Original Research Article

SOCIO-ECONOMIC IMPORTANCE BEEKEEPING IN THE TOGO PLATEAU REGION

ABSTRACT

This work consisted in evaluating the economic contribution of the beekeeping activity in the life of the producers of the region of the plateaus of Togo.
To achieve this objective, socio-economic surveys were carried out on the basis of a semi-structured questionnaire via individual interviews. The questionnaire took into account: profile of the beekeeper, annual investments, number and type of hive used, harvested products, quantity obtained per hive and per year, selling price...
The results obtained on the sale of honey and wax, showed that the beekeeping activity would be economically profitable. For the evaluation of profitability, the cost/revenue method was used. Production costs relate to materials and various expenses incurred. Gross receipts were estimated from cash flows from the sale of hive products. After investigation of the turnover, the profits are calculated by difference between income and expenditure for each product harvested for the year 2019. In short, the activity allows an average annual profit of 766,600 FCFA for beekeepers harvesting only honey and 829,000 FCFA for those harvesting both honey and bees wax, for an average number of 33 hives per producer.
This study has shown that a serious beekeeper who is well organized and has at least thirty hives can normally make a good living from this beekeeping activity.

Keywords: Beekeeping, economic contribution, Plateau region, Togo.

1. INTRODUCTION

Apiculture is the breeding of bees for the production of honey [1]. It is an activity that easily integrates with many other activities using natural resources such as agriculture, agroforestry, forestry. It guarantees the continuity of natural capital through the pollination of agricultural and wild plants with respect for the environment. From so-called picking beekeeping (the harvest of natural production), it moved on to the use of traditional hives (hollowed tree trunks, Canary, sheet metal hives, etc.), then to the use of hives combs and mobile frames (modern hives) known as modern beekeeping [2]. It generates a lot of products (honey, wax, pollen, propolis, royal jelly and bee venom), the best known of which for its medicinal and food properties is honey [3]. It is an important source of income and employment for many producers in sub-Saharan Africa [4; 5] as well as a livelihood for populations who depend on forests and non-timber forest products (NTFPs) in many developing countries [6].

In Togo, more particularly in the plateau region, the interest of local populations in beekeeping is growing day after day. However, several challenges remain to be met, in particular the development of beekeeping areas.

Given the importance of beekeeping in the conservation of natural resources [7], the sustainability of the activity appears to be of paramount importance. An activity is

sustainable if it is economically supported [8]. Given the sustained motivation and enthusiasm of the rural populations of this region to engage in beekeeping, it appears that beekeeping is an economically profitable activity. A question then arises: what socio-economic impact does beekeeping have on the life of a beekeeping producer in the plateau region? The general objective of this study is to contribute to a better understanding of beekeeping activity in the plateau region. Specifically, it is a question of evaluating the economic contribution of beekeeping activity in the experience of beekeepers in the plateau region of Togo.

2. METHODOLOGY

2.1 STUDY ZONE

The Plateau Region represents the geographical setting of this study (Figure 1). With Atakpamé as its capital, the Plateau Region is located between 6°32' and 8°21' North latitude and 0°44' and 1°36 East longitudes. In terms of area, it represents 29.6% of the national territory. Made up of 12 prefectures, it is bordered to the north by the Central Region, to the south by the Maritime Region, to the east by Benin and to the west by Ghana. The region enjoys a subequatorial climate characterized by two dry seasons and two rainy seasons. The long rainy season extends between March and June, followed by the short dry season from July to August, then comes the short rainy season from September to October, and finally the long dry season, from November to February. The average rainfall is around 1000 mm of water per year. However, it varies from one area to another between 800 and 1700 mm of water per year over the past 25 years. The region is crossed by the Mono River and its tributaries (Anié, Ogou, Ofé, etc.). Phytogeographically, the region overlaps two ecological zones, namely zone III and zone IV [9]. Zone III (eastern part) is the domain of Guinean savannas and dense dry forests which occupy the entire central plain. In zone IV (western part), corresponding to the southern part of the Togo mountains, also called the Atakora unit, are the plains of Litimé and Ahlon, the Akébou, Akposso, Dayes and Kloto plateaus. It constitutes the domain of humid and semi-deciduous forests of Togo [10].

The population of the study area is estimated at 1,375,165 inhabitants by INSEED in 2011. A diversity of ethnic groups live mainly on income from agriculture as their main activity.

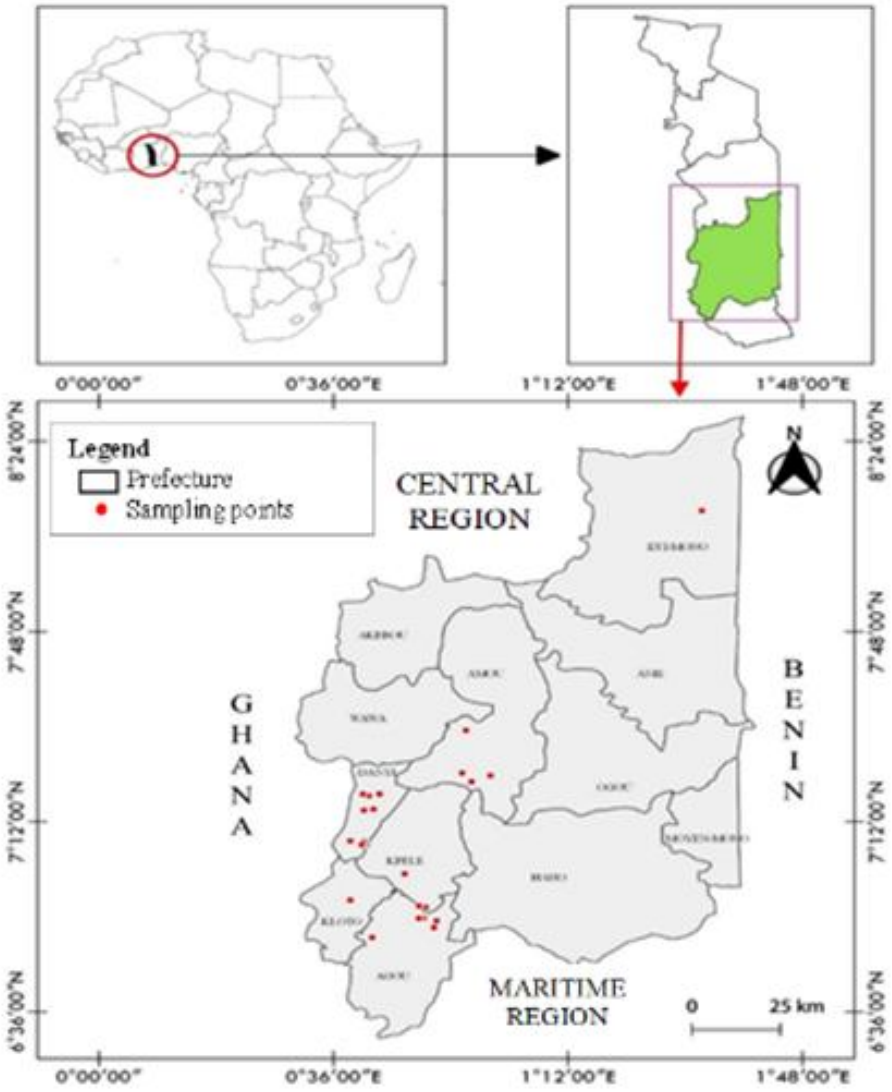

Figure 1: Geographical study framework

2.2 Method

Socio-economic surveys were conducted among 60 beekeepers in 6 prefectures of the plateau region using the snowball method. They were conducted through a semi-structured questionnaire with individual interviews. The questionnaires took into account the profile of the beekeeper, the annual investments, the harvest costs, the number of hives per beekeeper, the type of hive used, the harvest period, the hive products harvested, the quantity per hive, of each product obtained per year, the selling price of one liter or kilogram of each hive product harvested and the constraints linked to the beekeeping activity.

2.3 Data Processing

The data collected during the various activities were entered codified and organized into statistical data. The data collected was coded for descriptive analysis with Microsoft Office Excel 2016 and Minitab 13 statistical software.

To assess the profitability of beekeeping activity for beekeepers, the cost/revenue method was used [11]. Total production costs or expenses relate to materials and miscellaneous expenses. Gross receipts were estimated from cash flows from the sale of hive products (honey, wax, pollen and propolis). The benefit of the activity was calculated independently for twenty-one (21) respondents who responded to questionnaires that can help assess the benefit from the beekeeping activity, depending on whether or not they belong to a group. After investigation of the turnover, the profits are calculated by making the difference between the receipts and the expenses according to the products of the hive harvested for the year 2019.

3. RESULTS AND DISCUSSION

3.1 RESULTS

3.1.1 Typology of beekeepers in the plateau region

The study showed that the beekeeping activity is predominantly male: 88% men against 12% women. Considering the level of education of the respondents, the majority have a college level (62%), followed by the primary level (25%), the university level (10%) and finally the high school level (3%).

However, beekeeping is practiced by different socio-professional groups as a secondary activity, the most represented group being farmers: 66.66%. The moderately represented group is made up of people whose main activity is beekeeping and breeders represented respectively by 15% and 8.33%. The group least involved in the activity is made up of mechanics, carpenters with 3.33% each followed by educators and veterinarians each represented by 1.66%. On the organizational level, 80% of respondents are divided into thirteen (13 cooperatives) and 20% do not belong to any cooperative 88% of respondents are trained in beekeeping either by a beekeeper or by an NGO active in the field of beekeeping and 12% are trained on the state.

3.1.2 Beekeeping technique and practice in the plateau region

Four types of hives are identified in this study: the Kenyan type characterized by its V-shape (horizontal frameless hive); the Dadant type, also called super hive, characterized by its cubic shape (10 to 12 frames); the Langsthroth type characterized by its rectangular shape (frame hive) and the Layens type characterized by 9 frames. Of the four (04) types of hives, the Kenyan (35%) and dadant (32%) types are the most used, followed by the Langsthroth (20%) and Layens (18%) types which are the least used. Generally, the hives are installed in fields, fallows, savannahs, forests, and plantations. The average number of hives owned by beekeeper is 20 hives. The capture of swarms is done by trapping. The majority of beekeepers have at least one combination (beekeeping equipment) which is either purchased or handcrafted by themselves. More than half (65%) of producers do not have an extractor and smoker due to lack of financial means.

3.1.3. Annual honey production according to the types of hives

The honey harvest generally begins in the second year of installation of the hive regardless of the type of hive. According to the data in Table 1, it appears that the average quantity of honey harvested varies from 6 to 7.52 liters/year regardless of the type of hive used. Statistical tests reveal no significant difference (P-value =0.889) between these means. In reality, with the exception of the Kenyan type which offers one and only one harvest per season (or harvest year), the Dadant, Langsthroth, and Layens types offer the possibility of two to three harvests per year when the beekeeper has honey extractor (beekeeping equipment).

Table 1: Honey production according to types of honey

Types of hive	Mean	Minimum	Deviation
Dadant	6,85	3,72	6,85±3,72
Kenyane	6,07	2,69	6,07±2,69
Langstroth	7,52	0,48	7,52±0,48
Layens	6,57	2,57	6,57±2,57

3.1.4 Harvesting hive products

The harvesting of hive products in the plateau region is not done in a homogeneous manner. Harvesting is done mainly in the dry season and most often at night, when bees are less aggressive according to beekeepers. For harvested products, the surveys showed that 100% of the people surveyed harvest honey; while only 47% collect more wax or not. Pollen and propolis, which remain the least exploited, are only harvested by 2% of beekeepers in the region (Figure 2).

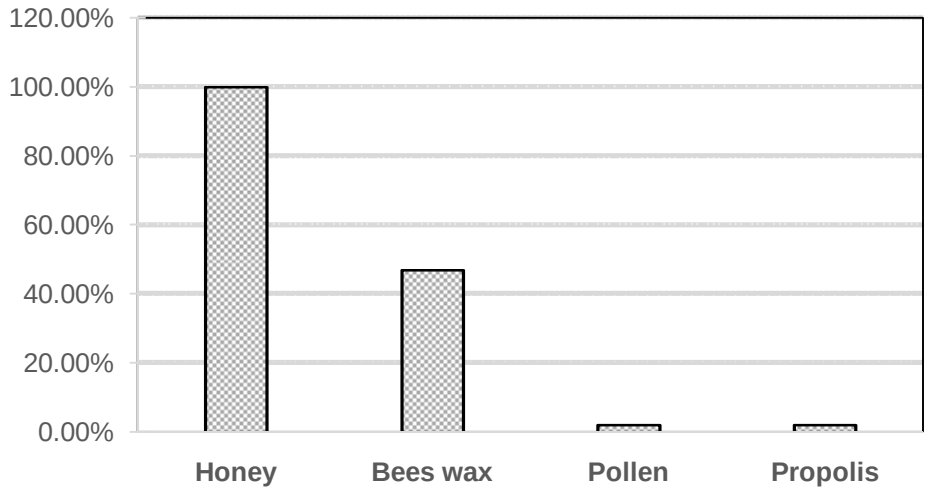

Figure 2: Importance given to hive products harvested in 2019

3.1.5 Encountered difficulties

The main difficulties encountered by beekeepers in the exercise of their activity remain: theft, vegetation fires, the lack of a honey extractor which limits some producers to a single harvest despite having a type of hive that can offer two (02) to three (03) harvests, bee predators, access to plant formations for the installation of hives.

3.1.6 Comparison of honey prices according to the prefectures

The average selling price of honey is 3375.5 FCFA in the study area. However, the analysis of the sale prices of honey according to the prefectures shows that the price of honey remains relatively low in the prefecture of Est-Mono with an average price of 3000 FCFA and high in the prefecture of Agou with a price average of 3618 FCFA. Moreover, the difference in the price of honey in the study area depends on the seasons. Indeed, at the start of the harvest, prices are relatively low; these prices increase according to the law of supply and demand. Honey is relatively cheaper in the dry season, which is generally the harvest season, and more expensive in the rainy season. This variability would be due to the law of supply and demand, the quality of the honey, the method of extraction, the type of market, the pressing need of the producer and the sales period. This variation in honey prices in the study area is not significant because the statistical tests reveal a P-value = 0.096 > 0.05.

3.1.7 Correlation and statistical analysis on the influence of the number of hives, the distance, the amount of wax and the amount of honey

There is a strong correlation between the amount of honey produced, the amount of wax and the number of hives. The statistical tests confirm this correlation between the quantity of hives and the independent variables (quantity of wax and number of hives (P-value = 0.000 < 0.05)).

The variables that explain the quantity of honey harvested are the number of hives and the distance with respective Betas of 1.004 and 0.075 and P-value respectively = 0.00 and 0.021 < 0.05. The amount of wax does not explain the amount of honey because P-value = 0.369 > 0.05.

3.1.8 Profit from the beekeeping activity

Although beekeeping is a seasonal activity, it is nonetheless important in the rural economy. The benefits from beekeeping vary from one beekeeper to another depending on whether the beekeeper collects honey only or collects honey and wax, depending on the number of hives. (Table 2). For an average number of 33 hives, the average profit of beekeepers harvesting only honey is estimated at 766,601.2 FCFA per year. For those who collect honey and wax, the average profit is 829,029.76 FCFA per year for the same number of hives. The costs taken into account by the activity in the study area concern the maintenance of the apiaries, the rental of the extractor and frame lifter and the labor of the workers for those who, during the harvest, adopt this option.

Table 2: Turnover table

N°	Number of hives	Qty honey (L)	Selling price	Qty wax (kg)	Selling price (FCFA)	Gross income honey (FCFA)	Gross income wax (FCFA)	Expenditure annual	Total profit
1	2	20	3500	0	-	70000	0	2000	68000
2	2	12	3500	0	-	42000	0	20000	22000
3	3	24	3500	0	-	84000	0	16550	67450
4	40	112	3500	25	3500	392000	87500	97000	382500
5	2	20	3500	0	-	70000	0	10000	60000
6	3	36	3500	0	-	126000	0	10000	116000
7	40	456	4500	0	-	2052000	0	92600	1959400
8	9	49	3500	0	-	196000	0	120000	76000
9	10	78	3000	3	3500	234000	10500	45000	199500
10	145	1130	3500	60	**15000**	3955000	900000	214000	4641000
11	112	780	3500	0	-	2730000	0	166000	2564000
12	10	98	3500	0	-	343000	0	150000	193000
13	20	196	3000	0	-	588000	0	22100	565900
14	6	30	3500	0	-	105000	0	50800	54200
15	37	172	3000	1	-	516000	0	88600	427400
16	2	7	3500	0	-	24500	0	6500	18000
17	16	80	3500	4	3000	280000	12000	35675	256325
18	50	400	4000	27	3500	1600000	94500	80300	1614200
19	40	280	3500	7	3000	980000	21000	123000	878000
20	86	640	3500	23	3500	2240000	80500	266750	2053750
21	60	400	3000	30	3500	1200000	105000	112000	1193000
Total	**695**	**5020**	**-**	**180**	**-**	**17827500**	**1311000**	**1728875**	**17409625**
Avg	33	239	-	8,57	-	848928,57	62428,57	82327,38	829029,76
Min	2	7	-	1	-	24000	10500	2000	18000
Max	145	1130	-	60	-	3955000	900000	214000	4641000

Qty = quantity; Min = minimum; max = max; Avg = average

3.2 Discussion

The high proportion of harvesting of hive products in the dry season by beekeepers is explained by the fact that 57.33% of the species flower in the dry season and 24% flower all year round. In the dry season, nectar is the element most available to bees and the temperature required for the transformation of nectar into honey is optimal: around 35°C [12]. The low proportion of nectariferous plants in the rainy season explains the non-harvesting of honey during this period. Indeed, honey comes mainly from the nectar and resin of plants. Just as this period constitutes a time of rest for the farmers involved in the production of honey, it represents a time of work for the bee colonies. The diversity of main activity of beekeepers in the region shows, on the one hand, the importance of the activity in the rural world, and, on the other hand, the opening of the activity to several sectors. The

high proportion of farmers is explained by the fact that attention is turned towards alternative income-generating activities in a context of climate change where agriculture is becoming unpredictable due to climate variability.

The involvement of men in this sector of activity (88%) against 12% of women is justified by the fact that it is a risky activity (performed mainly at night: when the dangerous animals go out into the bush) . The beekeeping activity requires a minimum of knowledge. 61.67% of beekeepers have a college level, which means that to be more successful in the beekeeping activity, a minimum of college level is required.

The average number of hives held per beekeeper (20 hives) in the plateau region of Togo is higher than that obtained by the work of Kouassi et *al*. [13] carried out in the Center-North of Côte d'Ivoire in the department of Katiola . However, this number remains very low compared to that observed in the Central African Republic (40 to 70 hives) by Mbétid-Bessane [14]. This can be explained by the fact that in Togo, beekeeping has long been neglected and relegated to the background in the lives of local populations. This has long resulted in the systematic cutting of trees sheltering bee colonies. The use of hives is only a new habit in agricultural practices in Togo.

Contrary to the average price practiced in Benin, i.e. 1600 FCFA per liter of honey [15] and that observed (1955 FCFA) by Kouassi et *al.* [13] Center-North of Côte d'Ivoire, the average price (3375.5 FCFA) of the honey obtained in this study remains largely high. This difference could be explained by the fact that these studies are older than this one, on the one hand, and on the other hand, the fact that the consumption of honey is becoming increasingly high (due to the fact that populations are abandoning consumption of sugar in favor of that of honey). In addition, the fact that it has more demand than production in the study area and the fact that GDPs differ from one country to another.

The average annual profit of beekeepers harvesting only honey is 766,601.2 FCFA and that of those harvesting honey and wax is 829,029.76 FCFA for an average number of 33 hives. These benefits remain far below the work of Ahouandjinou et *al*. [15] carried out in Benin and the work of Atakpama et *al.* [16] carried out in the community forest. This difference could be related to a difference in the selling price of hive products, the number of hives, the average production quantity of a hive and the types of market. Reported to the hive, a hive generates respectively an average annual profit of 21614.02 FCFA and 22342.37 FCFA per year depending on whether the beekeeper harvests only honey or honey and wax. This significant income is explained by the fact that the costs of honey harvesting are limited to beekeepers. For the most part, the harvest remains family-based, mutual aid between cooperative members or employment as laborers with low wages. Reported to the month, the profit is respectively 63883.43 FCFA and 69089.81 FCFA for those who harvest only honey and those who harvest honey and wax. This benefit remains much higher than the national minimum wage which is thirty-five thousand CFA francs (35,000 FCFA). Income from beekeeping activity allows beekeepers to meet their needs, which shows that income from beekeeping could greatly contribute to improving the living conditions of some people.

The preference of Kenyan hives in the study area to the detriment of other types of hives is corroborated by the work of Ahouandjinou et *al.* [15] carried out in Benin. In the study area, this preference is primarily explained by the lack of suitable beekeeping equipment (honey extractor, extremely expensive); then by the fact that there is not a significant difference between the annual harvest with the Kenyan hive and the other types of hive. In addition, the preference for the Kenyan hive is justified by a capital means to minimize the difficulties of harvesting several times, moreover to avoid the high cost purchase of honey extractor. Indeed, the other types of hive (Dadant, Layens and Langsthroth) are frame hives whose

honey extraction can be done with the extractor without breaking the cells. This method, which consists of not breaking the cells, allows the bees to quickly resume their production after a short time for repairing the cells that is still available. Whereas if the cells were destroyed, the bees are forced to start building new combs/cells again before production by the queen. This affects the production, time and quality of honey. The low harvest of wax, propolis and pollen (other hive products) is justified by a lack of harvesting technology, knowing that supply calls for demand and vice versa.

4. CONCLUSION

The results of this study show that there is a diversity of plants of beekeeping interest in the plateau region. Nectar is the element most sought after by bees in the dry season and almost all year round for the production of honey. Three categories of plants were distinguished: plants foraged for pollen, plants foraged for nectar and plants foraged simultaneously for pollen and nectar. Honey production is preferentially done by Kenyan type hives to the detriment of frame hives which offer two to three harvests. The harvest is mainly done in the dry season and remains nonetheless in the beekeepers' economy: 63883.43 FCFA as average profit for beekeepers harvesting only honey, 69089.81 FCFA for those harvesting honey; this for harvests on an average of 33 hives. This activity could constitute one of the effective pillars for the economy of the region at the same time as a means of sustainable management of forest ecosystems. To achieve this, local beekeeping initiatives must be promoted by providing beekeepers with support in equipment, training and the marketing of beekeeping products.

REFERENCES

1. Ahouandjinou, S.T.B., Yédomonhan, H., Tossou, G.M., Adomou, A.C., Akoègninou, A.,. Diversity of melliferous plants in the Sudanian zone: case of the classified forest of the Kouandé hills, North-West Benin . Afr. Science. 2017; 13, 149–163. Akpagana, 1992. French.

2. Hounnankpon Yédomonhan 1, Monique G. Tossou, Akpovi Akoègninou, Boris B. Demènou, Dossahoua Traoré. Diversity of melliferous plants in the Sudano-Guinean zone: case of the district of Manigri (Centre-West of Benin). Int. J. Biol. Chem. Science. 2009 ; 3(2): 355-366, 2009, ISSN 1991-8631, http://www.ajol.info, http://indexmedicus.afro.who.int. French.

3. Hamel, T., Boulemtafes, A.. Plants foraged by bees on the Edough peninsula (north-eastern Algeria). Livest. Res. Rural Dev. 2017; 29, 1–13. French.

4. Carroll, T., Kinsella, J. Livelihood improvement and smallholder beekeeping in Kenya: the unrealised potential. Dev. Pract. 2013; 23, 332–345.

5. Iritie, Bruno Marcel, Wandan, E.N., Paraiso, A.A., Fantodji, A., Gbomene, L.L. Identification of honey plants in the agroforestry zone of the higher agronomic school of Yamoussoukro (Ivory Coast). Eur. Science. D. 2014; 10. French.

6. FAO. FAOSTAT. Food and Agriculture Organization of the United Nations. http://faostat.fao.org/default.aspx; 2010.

7. Adomou, A.C., Yedomonhan, H., Djossa, B., Legba, S.I., Oumorou, M., Akoegninou, A. Ethnobotanical study of medicinal plants sold in the Abomey-Calavi market in Benin. Int. J. Biol. Chem. Science. 2012; 6, 745–772. French.

8. Matsop, A.T., Achu, G.M., Kamajou, F., Ingram, V., & Boboh, M.V. Comparative study of the profitability of two types of beekeeping in northwest Cameroon. Tropicultura, 2011; 29(1), 3-7. French.

9. Ern, H. Die Vegetation Togos. Gliederung, Gefährdung, Erhaltung. Willdenowia. 1979; 295–312.

10. Akpagana, K. The dense humid forests of the mountains of Togo and Agou (Republic of Togo). Bulletin of the National Museum of Natural History, Paris. 1992; 4th ser., 14, Section B, Adansonia, 109-172. French.

11. Dieye, P. N. ., Faye, A., Seydi, M., & Cissé, S. A. Peri-urban dairy production and improvement of the incomes of small producers in rural areas in Senegal. Cahiers Agricultures. 2002 ; 11(4), 251–257. Consulted at https://revues.cirad.fr/index.php/cahiers-agricultures/article/view/30351

12. Chauvin, R. Treatise on bee biology: History, ethnography and folklore. 1968. French.

13. Kouassi, D.F., Ouattara, D., Coulibaly, S., N'guessan, K.E., 2018. The collection, production and marketing of honey in the Department of Katiola (Centre-Nord, Côte d'Ivoire). Int. J. Biol. Chem. Science. 12, 2212–2225. French.

14. Mbétid-Bessane, E. Beekeeping, source of income diversification for small farmers: case of the cotton basin in the Central African Republic. Tropicultura. 2004; 22, 156–158. French.

15. Sfich T. B. Ahouandjinou, Hounnankpon Yedomonhan, Aristide C. Adomou, Monique G. Tossou, Akpovi Akoegninou. Technical characteristics and socio-economic importance of beekeeping in northwestern Benin: case of the commune of Cobly. Int. J. Biol. Chem. Science. 2016; 10(3): 1350-1369, June 2016 ISSN 1997-342X (Online), ISSN 1991-8631 (Print) DOI: http://dx.doi.org/10.4314/ijbcs.v10i3.35; http://ajol.info/index.php/ijbcs http://indexmedicus.afro.who.int. French.

16. Atakpama, W., Asseki, E., Amana, E. K., Koudegnan, C., Batawila, K., & Akpagana, K., 2018. Socio-economic importance of the Edouwossi-copé community forest in the prefecture of Amu in Togo. Moroccan Review of Agronomic and Veterinary Sciences, 6(1), 55-63. French.