

Socio-Economic Characteristics and Techniques of the Bee-Keeping in the Area of Goundi (Chad)

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Abstract

The study is related to the socio-economic and technical characteristics of 101 keepers into 28 villages around Goundi suprefecture of Chad. It was carried out by investigation using a semi-structured questionnaire, direct interviews, and observations, from July to September 2016. The results show that the bee-keeping is practised primarily by the men (99%) 43.2 years old. More half (53.5%) of the bee-keepers are Christians. They are the majority married (94.1%) with 1.53 ± 1.05 women and had 7.59 ± 6.140 children. More than 52% of the bee-keepers are educated in primary school. Agriculture and breeding are the main activities of the bee-keepers. The average duration in the activity is of 13.18 ± 10 , 18 years and varies between 2 and 54 years. The aim of the breeding is for sale and subsistence farming (100%). The colonies of bees are high in an extensive way. They belong to the *Apis* species *Mellifera adansonii* (yellow bee). The bee-keepers are using the traditional hives with little capacity (6.13 liters) of which the number varies from 1 to 304 hives, with an average of 17 hives per bee-keeper. Honey is the principal collected product. The average quantity of collected honey varies from 3 to 22 liters per colony. The annual production out of honey is on average 862.72 ± 1859.26 liters per bee-keeper. The average selling price of honey is 1676, 57 FCFA the liter. The annual average income gross by bee-keeper is of 834, 930 FCFA. The production of honey increases absolutely by the change of the practices of production through the framing, the training and to assist the bee-keepers.

Keywords: Bee-keeping; Characteristic-Socio-economic - Techniques; Goundi; Chad

Introduction

In sub-Saharan Africa, the products of the bee-keeping in particular honey, the wax and the propolis, play a significant role in the economy of the households and contribute to food safety [1]. The bees *Melliferes* play a role in the balance of the agricultural ecosystems and the maintenance of the vegetable biodiversity [2]. These pollinating insects, take part significantly in the improvement of the production and the productivity of the cultures [3,4].

In the majority of the Sub-Saharan countries of Africa, the bee-keeping is practised mainly in an extensive way. These countries, the majority of the bee-keepers exploit indigenous species of very low genetic potential. In spite of the richness of a *Flora Mellifere* extremely varied, the African bees produce only relatively small quantities of honey.

In Chad, the bee-keeping is localised primarily in the areas of Guerra, Salamat, the Moyen Chari and Mandoul. Unfortunately, a few studies were devoted to the bee-keeping in general and the practice production in particular.

The sub-prefecture of Goundi located to area of Mandoul was retained for the present study. This sub-prefecture is regarded as one of the great ecological zones of the country as regards production of honey. Indeed, the production of honey ensures food safety and gets considerable monetary incomes with the stockbreeders. The present study has like objective, to evaluate the socio-economic and technical characteristics of the bee-keeping of the zone of Goundi.

Materials and Methods

Study site

The choice of the area of study is justified by its significant potential of production of honey in Chad. It is regarded as the first apicole cattle-rearing area. Goundi is one of the three departments of the area of Eastern Mandoul and / is located at 58 km towards the North of the town of Koumra the population is estimated at 10 052 inhabitants (RGPH2 2009). Agriculture, the breeding (in particular bee-keeping), the craft industry and the trade constitute the principal activities of the population.

The annual average pluviometry of the area varies between 900 and 1300 mm annual. The vegetation consists of grown savanna mainly of type *Parkia biglobosa*, *Vitellaria paradoxa*, *Khaya senegalensis*, *Prosopis africana*, *Tamarindus indica*, *Isobertinia doka*, *Daniellia oliveri*, *Detarium microcarpum*, etc.

Sampling and data acquisition

The study proceeded between 12th July and 19th August 2016 at random investigation control to 28 villages chosen randomly into the 80 villages which account the area (either a rate of a survey of 35%).

On the whole, 101 bee-keepers were surveyed, using a questionnaire being used as guide of maintenance and compose of several parts carrying into the identification of the bee-keeper (name and first names, sex, matrimonial situation, a number of child, dependent, ethnics group, religion, level of schooling), the activities practised by the bee-keeper, the parameters of production, the practices of production, the control of the bees, the plants *Mellifères* used, the food practices, the exploitation of the products of hives, the performance of production, medical management as well as the constraints and the proposals for an improvement of the apicole breeding.

Data analysis

The collected data were seized in Excel and the various parameters were calculated using the software Statistical Package for the Social Science (SPSS, 2009). Collected information was synthesized expressed as a percentage and on average with standard deviations. Variables selected after a sorting flat were subjected to the variance analysis (ANOVA) with the test of multiple comparisons of Newman-Keuls. The threshold of significance retained on the differences in average was 5 %.

Results

Profile socio-economic of the bee-keepers

The bee-keepers were essentially old men on average of 43.21 ± 14.69 years with a minimum of 17 and one maximum 80 years. The average age of the men was significantly higher ($p < 0.05$) that of the women. The principal activity of the bee-keepers was agriculture and breeding. The totality of the stockbreeders practised the bee-keeping for the sale, subsistence farming, and the gift. The majority of the bee-keepers was married to 1.53 ± 1.05 wives and has 7.59 ± 6.14 children. And then, half has schooling of levels primary and secondary. Inquired was especially Christian or Muslim confession (Table 1). The average professional experiment in the activity was of 13.18 ± 10.18 years with a 2 years minimum and a 54 years maximum (Table 2).

Types of hives and practical of bee-keeping

The majority of the bee-keepers were used to the hollow tree trunk dead like hives (Table 3) among which, the majority of them were (82.2%) arranged these deadwoods to be useful itself as hive counters approximately 17% which bought the same type of hive to the markets (Figure 1).

Nearly 70.3% of hives were used to small and average format against 29.7% of large size. The choice of hives was dictated by the accessibility and the output (Table 3). Branches of fruit trees and roofs of boxes, as well as the drill shafts, were the principal sites of hives (Figure 1) (Table 3).

Control of the breeding

The beekeepers were exclusively by the head of the household. They are ensuring controls and follow-up of the bees once every two days.

Table 1: Socio-economic profile of the bee-keepers.

Parameters	States	Labour	P.100 (%)
Sex	Man	100	99
	Woman	1	1
Religion	Christian	54	53.5
	Muslim	45	44.6
	Animist	2	2
Level of Schooling	Primary	52	51.5
	Illiterate	37	36.6
	Secondary	11	10.9
	Academic	1	1
Matrimonial situation	Married	95	94.1
	Single	6	5.9
Principal activity	Agriculture/élevage	101	100
Objective of the breeding	Sale, subsistence farming, gift	101	100

Table 2: Parameters of production.

Parameters	Answers	Labour	P.100 (%)
The bees species of the area	3 species	63	63
	2 species	33	33
	4 species	4	4
Characteristics of species most exploited bees	Small	88	88
	Average	11	11
	smaller	1	1
Origin of the bees	Wild colonies	101	100
Identification of the bees	Form, aggressiveness	53	52.5
	Forme bee	36	35.6
	Color wing, wing	12	11.9
Selection criteria	Output	101	100
Method of acquisition of colony	Burn of wax in the hive	60	59.4
	Use of perfume	31	30.7
	Use of onion wild	7	6.9
	Hole of the trees and under ground	3	3

The renewal of colonies was practised by the majority of surveyed. It constituted the principal technique of maintenance of level of production at more half of the bee-keepers (Table 4).

Melliferous plants used

The flowers and nectars of natural plants in the area constituted the principal source of food of the bees. The most dominant plants were *Vitellaria paradoxa*, *Parkia biglobosa*, *Khaya senegalensis*, *Daniellia oliveri*, *Prosopis africana*, *Tamarindus indica*, *Detarium senegalense*, *Sorghum bicolor*, *Mangifera indica*, *Zea mays*, etc (Table 5).

Practical food

The nourishment of colony, certain bee-keepers distributed formulated food. The distributed food was exclusively from cereales, onion, bean or peas of ground. The majority of surveyed considered that the bees were demanding out of water and food. The food complements were practised by most of the bee-keepers (Table 6).



Figure 1: Various types of hives out of wooden used by the bee-keepers.

Table 3: Practical of the bee-keeping.

Parameters	Answers	Labour	P.100 (%)
Materials used for bee-keeping	Wood Trunk dug	99	98
	Hole of the trees and basement	2	2
Origin and nature of hive	Trunk arranged by Apiculture	83	82.2
	Order and purchase	17	16.9
	Hole of the trees and basement	1	1
Type of hive existing the most used	Small and Average	71	70.3
	Large	30	29.7
Selection criteria of Hive	Accessibility	51	50.5
	Output	31	30.7
	Resistance	19	18.8
Site of Hive	Orchard, roofs of box	75	74.3
	Forest	23	22.8
	Fields	2	2
	Hole	1	1
Selection criteria of the site of hive	To avoid the flight	74	73.3
	To avoid the aggressions of the bees	20	19.8
	Food availability	4	4
	Follow-up and control	3	3

Period, techniques, materials and product of harvests

For 46.5% of the producers, the optimum of production out of honey was located between May and March. For the unit, the head of the household was the principal person who ensured the harvest of the products of hives. For harvest, the bee-keepers used smoked to drive out the bees and the bucket like container (Table 7).

The principal product of the hive collected was essential the broken, dark or yellow honey of white colour (Figure 2).

The exploitation of product of the hive

Honey was exclusively the product of hives it's as much as sold. The head of household is the only one which decided sale of honey that the woman sold of markets of close villages. The period going from February to May was regarded as the most favorable moment of the honey flow, which was sold by Coro (Table 8).

Performance of production

The average number of the hive was 17.21 per bee-keeper for a capacity of 4 liters on average. Thus, the annual average production was 862.72 liters, with a frequency of approximately 17 days between two harvests. The annual average quantity of sold honey was 487 liters with a price of 1676, 57 FCFA, which ensured an average annual income moreover 834 930, 69 FCFA (Table 9).

Medical management

The majority of the bee-keepers affirmed to have noted the case of mortalities in their breedings. The principal causes of mortalities were the fire used at the time of harvest, the lack of water, the predation of the lizards and ants, the rains. The period of strong mortality was between March-April and July-August when the termites, the ants, the

lizards, the caterpillars, and the fall melliferous flowers would be the principal causes (Table 10).

The totality of the guardians declared a case of taking flight of the product hives by the unknown ones (95%), children of the village (3%), herdsmen (1%) like by the children of the bee-keeper (1%).

Table 4: Conduct of bees.

Parameters	Answers	Labour	P.100 (%)
Person in charge led	Head of household	101	100
Follow-up of the bees	Yes	100	99
	No	1	1
Method of Follow-up	Control each 2 days	61	60.4
	oversight	40	39.6
Nobody ensuring the follow-up	Head of Household	100	99
	Child	1	1
Renewal of colonies	Yes	75	75
	No	26	26
Causes of nonrenewal of colonies	Maintenance of the production	60	59.4
	Absence of causes	25	24.8
	Maintenance of the colony	16	15.8

Table 5: Melliferous plants are used a lot of by bees.

Numbers	Melliferous Plants	Quotations (a Number of times)	P.100 (%)
1	<i>Vitellaria paradoxa</i>	64	18.08
2	<i>Parkia biglobosa</i>	45	12.71
3	<i>Khaya senegalensis</i>	38	10.73
4	<i>Daniella oliveri</i>	33	9.32
5	<i>Prosopis africana</i>	25	7.06
6	<i>Tamarindus indica</i>	22	6.21
7	<i>Detarium senegalense</i>	17	4.8
8	<i>Sorghum bicolor</i>	16	4.52
9	<i>Mangifera indica</i>	15	4.24
10	<i>Zea mays</i>	12	3.39
11	<i>Gossypium herbaceum</i>	8	2.26
12	<i>Ziziphus mauritiana</i>	8	2.26
13	<i>Grewia bicolor</i>	7	1.98
14	<i>Borassus aethiopicum</i>	7	1.98
15	<i>Cucumis melo</i>	6	1.69
16	<i>Gardenia ternifolia</i>	6	1.69
17	<i>Ficus gnaphalocarpa</i>	3	0.85
18	<i>Psidium guajava</i>	3	0.85
19	<i>Moringa oleifera</i>	3	0.85
20	<i>Piliostigma reticulatum</i>	3	0.85
21	<i>Hibiscus vulgaris</i>	2	0.56
22	<i>Momordica indica</i>	2	0.56
23	<i>Hyphaene thebaica</i>	2	0.56
24	<i>Ximenia americana</i>	2	0.56
25	<i>Calotropis procera</i>	1	0.28
26	<i>Hibiscus esculenta</i>	1	0.28
27	<i>Phaseolus vulgaris</i>	1	0.28
28	<i>Combretum micranthum</i>	1	0.28
29	<i>Ficus ingens</i>	1	0.28
Total		354	100

The improvement constraints of production and proposals

The principal constraints of production were the robbers and the ignorance of the food techniques. The suggestions made by the bee-keepers were the fight against the robbers, their formation and the improvement of the hive (Table 11).

Table 6: Food practices.

Parameters	States	Labour	P.100 (%)
Type of food used	Flowers of the plants of the area	98	97
	Food manufactured	3	3
Nature of formulated food	Cereals, onion, bean and pea of ground	101	100
Practical of food complementation	Yes	68	67.3
	No	33	32.7
Requirements of the bees	Yes	95	94.1
	No	6	5.9
Nature of requirement	Water	96	95
	Food	5	5

Table 7: Period, techniques, materials and product of harvests.

Parameters	Answers	Labour	P.100 (%)
Period when the production is optimal	From March to May	47	46.5
	From February to April	35	34.7
	Between March, April, May, September	18	17.8
	All the year	1	1
Nobody ensuring the harvest of the products of the bees	Head of household	99	98
	Child	2	2
Collected product	Honey	101	100
Techniques used in harvest	Use of smoke	101	100
Material of harvest	Bucket	101	100
Honey color at the time of harvest	Broken white	78	77.2
	Sink	14	12.7
	Yellow	7	6.9
	Red	2	2

Table 8: Exploitation of products of the hive.

Parameters	Answers	Labour	P. 100 (%)
Product of hive sold	Honey	101	100
Who decides sale	Head of household	101	100
Who sells honey at the market	Man	93	92.1
	Woman	8	7.9
Place of sale of honey	Close villages	86	85.2
	Far villages	15	14.9
Favorable period of sale	Between February and May	101	100
Unit of sale used	Koro	100	99
	Liter	1	1

Table 9: Performance of the production of honey.

Variables	Averages	Standard deviation	Minimum	Maximum
Hive numbers	17.21	± 31.73	1	304
Output of hive (liter)	6.13	± 1.637	3	22.5
Frequency of production (days)	16.91	± 4.481	10	30
Duration of production (month)	4.07	± 1.18	3	12
Quantity honey produit/an (liter)	862.72	± 1859.26	18	18240
Honey quantity sold in liter/year	498	± 548.40	7.5	3000
Average price of liter (F CFA)	1676,57	± 335.078	1333.33	2000
Average annual income (F CFA)	834 ° 930,69	± 969155.97	10000	6 000 000



Figure 2: Collected honey color.

Table 10: Medical management and constraints of production.

Parameters	Answers	Labour	Percentage (%)
Noted mortality of the bees	Presence of case of mortality	83	82.2
	Absence of case of mortality	18	17.8
Causes of mortality of the bees (n=18)	Fire used during harvest	9	50
	misses water, lizard, rains, Fourmis	9	50
Period of strong mortality (n=14)	Mars, April, July, August	14	100
Medical follow-up	Lack follow-up	101	100
Observations of fall of production	No fall of production	58	57.4
	Falls of production observed	43	42.6
Causes of fall of production (n=43)	Termites and ants	12	27.9
	Lézards	12	27.9
	Caterpillars	10	23.2
	Falls of the melliferous flowers	9	20.9

Table 11: The improvement constraints of production and proposals.

Parameters	Answers	Labour	Percentage (%)
Constraints	Robbers	52	51.5
	Ignorance of the food techniques	45	44.6
	Ennemis of the bees	2	2
	Misses water	2	2
Proposal for an improvement of the production	Fight against the robbers	51	50.5
	Training of the bee-keepers	48	47.5
	To improve the hive	2	2

Discussion

The study characterized the system production of honey in the area Goundi. The results show that in this area the bee-keeping is practised mainly by the men. All the bee-keepers practise agriculture and the breeding like principal activity. The number of woman practising the bee-keeping in the area Goundi (1%) is lower than the number of the bee-keepers women observed in Cameroun, which is 3% [5]. This can be due to the persistence of the traditional perception for which the bee-keeping is a field exclusively reserved to the men. In case of Uganda and Mozambique, the women are more numerous in the bee-keeping. In Kenya, a considerable part of the incomes of women comes from bee-keeping. The area Goundi, the bee-keeping is regarded as a significant component of the agricultural sector. Thus, the products of the bee-keeping in particular honey constitute a considerable source of income for the households. It takes place with the reinforcement and the improvement of food safety and durable agriculture like Uganda, Kenya and South Sudan [3]. These results agree with the observations made in Kenya by Omondi, et al. [6] which shows that bee-keeping generates at the sometimes socio-economic and environmental advantages. These observations are made in many the countries of sub-Saharan Africa where the bee-keeping is an activity carried out mainly on the level rural household, like generating activity of part-time incomes and food [7]. Moreover, it is crucial for agricultural wellbeing because of the natural biological interdependence generated by insects. It constitutes a means useful to reinforce the means of subsistence [7].

Contrary to the results of the studies carried out in Cameroun by Tchoumboue, et al. [5], meadows of 37% of the bee-keepers are illiterate. Moreover, most of them are not received any formation to acquire modern technical training of the bee-keeping, which is preconditions for production of honey on a large scale [1]. The lack of instruction of the bee-keepers shows all the difficulty of intensifying the breeding can constitute a handicap in the optics of popularization and the adoption of the modern apicoles techniques [5].

The totality of surveyed affirms to have practised the bee-keeping for the sale and subsistence farming. Our similar results with the observations made in the zone of Adamaoua in Cameroun [8]. In the area of Goundi, the bee-keepers exploit 3 indigenous species of small size identifiable by their aggressiveness (52%) and/or by their form

and their wings (35.6 %). The choice for one or the other species is guided by the output of the bees. To install them in the hives, the bee-keepers get fire wax in the hive, or by using perfume or wild onion. The site of the hive is a function of the food availability and its aptitude to avoid the case of flight and the aggressiveness bees.

Inquired affirm, that the three species bees are all aggressive. These results corroborate with the observations made by Cosmas AB [9] regard that the African bees are described as very defensive with the biting is painful what makes their difficult management.

Our observations show that the colonies of bees are placed on the level of orchard, roofs of the box, forest, fields, and trees during all the year. Conversely, in Cameroun [5], the installation of the hives takes place between January and March whereas with benign [10] the placement of the hives is realized in two periods, between February at April in dry season and between September and mid-November to rain season.

The number of hives of 17,28 per bee-keeper observed, of exclusively traditional type is higher than the number of hives noted with Benign (14,48) by Yédomonhan et al. [1]. On the other hand, this number of hives remains lower than that observed in the west of Cameroun, which is of 42 hives [5] of which 62.2% of hives are improved types. The near-total of the bee-keepers of the zone of Goundi uses traditional hives made up of hollow tree trunk and hole of tree. The most used tree trunks are *Prosopis africana*, *Tamarindus indica*, *Vitellaria paradoxa* which are used as hive and the sheets of *Grewia Bicolor* R are used to make the cover. This practice clearly indicates modern technical the training and lack of training relating to the apicole breeding.

The nature of materials used as hive (deadwood trunk, hole in the ground, etc.) as their low output (6.13 liters) shows that the method of practised production is rudimentary. However, the cost of the material and its unavailability constitute the principal factors determining the method of production. The results of the studies carried out in the South of Kenya by Muriuki, [11] show that 75.6% of the surveyed bee-keepers use to the traditional method and 24.4% fact resort the modern technique.

Concerning the food practice, the bees nourish natural flowers and nectars of the trees of the zone. Only one minority of the bee-keepers (3%) distribute food manufactured whereas the majority does not practise the food complement.

The head of household is the person in charge of the control of the breeding and he decides harvest as well as sale of honey on the markets. Moreover, it ensures the follow-up of the ruchers which is carried out under control and of cleaning.

The harvest of honey is carried out approximately twice per month. The frequency between two harvests is approximately 17 days. On the other hand, elsewhere it was announced that harvest is carried out once in a year. The bringing together between two harvests would be due to the low capacity of the hives of the traditional type used whose capacity seldom does not exceed the 4 liters. On the other hand, in other countries, the hives are adapted better to contain more honey. Beyene, et al. [12], note that the use of hives improved combined with better practices of management can increase the honey yield and produce honey of better quality compared to the traditional hive. The studies carried out by these authors showed that honey the average yield of the modern hive (23,18 kg/hive) is higher than mixed hive (13.88 kg/hive) which was in its turn significantly higher than traditional hive (6.08 kg/hive).

Our observations show that the honey period or harvest is carried out at the majority of surveyed between March and May (46.5%), between February and April for 34% also corresponds to an optimum of output. These results are similar to those observed with the Cameroun West by Tchoumboué, et al. [5].

In the zone of study, our observations show that honey is the only product of hives sold with the level of local markets. The quantity of produced honey is about 862.72 liters per annum and by bee-keeper among whom 500 liters are sold at an average price of approximately 1676,57 F.CFA thus getting an annual average income gross about 834 930,69 F.CFA per bee-keeper. On the other hand, in Cameroun [5,13] with benign [10] in addition to honey, the bee-keepers sell wax, the propolis, pollen, and the royal jelly.

The bee-keeping is regarded as a potential economic activity [14]. Thus, our observations show that the gross income drawn from sale of honey is higher than the observations made in Benin which is about 237037 ± 159167 F.CFA/an/apiculture where the rough annual receipt by bee-keeper or grouping varies from 9 000 to 580 000 F.CFA [10]. In this country, the rate of marketing is 90% on average and the generated gross earnings amount to 155 000 F/an/apiculture [1].

The same observations are made Uganda, Kenya and South Sudan where the honey and the other products of the hive contribute to the generation of incomes in these countries [3].

The various receipts generated by the marketing of products of the bee-keeping show with sufficiency its undeniable economic role in the reduction of poverty through the satisfaction of the needs for the households. In Ethiopia, the Government and certain ONG are engaged for the promotion of the bee-keeping like a tool to reduce poverty [15].

Concerning medical management, our results show that in these cases of mortality are seldom noted (only by 17.8% of the bee-keepers). On the other hand, to Kenya, the study carried out in eight agro-ecological zones announced the presence of *Nosema microsporidia* [16]. In Tunisia, a case of parasites was also announced [17] and of the parasite-ravageurs were observed in the democratic Republic of Congo [18].

Being the constraints, the results of our study show that the flight and the ignorance of the food techniques of formulation constitute the major production constraints.

Conclusion

This study is undertaken with the aim of better knowing the socio-economic and technical characteristics of apicole production. It arises from this study, the bee-keeping plays a social and economic role very significant. It is practised in a traditional way by the men and its product is intended primarily for the sale and subsistence farming. Thus, the study emphasizes the principal characteristics of the producers, the materials used, the techniques of breeding, the medical practices as well as the constraints of the productions of the bee-keeping practised in the zone of Goundi. The results indicate that in this zone the bee-keeping has a great potentiality to regards production of honey and gets significant monetary incomes with the bee-keepers. Moreover, the products of rucher (honey) contribute to food self-sufficiency and the food safety of rural households. Unfortunately, the beekeeping is practised in a traditional way and suffers from several handicaps among which lack of technical training. Although the bee-keepings use traditional techniques and materials not adapted to weak capacity, the monetary incomes resulting from this activity are very appreciable.

The socio-economic importance of the bee-keeping through the sale of honey highlighted the interest of the development of this breeding to improve the income of the producers.

The production is increasing necessary by the intensification of the production through the framing and the training, the adoption of modern hives and the support of the bee-keepers.

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