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Health, Socio- Technical, and Economic Constraints of Beekeeping in Bamboutos, Western Highlands of Cameroon

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Abstract: ***Beekeeping is important as a source of food, employment, and rural poverty alleviation. Honeybees are also important as the main pollinator of agricultural and forestry crops. However, there is a decrease in honeybee population worldwide, hence the objective of this study who was to investigate some of the challenges of beekeeping in Cameroon. Thus, a total of 56 beekeepers were investigated in Bamboutos in western Cameroon, using a questionnaire. Pests, predators and diseases were diagnosed retrospectively using a plate which was shown to beekeepers during the questionnaire administration. Signs of diseases reported by beekeepers included diarrhea (17.9%), chalkbrood (28.6 %), black bee (50%), and deformed wings (3.6%). The only parasite reported was Varroa (3.6%). Common insect pests were wax moth (87.5%), small hive beetle (Aethina tumida) (91.1%), large African hive beetle (Oplostomus fuligineus) (39.3%) and African death's-head hawkmoth (Acherontia atropos) (51.8%). Other pests noticed by beekeepers were ants (96.4%), spiders (78.4%), lizards (69.6%), wasps (66.1%), termites (64.3%), squirrels (60.7%), flies (8.9%), snakes (5.4%), and cockroaches (5.4%). The socioeconomic constraints cited were: lack of funding (87.5%), robbery and vandalism (71.4%), shortage of apiarian lands (60.7%), and proliferation of adulterated honey (48. 2%). The technical challenges were: presence of pests, predators and diseases (100%), lack of technical knowledge (41.1%), pesticides issues (26.8%), and low hive stocking rate (12.5%). The environmental challenges encountered were: strong winds (60.7%), bush fires (64.3 %), and remoteness of apiaries (44.6%). Problems encountered by beekeepers can be addressed through collective efforts from governmental authorities, NGOs and beekeepers.***

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Keywords: Apiculture, Bee Diseases, Beekeeping Challenges, Bee Pests, Honeybee.

1. INTRODUCTION

Beekeeping is one of the oldest agricultural practice worldwide and especially in Africa (Tchoumboue et al., 2001). Unlike the predominant conventional livestock keeping (pig keeping, fowl keeping, ruminant keeping, and fish culture), beekeeping requires little financial inputs while providing products with highly nutritive and commercial value (Kajobe et al., 2016). For this reason, beekeeping is known to be helpful and accessible to vulnerable populations, providing them incomes and food supply. Another important service honeybees render to mankind is pollination of agricultural and forestry crops (Muli et al., 2014).
The top five countries honey producers are China (457,203 tons), Turkey (114,113 tons), Argentina (79,468), Iran (77,567), and Ukraine (71, 279) (AtlasBig, 2020). According to FAO (2020), the whole Africa continent yield of honey and wax in 2020 was 150,911 tons and 16,186 tons respectively, which is equal to 8.52% and 26.05% of the world production (1, 770 and 62,116 tons respectively). The top 5 countries honey producers in 2020 in Africa in increasing order are Ethiopia (50,000 tons), Tanzania (130,584 tons), Angola (23,411 tons), Kenya (20,525 tons), and Central African Republic (CAR) (16,200 tons). Cameroon ranks 10th with only 4500 tons of honey produced (AtlasBig, 2020), and the Cameroon honey production had been estimated to be about 2% of the Africa production (Founadoudou, 2007). Given that Cameroon is known as Africa in miniature having the same climatic and environmental conditions as the greatest countries honey producers in Africa (Central African Republic, Angola, Kenya…), Cameroon is expected to be among the first African countries honey producers and to produce a very high amount of hive products. Several hindrances limiting the production level of hive products in Cameroon have been reported in several instances. According to Minepia (2011), poor technical knowledge and high cost of apiculture equipment were the main reasons for the low production observed. Pests and predators, diseases, poor harvesting techniques, drought, use of fertilizers and pesticides by farmers in controlling crop pests, and poor hives handling have been documented as the cause of either empty hives, absconding, brood destruction or decrease in colony size (Njukang et al., 2021) which led to low production of honey and other hive products. Low honey production has also been attributed to forest degradation which led to decreasing availability of melliferous species such as Prunus Africana (Ingram et al., 2020).
While the Adamawa and Centre regions of Cameroon appeared as the highest honey producers regions with 2018. 9 and 3682.1 tons respectively in 2021, the production of none of the remaining eight regions never reached 1125 tons that same year (INS, 2021).
Thus, the very low amount of honey produced by Cameroon is a cause of concern. Hence the objective of this study which was to determine the health, technical and economic challenges jeopardizing the expansion of beekeeping in the western highlands of Cameroon.

2. RELATED WORKS

Kajobe et al. (2016) in Uganda reported some health impediments to beekeeping including honeybee pests and predators. The important pests causing economic losses they recorded

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were black ants, small hive beetles, wax moths and bee hornets. In Ethiopia, constraints to beekeeping have been extensively documented and include: low quality products, unpleasant behaviors of bees (aggressiveness, swarming tendency, and absconding behaviors), lack of skilled manpower and training institutions, low level of technology used, high price of improved beekeeping technologies, lack of initial capital, drought and deforestation of natural vegetation, misuse of agro-chemicals, shortage of bee colonies, shortage of modern bee hives, honeybee diseases, pests and predators, poor extension services, poor society awareness, absence of coordination between research, extension and farmers, lack of policy application in apiculture, lack of enough space, lack of bee-keeping equipment (like modern beehives, wax molds, honey extractors, queen excluders) and accessories, shortage of records and up-to-date information, lack of information on pests and predators of honeybees, lack of training on beekeeping technology and inadequate research institutions to address the problems (Berhe et al., 2016, Mekonnen et al., 2018; Shanku and Ijara, 2024). In Rwanda, the reported challenges and limitations of beekeeping included lack of education, gender bias, pests and diseases, absconding and swarming of bees, and lack of modern apicultural equipment (Mushonga et al., 2019). Hindrances, challenges, and limitation have been recorded in other countries outside Africa. In Nepal for instance, the high demand for local honey, the distance to the market, the scarcity of bee colonies, disease outbreaks were documented as the most frequent challenges in managing honey bee practices (Nepali et al., 2023). In Malaysia, poor society awareness, pests, predators and diseases, lack of training of beekeepers and extension workers in business and beekeeping related activities were documented as the main challenges to beekeeping (Gratzer et al., 2019).

In Cameroon, technical constrains faced by beekeepers previously reported included lack of training and colony absconding in Adamawa grasslands in Cameroon (Meutchieye et al., 2018), and lack of adequate information for managing the pests. Vandalism towards hives, bush fires, lack of funding, pests and diseases among others were also reported as constraints for sustainable beekeeping in the West region of Cameroon (Fotso et al., 2014). Two decades ago, Tchoumboue et al. (2001) reported that lack of training, bee's enemies and theft were the main constraints to beekeeping in the western highlands of Cameroon. A recent study (Njukang et al., 2021) documented some constraints some of which were climate change and deforestation, poor hive management practices, pests and predators, poor market system, absconding, application of toxic agro-chemicals, poor hive management, poor harvesting techniques, and existence of poisonous flowering plants.

3. MATERIAL AND METHODS

3.1. Study Area and Period

The study was carried out from March to May 2022 in Bamboutos Division (5° 37' 34'' N and 10°15'17''E, mean altitude=1376 m) in the West region of Cameroon (**Fig. 1**). Subdivisions within Bamboutos includes Mbouda, Batcham, Galim and Babadjou. Bamboutos is characterized by a long rainy season running from mid-March to mid-November but interrupted by short drought periods between June and July; the dry season stretches from mid-November to mid-March with frequent annual variations due to climatic disturbance. The mean annual rainfall is 1972 mm, with December being the driest month

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(mean rainfall=6mm) and September the most humid (mean rainfall= 288 mm); the mean temperature in Bamboutos is 21.8 °C, with February remaining the hottest month (mean temperature = 24.4 °C), and August the coldest month (mean temperature 19.6 °C) of the year (Climate-data, 2020).

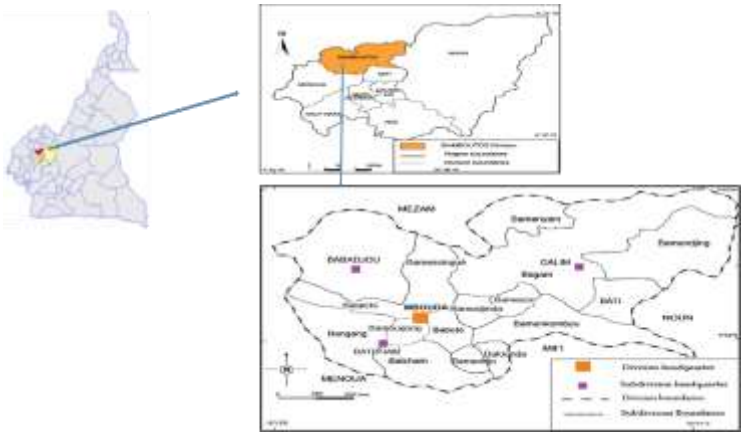

Fig 1 Map of Bamboutos Division Showing the Sampling Locations

3.2. Study Population and Sampling

The study population consisted of beekeepers with a least one year experience in beekeeping. The sampling was done using the snowball sampling technique (Goodman, 1961) whereby previously located beekeepers helped to locate the next one until no new beekeeper could be found. The first beekeepers were found using the list of beekeepers of the Bamboutos Division as established by Fotso (2015). The aim of the study was explained to beekeepers then, consent to participate was given orally. Volunteer beekeepers were then submitted to the study questionnaire. Questions were asked about the constraints of beekeeping in their area.

3.3. Health Challenges

Pests, predators and diseases were diagnosed retrospectively using a mounted plate which was shown to beekeeper during the questionnaire administration. Beekeepers were asked to identify from the plate the picture of pests, predators or clinical signs of a disease they ever noticed in their apiary. The plate was used as a memory guide. Before collecting the data, beekeepers were first capacitated to identify the pests, predators and clinical signs of diseases using the plate and photographs. They were also asked to provide in local language or in French the name of any pest, predator or clinical sign of the disease they ever saw but which was not showed them.

3.4. Statistical Analysis

The Chi squared test was used to assess any association between the sampled subdivisions and different parameters. The significance level was set at $p \leq 0.05$.

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4. RESULTS AND DISCUSSION

4.1. Health Constraints

A total of 56 beekeepers were investigated. Health challenges were due to diseases, parasites and pests. Signs of diseases reported by beekeepers included diarrhea (17.9%), chalkbrood (28.6 %), black bee (50%), and deformed wings (3.6%) (Table 1).

Table 1. Disease Constraints Met by Apiarists in Bamboutos, Western Highlands of Cameroon

Clinical signs of honeybee diseases	**Subdivision**				**Total (N = 56)**	**p value**
	Babadjou (N = 20)	Batcham (N = 10)	Galim (N = 6)	Mbouda (N = 20)		
	% (n)	% (n)	% (n)	% (n)	% (n)	
Diarrhea						
Yes	8.9 (5)	5.4 (3)	1.8 (1)	1.8 (1)	17.9 (10)	0.266
No	26.8 (15)	12.5 (7)	8.9 (5)	33.9 (19)	82.1 (46)	
Chalkbrood						
Yes	143 (8)	5.4 (3)	1.8 (1)	7.1 (4)	28.6 (16)	0.489
No	214 (12)	12.5 (7)	8.9 (5)	28.6 (16)	71.4 (40)	
Black bee						
Yes	19.6 (11)	8.9 (5)	7.1 (4)	14.3 (8)	50.0 (28)	0.644
No	16.1 (9)	8.9 (5)	3.6 (2)	21.4 (12)	50.0 (28)	
Deformed winds						
Yes	0.0 (0)	1.8 (1)	0.0 (0)	1.8 (1)	3.6 (2)	0.516
No	35.7 (20)	16.1 (9)	10.7 (6)	33.9 (19)	96.4 (54)	

(N): Number of interviewed apiarists; n= number of interviewed apiarists per category; %: Percentage of interviewed apiarists per category.

The only parasite reported was Varroa (3.6%). The pests affecting the brood and encountered by beekeepers were wax moth (87.5%), small hive beetle (Aethina tumida) (91.1%), large African hive beetle (Oplostomus fuligineus) (39.3%) and African death's-head hawkmoth (Acherontia atropos) (51.8%). Other pests causing troubles in and outside the hive were ants (96.4%); spiders (78.4%); lizards (69.6%); wasps (66.1%); termites (64.3%); squirrels (60.7%); flies (8.9%); snakes (5.4%); cockroaches (5.4%) (**Table 2**).

Table 2. Pest and Predator Constraints Met by Apiarists in Bamboutos, Western Highlands of Cameroon

Bee pests and predators	**Subdivisions**				**Total (N = 56)**	**p value**
	Babadjou (N = 20)	Batcham (N = 10)	Galim (N = 6)	Mbouda (N = 20)		
	% (n)	% (n)	% (n)	% (n)	% (n)	
Ants						
Yes	35.7 (20)	17.9 (10)	10.7 (6)	32.1 (18)	96.4 (20)	0.292
No	0.0 (0)	0.0 (0)	0.0 (0)	3.6 (2)	3.6 (2)	

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Termites Yes No	25.0 (14) 10.7 (0)	12.5 (7) 5.4 (3)	5.4 (3) 5.4 (3)	21.4 (12) 14.3 (8)	64.3 (36) 35.7 (20)	0.772
Wasp Yes No	23.2 (13) 12.5 (7)	10.7 (6) 7.1 (4)	8.9 (5) 1.8 (1)	23.2 (13) 12.5 (7)	66.1 (37) 33.9 (19)	0.805
Squirrel Yes No	23.2 (13) 12.5 (7)	8.9 (5) 8.9 (5)	7.1 (4) 3.6 (2)	21.4 (12) 14.3 (8)	60.7 (34) 39.3 (22)	0.866
Lizard Yes No	28.6 (16) 7.1 (4)	14.3 (8) 3.6 (2)	7.1 (4) 3.6 (2)	19.6 (11) 16.1 (9)	69.6 (39) 30.4 (17)	0.311
Snake Yes No	1.8 (1) 33.9 (19)	0.0 (0) 17.9 (10)	0.0 (0) 10.7 (6)	3.6 (2) 32.1 (18)	5.4 (3) 94.6 (53)	0.623
Spider Yes No	28.6 (16) 7.1 (4)	14.3 (8) 3.6 (2)	8.9 (5) 1.8 (1)	26.8 (15) 8.9 (5)	78.6 (44) 21.4 (12)	0.966
Cockroach Yes No	5.4 (3) 30.4 (17)	0.0 (0) 17.9 (10)	0.0 (0) 10.7 (6)	0.0 (0) 35.7 (20)	5.4 (3) 94.6 (53)	0.127
Wax moth Yes No	32.1 (18) 3.6 (2)	14.3 (8) 3.6 (2)	10.7 (6) 0.0 (0)	30.4 (17) 5.4 (3)	87.5 (49) 12.5 (7)	0.659
Small hive beetle Yes No	32.1 (18) 3.6 (2)	17.9 (10) 0.0 (0)	10.7 (6) 0.0 (0)	30.4 (17) 5.4 (3)	91.1 (56) 8.9 (5)	0.475
Large African hive beetle Yes No	16.1 (9) 19.6 (11)	3.6 (2) 14.3 (8)	3.6 (2) 7.1 (4)	16.1 (9) 19.6 (11)	39.3 (22) 60.7 (34)	0.533
African death's-head hawkmoth Yes No	14.3 (8) 21.4 (12)	10.7 (6) 7.1 (4)	7.1 (4) 3.6 (2)	19.6 (11) 16.1 (9)	51.8 (29) 48.2 (27)	0.573
Flies Yes No	1.8 (1) 33.9 (19)	5.4 (3) 12.5 (7)	0.0 (0) 10.7 (6)	1.8 (1) 33.9 (19)	8.9 (5) 91.1 (51)	0.078
Varroa Yes No	0.0 (0) 35.7 (20)	0.0 (0) 17.9 (10)	1.8 (1) 8.9 (5)	1.8 (1) 33.9 (19)	3.6 (2) 96.4 (54)	0.123

(N): Number of interviewed apiarists; n= number of interviewed apiarists per category; %: Percentage of interviewed apiarists per category

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4.2. Socioeconomic and Technical Constraints

Socioeconomic constraints to sustainable apiculture mostly noticed by beekeepers were: lack of funding (87.5%), robbery and vandalism (71.4%), and shortage of apiarian lands (60.7%). A considerable proportion of apiarists (48. 2%) reported that proliferation of adulterated honey was an obstacle through its modulation effect on market price.

Concerning technical challenges, the following were mentioned: presence of pests, predators and diseases (100%), lack of technical knowledge (41.1%) in some aspects of apiculture and product processing, pesticides issues (26.8%), low hive stocking rate (12.5%). Environmental challenges reported were: strong winds (60.7%), bush fire (64.3 %), and remoteness of apiaries (44.6%). Enclosed roads were also accounted as a challenge by some beekeepers (28. 6%), and the number of beekeepers complaining for enclosed roads was significantly higher in Babajou Subdivision compared with other Subdivisions of Bamboutos Division (Table 3).

Table 3. Sociotechnical and Economical Constraints Met by Apiarists in Bamboutos, Western Highlands of Cameroon

Contraints	**Subdivisions**				**Total (N = 56)**	**p-value**
	Babadjou (N = 20)	Batcham (N = 10)	Galim (N = 6)	Mbouda (N = 20)		
	% (n)	% (n)	% (n)	% (n)	% (n)	
Socio-economic						
Lack of funding						
Yes	33.9 (19)	16.1 (9)	10.7	26.8	87.5 (49)	0.187
No	1.8 (1)	1.8 (1)	(6)	(15)	12.5 (7)	
Market instability			0.0 (0)	8.9 (5)		
Yes	5.4 (3)	5.4 (3)			16.1 (9)	0.454
No	30.4 (17)	12.5 (7)	0.0 (0)	5.4 (3)	83.9 (47)	
Shortage of apiarian land			10.7	30.4		
Yes	19.6 (11)	12.5 (7)	(6)	(17)	60.7 (34)	0866
No	16.1 (9)	5.4 (3)			39.3 (22)	
Apiarian equipment			7.1 (4)	21.4		
costly	143 (8)	10.7 (6)	3.6 (2)	(12)	44.6 (25)	0.383
Yes	21.4 (12)	7.1 (4)		14.3 (8)	55.4 (31)	
No			7.1 (4)			
Processing equipment			3.6 (2)	12.5 (7)		
costly	2.5 (7)	8.9 (5)		23.2	393 (22)	0,782
Yes	23.2 (13)	8.9 (5)		(13)	607 (34)	
No			5.4 (3)			
Robbery and vandalism	26.8 (15)	10.7 (6)	5.4 (3)		71.4 (40)	0.753
Yes	8.9 (5)	7.1 (4)		12.5 (7)	28.6 (16)	
No			8.9 (5)	23.2		
Proliferation of			1.8 (1)	(13)		
adulterated honey	214 (12)	107 (6)			482 (27)	0308
Yes	143 (8)	71 (4)		25.0	518 (29)	
No			36 (2)	(14)		

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Techniques			71 (4)	10.7 (6)		
Lack of technical knowledge	8.9 (5)	8.9 (5)			41.1 (23)	0.239
Yes	26.8 (15)	8.9 (5)		125 (7)	58.9 (33)	
No			3.6 (2)	232 (13)		
Low hive stocking rate	3.6 (2)	5.4 (3)	7.1 (4)		12.5 (7)	0.257
Yes	3.6 (2)	12.5 (7)			87.5 (49)	
No			1.8 (1)			
Pesticides issues	10.7 (6)	54 (3)	8.9 (5)	196 (11)	268 (15)	0.859
Yes	25.0 (14)	125 (7)		16.1 (1)	732 (41)	
No			36 (2)			
Diseases and pests	35.7 (20)	17.9	71 (4)	1.8 (1)	100.0	1.000
Yes	0.0 (0)	(10)		33.9	(56)	
No		0.0 (0)	10.7	(19)	0.00	
Strong winds	26.8 (15)		(6)			0.275
Yes	8.9 (5)	7.1 (4)	0.0 (0)	71 (4)	60.7 (34)	
No		10.7 (6)		286 (16)	39.3 (22)	
Heavy precipitations and atmospherique humidity	23.2 (13)		7.1 (4) 3.6 (2)	35.7		0.866
Yes	12.5 (7)	8.9 (5)		(20)	60.7 (34)	
No		8.9 (5)		0.0 (0)	39.3 (22)	
Bush fire	26.8 (15)		7.1 (4)			0.072
Yes	8.9 (5)	8.9 (5)	3.6 (2)	19.6	64.3 (36)	
No		8.9 (5)		(11)	35.7 (20)	
Apiary very far	16.1 (9)		10.7	16.1 (9)		0.696
Yes	19.6 (11)	7.1 (4)	(6)		44.6 (25)	
No		10.7 (6)	0.0 (0)		55.4 (31)	
Enclosed roads	17.9 (10)			21.4		0.019*
Yes	17.9 (10)	1.8 (1)	7.1 (4)	(12)	26.8 (15)	
No		16.1 (9)	3.6 (2)	14.3 (8)	73.2 (41)	
			3.6 (2)	17.9		
			7.1 (4)	(10)		
				17.9		
				(10)		
				14.3 (8)		
				21.4		
				(12)		
				3.6 (2)		
				32.1		
				(18)		

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(N): Number of interviewed apiarists; n= number of interviewed apiarists per category; %: Percentage of interviewed apiarists per category; *: significant p value.

The health challenges reported by beekeepers had to do with pests, parasites and diseases. At least 50% of beekeepers reported to have noticed the occurrence in their hive of the small hive beetle (91.1%), wax moth (87.5%) and African death's-head hawkmoth (51.8%) while only 39.3% mentioned the presence of large African hive beetle. These are large insects which are easily identified with naked eyes and may explain why the large number of beekeepers were able to identify them. Some of these pests have been documented in Cameroon. Indeed Aethina tumida, Oplostomus fuligineus, Acherontia atropos, the Greater Wax moth (Galleria mellonella), and the Lesser Wax moth (Achroia grisella) were found across four agroecological zones of Cameroon, comprising the west region of Cameroon (Cham, 2017; Oldroyd and Allsopp 2017). Galleria mellonella seems to be the most important wax moth pest in apiculture in the West region of Cameroon as it has been found infesting hives in the Menoua Division where half or three quarters of the surface of infested hives were found to be invaded by this pest (Ouaba et al, 2015). This is unfortunate since the greater wax moth is known to cause more destruction than the lesser wax moth (Ellis and Graham, 2013; Vidal-Naquet, 2015). The higher number of beekeepers reporting these pests in their apiaries suggest that these pests are widespread and should be diligently looked after to slow down the drop in honey bee population.

Similarly the retrospective prevalence of ants (96.4%), spiders (78.4%), lizards (69.6%), wasps (66.1%), termites (64.3%), and squirrels (60.7%) was high, suggesting that these pests are common in bee hives in the region. Cham (2017) documented the occurrence in Cameroon of 8 ant species infesting honeybee colonies.

The damage caused by them in beekeeping are well known. The Greater Wax moth larvae feed on wax, on deposits of pollen, and cause galleriaisis which is a condition in which the newly developed adult bees will become trapped by the silken threads on eclosure and be unable to emerge (Ellis et al., 2013). African death's-head hawkmoth only consume honey/nectar and do not cause any obvious damage in the colony (Swart et al., 2001). Wasps attack the guard bees and rob honey and nectar from the hives. Depending on the species of ant present they may eat dead bees and brood, eat nectar and honey stores, and make nests within hives and stored equipment while large hive beetles cause significant damage to a hive by consuming the brood and destroying the comb (Kyle, 2021). Adults and larvae small hive beetle feed on honey, pollen and bee brood during which the wax comb is destroyed and honey gets fermented, likely due to the presence of particular yeasts associated with small hive beetles (Ellis and Ellis, 2010). Squirrels can do considerable damage to hive body, making bees more reluctant to use, as observed on the field. Presence of flies and snakes were less cited as constraints (8.9% and 5.4 % respectively) but there are several predatory flies that eat bees (Kyle, 2021). Without a knowledge of the identity of the observed flies by beekeepers, it is difficult to discuss their importance on beekeeping in the study area. However, the phorid fly Megaselia scalaris has been described in the North West region of Cameroon (Cham, 2017). Snakes are not known as hive or bee pest but their presence around

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the hive is probably associated with the search of mice looking for a save corner to make a nest. The presence of a snake inside traditional hives may cause the bee colony to abscond. Termites were cited as a challenge by 64.3% of beekeepers probably because of the damage they cause on wooden hives, given that termites feed upon and live in wood. Spiders and cockroaches have been reported to have little to no impact on the health or productivity of the colony and consequently, do not cause economically significant damage (Kyle, 2021). The continued presence and disturbance of these pests can cause colonies to abscond. The very devastating Varroa sp. was cited by a few beekeeper (3.6%). Because of their small size (1.5–2 mm wide, and only 1–1.8mm long) (Peck, 2021) the infestation may be unnoticed in case of low infestation. In addition, V. destructor has already been documented across four regions of Cameroon including North West, South West, Adamaoua and East (Cham, 2017). V. destructor is the vector of DWV, so the presence of bees with deformed wings is suggestive of the fact that both varroasis and deformed wing disease are underestimated.

Diarrhea was noticed by 17.9% of beekeepers. It could be due either to Nosema apis infection (Mumoki et al., 2014) or stress, induced by weather conditions in temperate regions (Hummel and Feltin, 2014). Nosema disease has not yet been documented in Cameroon but Nosema spores were found in bee colonies in Nigeria, a neighboring country (Akinwande et al., 2013). Chalkbrood and black bee diseases were cited by 28.6 % and 50% of beekeepers respectively. While chalkbrood has been reported in Nigeria (Akinwande et al., 2013), black bee disease due to chronic bee paralysis virus (CBPV) has been documented in Uganda (Otim et al., 2019). Given the higher number of beekeepers reporting black disease, further studies to confirm the identity of CBPV are required.

Most of the sociotechnical and economical constraints cited by beekepers in the western highlands of Cameroon are the same as those reported in Adamaoua region of Cameroon. The common challenges are lack of funding, robbery, pests; diseases, and vandalism (Tchoumboue et al., 2001; Founadoudou, 2007; Meutchieye, 2018). Thus, these constraints appear to be widespread all over Cameroon and deserve the full attention of the ruling authorities. Action against robbery and vandalism which concern 71.4% of beekeepers in the western area of Cameroon, can easily be taken through strict regulations. All beekeepers complained for pests and predators, showing that these challenges should be looked into for a better solution. In this respect, conventional and ethnoveterinary solutions would certainly be appreciated. Meutchieye et al. (2018) reported that beekeepers in the Adamawa region of Cameroon were helpless towards diseases and pests. Bush fires and strong winds have already been documented as a treat to beekeeping in Cameroon (Ingram et al., 2020), as well as lack of technical knowledge (Njukang et al., 2021). Low hive stocking rate and storms issues can be addressed by planting melliferous tree species to both slow down the wind speed and provide food (pollen and nectar) for the bees. Forest lands must be preserved not only for the environment sake, but for the sake of honeybee too. Establishing apiaries in forests instead of agricultural lands will keep the bees from pesticides. At the same time, given that bush fire is very often of human origin, the villagers (hunters, herders, farmers) around the forest should first be sensitized on the damaging effects of bush fire, and then strict regulations against those using fire in the forest must follow.

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5. CONCLUSION

The challenges faced by beekeepers in the western highlands of Cameroon are many, and are similar to the same challenges encountered in other apiarian areas of Cameroon. These threats to beekeeping which are mostly of human and environmental origin can be addressed through training, strict regulations and strong action from NGOs and the governmental authorities.

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6. REFERENCES

1. Akinwande KL, Badejo MA, Ogbogu, SS, 2013. Challenges associated with the honey bee (Apis mellifera adansonii) colonies establishment in south western Nigeria. African Journal of Food, Agriculture, Nutrition and Development, 3: 7467-7484
2. AtlasBig, 2020. Production mondiale de miel par pays. Available from https://www .atlasbig .com/fr-lu/pays-par-production-de-miel (accessed 27 April 2023).
3. Berhe A, Asale A, Yewhalaw D. 2016. Community perception on beekeeping practices, management, and constraints in Termaber and Basona werena districts, central Ethiopia. Advances in Agriculture, Article ID 4106043.
4. Cham, D. T., 2017. Diversity of honey bee Apis Mellifera subspecies (Hymenoptera: Apidae) and their associated arthropod pests in Cameroon. Doctoral thesis, University of Nairobi.
5. Climate-data, 2020. Available from https://en.climate-data.org/africa/cameroon/west /mbouda-894667/ (accessed 8 may 2023).
6. Ellis JD, Ellis A, 2010. Featured Creatures: small hive beetle. https://entnemdept.ufl.edu/creatures/misc/bees/small_hive_beetle.htm (accessed 27 April 2023).
7. Ellis JD, Graham JR, Mortensen A., 2013. Standard methods for wax moth research, Journal of Apicultural Research. 52: 1-17. DOI: 10.3896/IBRA.1.52.1.10
8. Food and Agriculture Organization. FAOSTAT, 2020. Available from https://www.fao.org/faostat/fr/#data (accessed 27 April 2023).
9. Fotso KPR., 2015. Caractéristiques socio-économiques et techniques de l'Apiculture dans les départements de Bamboutos, Mifi et Menoua (Région de l'Ouest-Cameroun). Master thesis, University of Dschang.
10. Founadoudou. 2007. Caractéristiques socio-économiques et techniques de l'Apiculture de la zone Soudano-Guinéenne de l'Adamaoua (Cameroun). Master thesis. University of Dschang.
11. Goodman, LA, 1961. Snowball sampling. Ann. Math. Stat. 1961; 32: 148–170. https://doi.org/10.1214/aoms/1177705148.
12. Gratzer K, Susilo F, Purnomo D, Fiedler S, Brodschneider R(2019) Challenges for Beekeeping in Indonesia with Autochthonous and Introduced Bees, Bee World, 96:2, 40-44, DOI: 10.1080/0005772X.2019.1571211

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13. Hummel, R. Feltin, M. 2014. Reconnaître les maladies des abeilles quand on est apiculteur débutant. Syndicat des apiculteurs de Thann et environs
14. Ingram V, Hansen ME, Bosselmann AS., 2020. To Labelor Not? Governing the Costs and Benefits of Geographic Indication of an African Forest Honey Value Chain. Frontiers in Forests and Global Change. 3: 102. DOI: 10.3389/ffgc. 2020.00102.
15. INS. 2021. Annuaire Statistique du Cameroun Édition 2021, Yaoundé: Institute National de la Statistique.
16. Kajobe R, Kato E K, Otim S A, Kasangaki P, Abila P P., 2016. The status of honeybee pests in Uganda. Bulletin of Animal Health and Production in Africa, 64: 105 – 117
17. Kyle B., 2021. Honey Bee Parasites and Pests. In Kane TR, Faux CM, Editors. Honey Bee Medicine for the Veterinary Practitioner. Hoboken, USA: Wiley-Blackwell
18. Mekonnen E, Jenberie A, Mekuriaw Y, Ebiro A. 2018. The Challenges and Opportunities of Honey Production Systems in Ada Berga District, West Shoa Zone, Oromia, Ethiopia. Food Science and Quality Management. ISSN 2224-6088, Vol.77.
19. Meutchieye F, Ngamadjeu, DD, Tchoumboue, J, 2018. Beekeeping features in the Cameroon Adamawa grasslands. Genetics and Biodiversity Journal. 2: 11-16.
20. Muli E, Patch H, Frazier M, Frazier J, Torto B, Baumgarten T, Kilonzo J, Kimani JN, Mumoki F, Masiga D, Tumlinson J, Grozinger C., 2014. Evaluation of the Distribution and Impacts of Parasites, Pathogens, and Pesticides on Honey Bee (Apis mellifera) Populations in East Africa. PLoS ONE. 9: e94459. doi:10.1371/journal.pone.0094459.
21. Mumoki FN, Fombong A, Muli E, Muigai, AWT, Masiga, D., 2014. An inventory of documented diseases of African honeybees. African Entomology, 22: 473–487.
22. Nepali PB, Saru A, Chokhal K and Rana HB. 2023. Study on Management Practice and Challenges on Beekeeping in Bagnaskali, Palpa, Nepal. Prāgyik Prabāha 11(1): 93-101
23. Njukang AP, Kim D, Kang EJ, Park HG, Choi YS, 2021. Status of Honey Bee (Apis mellifera L.) Industry in Cameroon: A Review Article. Journal of Apiculture. 36: 1-10. DOI: 10.17519/apiculture.2021.04.36.1.1
24. Oldroyd BP, Allsopp MH., 2017. Risk assessment for large African hive beetles (Oplostomus spp.) – a review Apidologie. 2017; 48: 495–503. https://doi.org/10.1007/s 13592-017-0493-7
25. Otim AS, Kajobe R, P'Odyek Abila P, Kasangaki P, Echodu R, 2019. Viruses Circulating in African Honey Bees in Uganda, Bee World.; DOI:10.1080/0005772X.2019.1698103 https://doi.org/10.1080/0005772X.2019.1698103
26. Ouaba J, Tchuinkam T, Waïmane A, Magara HJO, Niassy S, Meutchieye F., 2022. Lepidopterans of economic importance in Cameroon: A systematic review. Journal of Agriculture and Food Research. 8: 100286. https://doi.org/10.1016/j.jafr.2022.100286
27. Peck, DT., 2021. The Parasitic Mite Varroa destructor: History, Biology, Monitoring, and Management. In Kane TR, Faux CM, Editors. Honey Bee Medicine for the Veterinary Practitioner. Hoboken, USA: Wiley-Blackwell
28. Shanku E and Ijara E (2024). Current Status and Challenges of Improved Bee Keeping Technology Adoption in Ethiopia: A Review. Cross Current International Journal of Agriculture and Veterinary Sciences, 6(2), 23-30.

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29. Swart JD, Johannsmeier, MF, TribeGD, Kryger, P., 2001. Diseases and pests of honeybees. In Johannsmeier, M F (ed.) Beekeeping in South Africa. Plant Protection Research Institute Handbook No. 14, Agricultural Research Council of South Africa; Pretoria, South Africa (3rd edition, revised) pp. 198–222
30. Tchoumboue J, Tchouamo IR, Pinta JY, Njia MN. 2001. Caractéristiques socio-économiques et techniques de l'apiculture dans les hautes terres de l'ouest du Cameroun. Tropicultura. 2001; 19: 141-146.
31. Vidal-Naquet, N. 2015. Honeybee Veterinary Medicine: Apis mellifera L. Sheffield, UK: 5m Publishing