89 percent are traditional hives. Ethiopia has a share of around 23.58 and 2.13% of total African and world honey production, respectively (Workneh & Ranjitha, 2011). An early study by Kassaye (1990) shows Ethiopia is the leading honey producer in Africa and the tenth largest honey producing country in the world. Oxfam Canada's study (2008), indicates there were 166 736 traditional and 682 modern beehives available in Benishangul Gumuz regional state.

Adequate forage availability coupled with favorable and diversified agro-climatic conditions in Ethiopia creates environmental conditions conducive to the growth of over 7000 species of flowering plants which have supported the existence large number of bee colonies in the country (Beyene & David, 2007). Beekeeping is one of the agricultural sub-sectors that most suits the rural poor people being simple and relatively cheap to start, as it requires a very low level of inputs such as labor, capital, and knowledge (Gemechis et al., 2012). In Ethiopia, 95% of beekeepers follow the traditional method of beekeeping practice with no improved techniques or technology and the beekeeper still has very traditional knowledge and skill of honey and beeswax production (Belie, 2009).

Over 150 000-200 000 km^2 of the west and south-west region of Ethiopia is infested by Tsetse fly (Tikubet,

2000). Benishangul Gumuz regional state is part of south-west Ethiopia, endowed with vast arrays of livestock resources and it is an area of highly trypanosomiasis stricken, it has an estimated tsetse infestation area of about 31 000 km^2. Much of this land is potentially productive but its full economic development is being denied because of the impact of trypanosomiasis. This situation retarded the livestock sector other than beekeeping development and societal livelihood improvement.

Over 60% of Benishangul Gumuz is covered with forest, including bamboo, eucalyptus and rubber trees, incense and gum forests as well as indigenous species (Kassa et al., 2015). This high coverage of the forest and honey bee flora creates an opportunity for the majority of beekeepers in the study areas to practice traditional forest beekeeping followed by backyard beekeeping. In Benishangul Gumuz traditional forest beekeeping is practiced by placing hives in the forest on very tall trees for catching swarms and honey harvesting. Its disadvantages are lack of close follow-up and during the honey harvesting period as the beekeeper drops down the hive from the tree, it damages the honeybee colony and reduces the honey bee colony population. It is also dangerous for the beekeeper to climb a tall tree at the night (HBRC, 2004). A study by Abebe et al. (2016) indicates during honey collection from traditional hives, beekeepers in Benishangul Gumuz regional state of Ethiopia remove all combs and destroy a colony.

In Benishangul Gumuz even in the traditional beekeeping system still, the sector is one of the economically important sub-sector for income generation activity. Observation shows as compared to other regional states Ethiopian beekeepers in the region widely practiced traditional forest beekeeping.

In the region majority of beekeepers purposively prepare one side fully closed and the other side moveable to cover a short-length traditional hive about 1-1.5 m in length and 30-50 cm in width to hang easily on the tall tree at the time of the flowering season (Fikadu, 2018). Those colony management systems in the region have different problems for regional beekeepers to manage honey harvesting, quality and quantity of honey, disease, pest and predator controls, and inspecting the colony in general.

Bambasi, Homosha, and Mao-Komo districts of Benishangul Gumuz regional state are believed to be potential areas for beekeeping development as they have good climatic conditions and diversified bee flora. Moreover, in these areas, the improved beekeeping sector creates huge job opportunities for youth and women in particular. But traditional forest beekeeping system in the region generally and specifically in the study area only participates in traditionally experienced persons who climb long trees to hang and harvest honey from the traditional hive. This type of beekeeping has highly reduced the participation of youth and women in the beekeeping sector. So, the region to get benefit from the sector and save the honey bee colony population must transform from traditional forest beekeeping to improved beekeeping by introducing modern beekeeping practices. At this time there is no data about the regional forest beekeeping practice status and challenge. Therefore, this study aims to assess the status of traditional forest beekeeping and related challenge in the beekeeping sector in the study area.

Materials and Methods

Description of the Study Area

This study was conducted in three districts of the Benishangul Gumuz regional state, namely Bambasi, Homosha, and Maokomo. The study areas were selected based on honey bee colony potential and road access. Assosa town Benishangul Gumuz capital city located 670 km west of Addis Ababa. Bambasi is located about 40 km south of Assosa, Maokomo is located about 105 km south of Assosa town and Homosha is located about 30 km west of Assosa town. The regional state is located between geographical coordinates: 9°30'N-11°39'N latitude and 34°20' E to 36°30' E longitude with altitudes ranging from 580 to 2730 m above sea level. Mean annual rainfall and temperature in the region range between 700 to 1450 mm and 21 to 35°C respectively (AMS, 2008). Benishangul Gumuz regional state has high forest cover in Ethiopia and possesses around 20% of the national forest areas (Bessie et al., 2016).

Data Type, Source, and Data Collection Techniques

Through purposive sampling techniques select three districts (Bambasi, Homosha, and Maokomo) based on accessibility to the road, and the population of the honey bee colony. In this study, a semi-structured questionnaire was prepared and administered to collect information from the randomly identified beekeepers. For this study, both primary and secondary data were used. To collect primary data systematic random sampling techniques were employed to select household heads, while secondary data was collected from the livestock and fishery agency and extension workers of respective study districts. A formal survey was conducted by frequent visiting during a time of honey production season. And also, to get a general overview of the beekeeping system an informal survey was conducted with key informant farmers, extension workers, and the district agricultural office interview.

A pre-tested semi-structured questionnaire was used to interview the selected beekeepers. The interview was held on their respective farms using a

translated local language. The questionnaire covered a large range of variables which include demographic characteristics, resource holdings, beekeeping system and management practices, honey production system, honey pests and predators, and challenges of beekeeping.

Information about the beekeeping system and the factors affecting the beekeeping system was collected through semi-structured interviews with 167 beekeepers. The semi-structured questionnaire, observation, in-depth interviews, and focus group discussions with key informants and extension agents were held in each district.

To obtain secondary data, reviewing different books, thesis papers, dissertations, magazines, and journals were reviewed to acquire in-depth information that was more related to the beekeeping system. The survey data was done from January 2020 up to June 2020.

Data Analysis

The data collected from beekeepers were analyzed using descriptive statistics through SPSS (Version 23). Percentages, frequency, T-test, and chi-square test were used to describe socioeconomic characteristics and beekeeping management. A T-test is used to assess the age, experience, and the honey bee colony status of the beekeepers. The Chi-square test was used to determine differences in percent frequencies of nominal data. Rank index calculation was also employed to identify economically important major pests and predators and constraints for honey bee production in the study area (Musa et al., 2006). The level of significance was set at 5%.

Results and Discussion

Socio-demographic Characteristics of Respondents

In the study areas, the participation of females in beekeeping activity was significantly lower (10.2%) than males (89.8%). This may be due to the beekeeping system of the region is difficult for females to work in the forest area. A similar result was also observed by Fikadu (2018) in Wombera district of Benishangul Gumuz from the total respondent beekeepers, 98% were male and 2% were female. A study by Bogale (2009) affirmed in Ethiopia beekeeping is the man's job.

Of the total respondent 34.7% of beekeepers there is no formal education. This lower level of education in the study area may affect the adoption of improved honey bee technology. A study by Mulatu et al. (2021) indicates the use of modern beekeeping technology is a direct relationship with education level. The respondent household head in the study area on an average of 12.41 years of experience in beekeeping (Table 1).

Table 1. Household characteristics

Household head		Frequency	Percent (%)
Sex	Male	150	89.8
	Female	17	10.2
	Total	167	100.0
Education Status	Illiterates	58	34.7
	Read and write	17	10.2
	Elementary	73	43.7
	Grade 9-10	17	10.2
	Grade 11-12	1	0.6
	Higher education	1	0.6
	Total	167	100

	N	Mean	SD	Min	Max
Age	167	40.55	12.7	18	71
Beekeeping Experience	167	12.41	9.34	1	40

N: Number of respondent, SD: Standard deviation, Min: Minimum, Max: Maximum

Beekeeping System

The result indicates traditional beekeeping in the forest system was perceived predominant practice in the Benishangul Gumuz regional state of Ethiopia (Table 2). The beekeeping system no difference (P>0.05) across the study districts. About 71.3% of the beekeepers in the study area were managing honey bee colonies in the forest area locally known as Berha. The finding of this study is in line with those of Amssalu et al. (2004) and Workneh (2011) who reported that beekeeping practice in south and southwestern Ethiopia is predominantly traditional. The study by Abebe et al. (2016) also shows in Benishangul Gumuz most beekeepers hang their traditional hives upon trees in the forest or homestead area until honey harvesting season. In general, beekeepers' response indicates hang a traditional hive on the selected tree in the forest area is a major practice in the study area to catch swarms, absconded, and migratory colonies. Whereas the backyard and under the roof still practice very low in the study area at 22.8% and 1.2% respectively.

Table 2. Honey bee colony management

	Traditional beekeeping system (%)				
Districts	**Backyard**	**Forest**	**Other**	**X^2**	**P- value**
Bambasi (N=57)	24.60	71.90	3.50	5.44	0.24
Homosha (N=58)	29.30	65.50	5.20		
Mao Komo (N=52)	13.50	76.90	9.60		
Total (N=167)	22.80	71.30	6.00		

N: Number of respondents per district, * and ** are significant at *P*< 0.05 and 0.01 respectively.

Traditional Forest Beekeeping System

The survey result shows that the reasons to keep honey bee colonies traditionally in the forest area are no different (*P*>0.05) across the district (Table 3). The beekeeper's response shows figuratively lack of awareness of improved beekeeping practice was the greater factor to keep honey bee colonies traditionally in the forest area (Figure 1). The second reason is due to the *A. m. scutellata* (*Apis mellifera scutellata)* race's highly aggressive behavior that is difficult to keep in the homestead area. A study on the aggressiveness of the *A. m. scutellata* race by Amssalu (2002) indicates that the honey bee race found in the lowland parts of Ethiopia is more aggressive from September through November. And another study by Collins et al. (1988) also shows that *A. m. scutellata* honey bees had high defensive behaviors. Moreover, other reasons also play a huge role in beekeepers practicing traditional forest beekeeping like lack of pest and predator control mechanisms and higher availability of flora species in the forest area.

Table 3. Reasons for traditional forest area beekeeping

	Districts (%)					
Variables	Bambasi (N=41)	Homosha (N=38)	Mao Komo (N=40)	Total (N=119)	**X^2**	**P-value**
Aggressiveness behavior of bees	31.70	18.40	20.00	23.50	5.19	0.75
Flora species availability	14.60	28.90	17.50	20.20		
Lack of awareness of improved beekeeping practice	19.50	26.30	27.50	24.40		
To prevent pests and predators	14.60	10.50	12.50	12.60		
To catch swarm	19.50	15.80	22.50	19.30		

N: Number of respondents per district, * and ** are significant at *P*< 0.05 and 0.01 respectively.

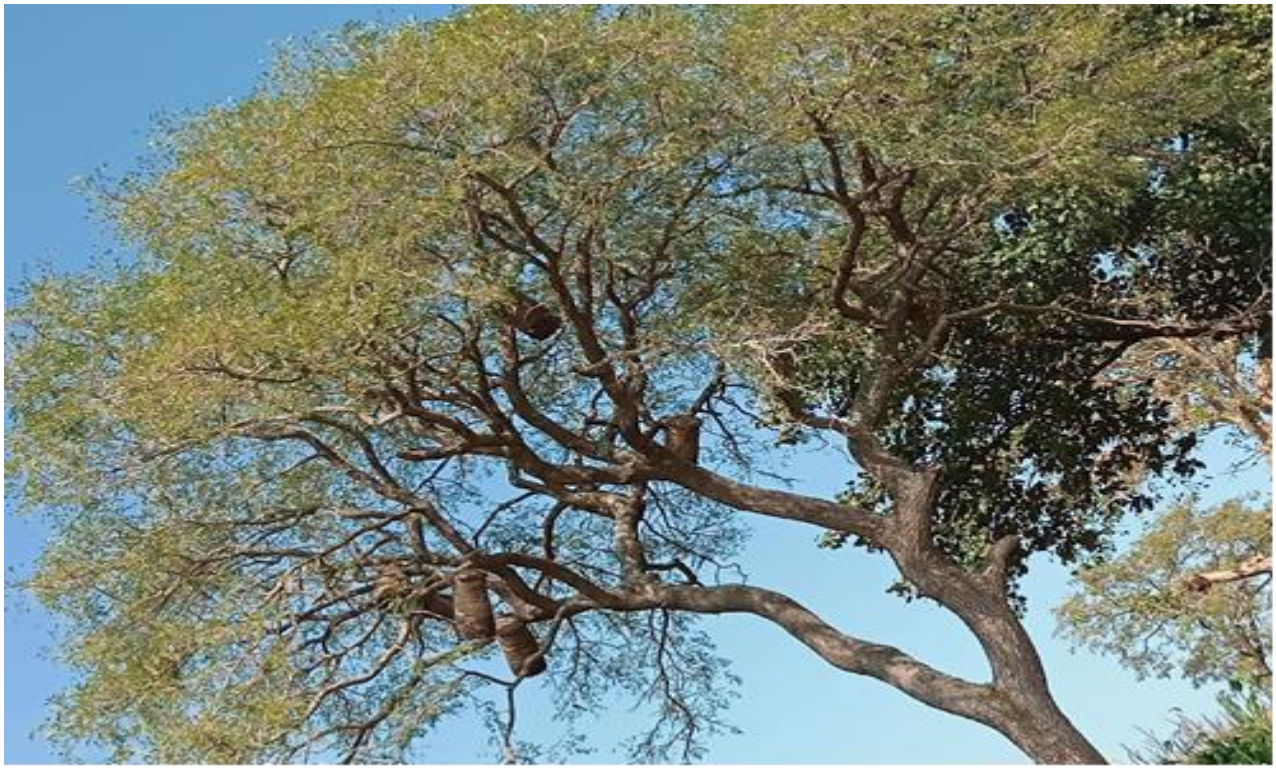

Figure 1. Traditional hives hanged in the forest area from a long tree during the time flowering season

Honey Bee Colony Status

Benishangul Gumuz regional state compared to other regional states of Ethiopia found a higher colony population per beekeepers (Table 4). The respondent beekeepers contain on average 12.98 colonies in the study area. The high number of colonies in our study area may be related to a wide range of honey bee flora species, forest areas, agricultural land, and water resource availability. Moreover, the beekeeper's response shows that hanging a large number of traditional hives on a selected tree in the forest area is an alternative means to increase the honey yield per harvesting season. A different study shows in another region of Ethiopia like Oromia regional state in the Arisi zone beekeeping potential area on average 5.68 colonies per respondent (Gebiso, 2015) and also in Tigray regional state Ahferom district among the major honey-producing districts average number of beehives with bee colonies for the total sample smallholder beekeepers was around 5 (3 traditional and 2 improved) with a minimum of 1 and maximum of 13 beehives (Gebremichael & Gebremedhin, 2014).

Table 4. Colony ownership status

Colony	N	Min	Max	Mean	SD
Total number of colony	166	0.00	75.00	12.98	14.70
Honeybee colony in traditional hives	164	0.00	125.00	11.50	16.41
Honeybee colony in transitional hives	159	0.00	5.00	0.37	3.97
Honeybee colony in box hive	160	0.00	20.00	0.91	2.16

N: Number of the respondent, SD: Standard deviation

Traditional Hive Management

In the study area, traditional hives were collected after honey harvesting from the forest area due to different reasons (Table 5). The response shows beekeepers collecting traditional hives after the honey harvested is the major one (49.1%) for hives without colonies. This study is in line with Serda et al. (2015) most of the local beehives are hung on a high tree during the time of the honey flow period, and collect traditional hives after honey harvest for the second honey flow period. This traditional forest beekeeping type of hive management in the study area causes huge colony losses in each production year. Moreover, the respondent's response shows that work at the time of hive hanging on the tree, honey harvesting at night time, and other beekeeping activities are very risky to beekeepers.

Table 5. Traditional hive management

Reasons for hives without colony	Frequency	Percent
Absconding due to pests and predators	70	41.91
Migration	15	9.00
Hives collected after honey harvest	82	49.10
Total	167	100.00

Honey Production System

The result indicates still in Benishangul Gumuz the beekeepers practice traditional forms of honey collecting by the destruction of the entire colony when the honey was harvested. The result shows that 47.9% of beekeepers harvest comb containing sealed honey and 43.71% of beekeepers by throwing the hive from the long tree and collecting the entire available hive product at night time of the day (Table 6). After harvesting all the hive product mix without extraction and storing for household consumption and marketing purpose. In the study area at the time of the honey flow period, huge colony death and migration occur because beekeepers harvest the entire available hive product and collect the hive for the next honey flow period. This type of honey harvesting still highly affects the honey quality, quantity, and honey bee colony population itself. The honey bee colony in the study area has very low productivity and poor quality of bee products which is the major economic impediment for rural beekeepers (Nuru, 1999). Group discussion participant response indicates due to the destruction of the colony at the time of honey harvesting in the region year to year the honey bee colony population is highly reduced.

Table 6: Kind of hive product harvested

Woreda		Kind of comb harvested					X^2	P-value
		With nectar	With pollen	Sealed honey	Any available at the hive	Total		
Bambasi	N	3	1	31	22	57	6.75	0.34
	%	30.00	25.00	38.80	30.10	34.10		
Homosha	N	6	1	22	29	58		
	%	60.00	25.00	27.5	39.70	34.70		
Mao komo	N	1	2	27	22	52		
	%	10.00	50.00	33.80	30.10	31.10		
Total	N	10	4	80	73	167		
	%	6.00	2.40	47.90	43.70	100.00		

N: Number of respondents per district, * and ** are significant at *P*< 0.05 and 0.01 respectively.

Honey Bee Pests and Predators

The major honey bee pests and predators in the study areas are indicated in Table 7. The ant was the most important pest in Bambasi and Mao Komo districts. But in the Homosha district, spider highly affects the honey bee colonies. Generally, in the study area ants, spiders, honey badgers, birds, and hive beetles greater effect on the beekeeping sectors. This result is in line with the findings of Ejigu et al. (2009), who reported that ants, honey badgers, bee-eater birds, wax moths, spiders, and beetles were the most harmful pests and predators in order of decreasing the importance of beekeeping in Amhara region of Ethiopia. Another study in Benishangul Gumuz by Abebe et al. (2016) also showed that ants, honey badger, wax moth, small hive beetle, and spider were frequently occurring pests and predators. Sample household response indicates that the first solution to prevent colonies from pests and predators is hanging on trees in the forest area is the preferable site for beekeepers. Research Centre produces different technology to prevent the incidence of ants on honey bee colonies but due to the regional beekeeping system still, the technology is not in practice by most of the regional beekeepers.

Table 7. Major honeybee pests and predators in each district

Pests/Predators	Bambasi		Homosha		Mao Komo	
	Index	Rank	Index	Rank	Index	Rank
Ant	0.38	1	0.22	2	0.25	1
Birds	0.06	5	0.04	7	0.11	3
Hive beetles	0.08	4	0.10	3	0.09	5
Honey badger	0.12	3	0.06	6	0.21	2
Lizard	0.04	6	0.09	4	0.05	6
Spider	0.23	2	0.40	1	0.10	4
Wax moth	0.08	4	0.08	5	0.10	4
Monkey	0.01	7	0.01	8	0.09	5

Challenge of Beekeeping Development

The major challenges of keeping honeybees in the study areas are indicated in Table 8. Honeybee pests and predators (28.9%) were the most important challenges of keeping honeybees for beekeepers. The survey result also shows indiscriminate utilization of agrochemicals huge problem in a honey bee colony. Moreover, in the study area lack of extension supports for an improved honey bee colony production system is one of the major challenges for beekeeping.

Table 8. Challenges of beekeeping in the study areas

Challenge	Beekeepers	
	N(Index)	Rank
Shortage of beekeeping materials	40(0.078)	5
Death of colony	3(0.005)	12
Drought	7(0.010)	10
Marketing	10(0.020)	9
Beekeeping skill	18(0.036)	8
Lack of credit facility	0(000)	14
Low-quality beekeeping materials	4(0.006)	11
High cost of beekeeping materials	28(0.038)	6
Disease, pest, and predators	97(0.289)	1
Shortage of bee forage	15(0.003)	13
Reduction of honey bee colonies	24(0.038)	7
Indiscriminate application of agro-chemicals	65(0.158)	2
Lack of extension support	67(0.147)	4
Absconding and migration of colony	74(0.149)	3

N: Number of respondent

Conclusion

Even if the major beekeeping system is traditional forest beekeeping in the region the sectors still play a vital role by creating a variety of assets for the beekeepers in the study areas. However, households have not sufficiently benefited from the beekeeping industry. Traditional forest beekeeping found in the study area is highly practiced and huge colony losses during the time of honey harvesting time and quantity of honey. The study further shows still the regional beekeepers practice traditional forms of hive and honey collecting by the destruction of the entire colony when the honey was harvested. The participation of youth and women in beekeeping activities is also at a very low level. Majorly, honey bee race aggressiveness and poor awareness about improved beekeeping practices lead the beekeepers to work in the forest area. In the area of pests and predators ants are the major challenge for beekeepers. Generally, pests and predators, indiscriminate application of agrochemicals, absconding and migration of colonies, and lack of extension support are the major constraints that undermine the beekeeping practice in the study area. Further activities must be done by a Research Centre on reducing honey bee race aggressiveness behavior. Moreover, emphasis must be given to women and youth to participate in beekeeping activities and create job opportunities. Finally, in the region strengthening the extension system on improved beekeeping practice system is the major one especially to save the colony from distraction at the time of honey harvesting time.

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Ethical Statement

The ethical statement does not apply to this study and does not involve any animal that requires approval from the ethical committee

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Author Contributions

The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

Statements and Declarations

The authors declare that they have no known competing interests or personal relationships that could have appeared to influence the work reported in this paper.

Conflicts of Interest

The authors have declared that no competing interests exist.

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