African Cashew Initiative (ACi),

The Study of the Effects of Integrating Beekeeping into Cashew Farms in Ghana and Benin

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Executive summary

The integration of beekeeping into cashew orchards has great potentials of increasing nut yields and also improving farmers' income through the sale of hive products. However, facts and figures of the benefits of this integration are not available in cashew producing countries. This study investigated how beekeeping relates to the productivity of cashew orchards and impacts farmer incomes in Ghana and Benin. It also looked at the possibility of integrating other crops and animals into cashew farms with closed canopy trees. Two cashew farms with similar growth characteristics and management regimes were selected in communities within the cashew belts of Ghana and Benin. Seventy (70) cashew trees on each farm were marked to represent the experimental plots. Two (2) hives containing strong honeybee (*Apis mellifera adansonii*) colonies were placed close to the experimental plot of farm 1; farm 2 had no colonies of bee. The treatments were replicated 4 times at different locations in both countries. Weekly data were recorded for colony weight and total cashew nut yield per the experimental plots. Two hundred (200) nuts were sampled from the total nut yield of the experimental plots and weighed. Honey, beeswax and propolis were harvested from the honeybee colonies and their quantities weighed and recorded. Eighty (80) cashew farmers and beekeepers in Ghana and 40 in Benin were interviewed with a structured questionnaire to collect production data for both cashew nuts and bee products. Investigations into the integration of other crops and animals into cashew production systems were conducted through interviews.

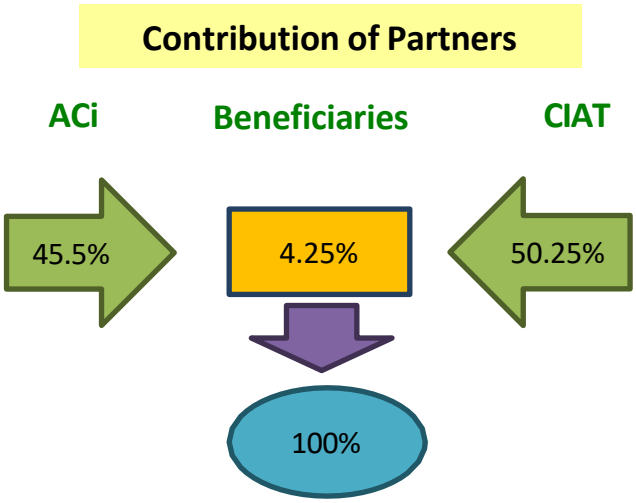
Summary of findings

The following were the results:

- The pollination activities of the honeybee colonies increased raw cashew nut (RCN) yields by 116.7 % in Ghana and 212.5 % in Benin. RCN yield per tree per season increased from 4.2 kg to 9.1 kg in Ghana and 2.16 kg to 6.75 kg in Benin.
- One hectare of cashew farm with 2 honeybee colonies produced 41.4 kg of honey, 2.8 kg of beeswax and 0.74 kg of propolis within the season with a total value of US$ 208.53 in Ghana; in Benin 27.48 kg of honey, 1.84 kg beeswax and 0.5 kg propolis worth US$ 138.40 was obtained.
- A total annual income of a cashew farm with honeybee was US$ 591.74/ha/yr in Ghana and that of Benin was US$ 575.96.
- The study also established that closed canopy orchards could integrate domestic birds (chickens, ducks, etc.), sheep and goats, and snails into the production systems. Crops such as ginger, cocoyam, and black/ white pepper could be cultivated in cashew farms for additional income.

1.0. Introduction

During the first phase of the African Cashew initiative (ACi), the project beekeeping was introduced to selected cashew farmers and women group in order to improve pollination of the cashew farms and also provide extra income to the beneficiaries. In Benin, a private-public partnership program was formed between the African Cashew initiative, "le Centre International d'Apiculture Tropicale et Ecotourism" (CIAT) and 90 beneficiary farmers in Tchaourou community. The goal was to diversify income of the target group and provide consistent supply of bee-products, notably honey to CIAT.



Financial contribution of PPP partners

In 2011, three beekeepers cooperatives were organized made up of 90 bee keepers (32 being women). Three thousand, three hundred and seventy (3370) litres of honey and 169 kg of wax and propolis were produced and marketed by the beneficiaries to CIAT valued at USD20.000. This has created a sustainable business linkage between the beekeepers and the CIAT centre to date.

In Ghana, 2 groups made up of 80 women in Tuna and Bole were trained in beekeeping. The goal was to increase the income generation of these women who do not own land. The women therefore placed their hives on the farms of male cashew farmers. In 2012, the group in Tuna harvested 360 litres of honey valued at USD2800.

1.1. Objective of the study

In order to re-enforce the integration of bee keeping in cashew orchards and to verify, the contribution of beekeeping in increasing yield and quality of cashew nuts the African Cashew initiative commissioned this study between October, 2012 and June, 2013. The incorporation of bees into cashew farms in Ghana and Benin was carried out in order to come out with the exact impact of the integration.

The study was aimed at finding the impact of beekeeping on cashew production and income. Recommendations of best practices of keeping bees on cashew farms will be extended to farmers for adoption.

The main objective of this study was therefore to find out how beekeeping relates to the productivity of cashew trees and impacts farmer income in terms of the sale of hive products.

Other farm activities (crops and animals) that can integrate with cashew orchards with closed tree canopies were also to be studied.

1.2. The study

The study was conducted in the cashew growing belts of Ghana and Benin. In Ghana two experimental farms were set up in each of the following cashew growing communities in Brong Ahafo: Kranka, Tanobuase, Wenchi, and Brodi. In Benin experimental farms were selected in Ouesse, Parakou, Tchaourou and Bassila. There were therefore 8 farms each in Ghana and Benin. Within each community, two farms with trees of similar age, good cultural practices and spaced not less than 2 km apart were used. The study commenced in October, 2012 when cashew trees in both countries had just started flowering.

Honeybee Worker Foraging on Cashew Flowers

Two honeybee colonies (*Apis mellifera adansonii*) in hives were set very close to the first farm. The colonies were inspected internally and placed on bathroom scales and their initial weight recorded. On the same orchard 70 cashew trees (7 rows, 10 on each row) were marked with red oil paint. The second study farm (control) was selected from a distance not less than 2 km away from the first and without managed honeybee colonies. Seventy (70) trees were similarly marked with red oil paint. Raw cashew nut production of these marked trees was recorded throughout the season.

1.3. Data collection

Four beekeeper-cashew farmers, in most cases owners of the experimental farms in Ghana and Benin were given a good orientation to the details of the study after they had given their consent to fully support the research work. The farmers were taught to carry out the following functions:

1. Accurate scale reading;
2. Weighing hives weekly and recording their weight accurately;
3. Weekly collection, weighing and recording nut yields of the 70 marked trees on the 2 experimental farms;
4. Weekly sampling, weighing and recording weight of 200 nuts from the total obtained from the 70 marked trees.

Record note books already marked with relevant tables for the collection of data were explained to the farmers and supplied to them for record keeping.

1.4. Questionnaire administration and interviews

A total of eighty (80) cashew farmers in Ghana and forty (40) in Benin, some of them beekeepers were met on one- on-one basis and taken through the structured questionnaire items (Appendix 6). Their responses were recorded and subjected to statistical analysis using the software SPSS 16.0 for Windows.

Key players in the cashew-beekeeping sector and possible future collaborators were contacted in both countries and interviewed (ref. to Profiles in Appendix 4). Discussions were held with Mr Sarki Yantannou, promoter of the "Centre Intégré d' Apiculture Tropicale et d'Ecotourisme" (CIAT) and his team of technical officers to obtain an insight into their activities concerning beekeeping promotion in Benin. Some supermarkets in North-Benin (Parakou, Djougou, and Bassila) were visited to obtain some insight into honey retailing in Benin. In Ghana Wenchi Farm Institute was identified as a major stakeholder in the sector that provided beekeeping training to farmers in the area. Discussions were held with the Principal and some members of staff of the institute. Mr Thomas Ahimah of Ofuma Farm Complex was met and interviewed on the farm's operations in relationship to cashew production and beekeeping.

2.0. Results

2.1. Findings from interviews in Ghana

2.1.1. Cashew farmers

Eleven (11) communities in 6 districts were covered in the cashew belt of Brong Ahafo Region of Ghana. Out of the 80 farmers interviewed, 21.2 % were females; 78.8 % being males with an average age bracket of 46-55 years. Majority of the cashew farmers (64.6 %) were educated up to the Middle School level (Basic education level). Most of these farmers (60 %) have farms size of 5 ha or less which are between 11 and 20 years or more.

2.1.2. Crop and animal integration

Majority of farmers (88 %) do not grow any crop under the closed canopy of the orchard. The remaining 12 % cultivate one or more of the following crops under the trees: avocado pear, yam, cocoyam, cocoa, ginger and plantain. Thirty eight percent (38 %) of the farmers could not think of any crop that can be grown under cashew trees for additional income.

Majority of farmers do not keep animals on their farms but a small number (26.3 %) keep bees, chickens, snails and sheep.

The Giant Snails of West Africa: a possible addition to cashew

Ginger Plants Growing under Cashew Trees in Ghana

2.1.3 Agrochemical usage

Almost all the farmers (<90 %) do not use chemical pesticides or fertilizers in their farms. The *Oecophylla* red ants were widespread and used as biological agents for pest control on cashew orchards.

2.1.4. Nut production on farms

Trees begin to flower in October and nuts are collected every 3 days from January and ends in May on most farms. Most farmers (89.7 %) produce between one and 40 full bags (100 kg bags thus 100-4000kg) of nuts per year which are dried for between 1-3 days before selling to buyers at an average price of GHC 1.00 per kilogram. Cashew apples are not utilized for anything but thrown away onto the farm floor.

2.1.5. Cashew farmer-beekeepers

A small number of cashew farmers (17.1 %) keep bees on their farms for pollination and also to harvest honey. Majority of these farmers attended training workshops that were one to two weeks long. Sixty-nine percent (69 %) of the farmer-beekeepers manage between 1 and 20 top bar hives (Kenyan or Saltpond types). Thirty-seven and a half percent (37.5 %) of the beekeepers do not have basic equipment (bee suit, smoker and a hive tool) but have hives on their farms. Twenty-one percent (21 %) of the beekeepers are in groups or associations and 100 % of all equipment is individually owned. Beekeepers harvest honey two or three times in a year, normally in March and April. Majority of them (80 %) process the honey combs to liquid honey by crushing and draining with baskets. Only 40 % process broken combs into beeswax and a small number (6.7 %) collect propolis. Majority of the beekeepers (80 %) produce between 6-80 kg of honey in a year with an average yield of 7-21 kg per hive per year. Honey is mainly sold in bulk to buyers at a price of GHC 50.00-60.00 (USD25-30) per gallon (7litres).

Beekeeping extension support is not available and beekeepers are confronted with challenges of colony absconding, stealing of harvest and hives, high cost of equipment, pests and bush fires.

Honey

Wax

Propolis

2.2. Findings from interviews in Benin

2.2.1. Cashew farmers

Cashew farmers, some of whom are beekeepers from 11 communities in 5 districts were covered in the study. Majority of these (92.5 %) were males in an age bracket of 46-55 years and with basic level of

education. Majority of farms in the areas covered (92.3 %) are between 2 ha and 20 ha and are between 5 and 20 years old.

2.2.2. Crop and animal integration

None of the farms have any crop growing at the undergrowth and only 3 farmers keep chickens and cattle. Over 90 % of cashew farmers interviewed in Benin keep bees on their farms. All the farmers could not think of any crop that can be cultivated under the trees that could earn them extra income. It was however observed that the spice, *Aframomum melegueta* (also known as Guinea pepper) was growing wild in the forest vegetation adjourning cashew orchards. Its integration into cashew orchards could be explored.

Aframomum melegueta (Guinea pepper)

2.2.3. Agrochemical usage

Over 80 % of the farmers do not apply chemical pesticides or use chemical fertilizers on their farms. Here again the *Oecophylla* ants are widely adopted on farms for biological pest control.

2.2.4. Nut production on farms

Majority of orchards (78.4 %) begin to flower in November and first nuts are collected in January and continue until May. Many farmers (94.7 %) pick nuts every 3 days and collect between 1 and 35 full bags (100 kg bags thus 100-3500kg) in a season. The nuts are dried for 3 days before selling them to buyers at a price of between CFA 175.00 and 350.00 (US$ 0.35-0.70[∞]) per kilogram. Only 13.2 % of the farmers make use of the cashew apple, some of them into fruit juice and alcohol.

2.2.5. Cashew farmer-beekeepers

About 50 % of the cashew farmers covered in the study keeps bees on their farms mainly for the production of honey; not very much for the pollination of the crop. Sixty-five percent (65 %) of the farmers attended training workshops for between 1 and 2 weeks to learn how to keep bees. Majority of beekeepers (65 %) manage between 6 and 20 Kenyan top bar hives that are made of concrete. About sixty percent (60 %) of the beekeepers do not have basic equipment (bee suit, smoker and a hive tool) but keep bees on their farms. Most beekeepers buy and keep their own equipment even though over 80 % belong to associations or groups in the communities. Majority of beekeepers (76.2 %) make one harvest a year in March and April and process the combs into liquid honey using the method of crush and drain using baskets. Most beekeepers (68.4 %) do not regard beeswax as an economic hive product. Over 70 % of farmers produce between 5 and 50 kg of honey per year with an average yield of 7-14 kg per hive per year. The honey is sold to bulk buyers at between CFA 1,125.00 and 1,500.00 (US$ 2.25-3.00) per kg.

There was no beekeeping extension support in the study area covered and so farmers were confronted with management problems (pests, absconding, etc.). Stealing of harvests and also availability and high cost of equipment were other problems that beekeepers had to deal with. A summary of the responses above is presented in Table 1.

[∞]2013 exchange rate of US$ 1.00 = CFA 500.00

Table 1: A summary of responses to the Questionnaire administered to farmers in Ghana and Benin.

No	PARAMETER/INDICATOR	GHANA (%)	BENIN (%)
1	Males interviewed	78.8	92.5
2	Females interviewed	21.2	17.5
3	Agro-Chemical usage	< 10	< 20
4	Cashew farm intercropped with other crops	12	0
5	Farmers Keeping animals on farm	26.3	0
6	Farmers Keeping bees on the farm	17.1	57.5
7	Bee hives in Ghana farm (1-20); in Benin (6-20)	69	65
8	Basic beekeeping equipment ownership	62.5	40
9	Farmers joining beekeeping associations	21	80
10	Processing method using crush and drain	80	76.2
11	Annual honey production (Ghana: 6-80 kg; Benin: 5-50 kg)	80	70
12	Productivity of farmers' hives (Ghana: 7-21 kg; Benin: 7-14 kg honey/hive/yr)	80	70
13	Processing of empty broken combs into beeswax	40	31.6
14	Availability of beekeeping extension services	0	0
15	Annual nut production of farmers (Ghana: 100-4000 kg; Benin: 100-3,500 kg)	89.7	94.7
16	RCN drying (1-3 days)	89.7	94.7
17	Farmers processing cashew apple	3.8	13.2

Ref. SPSS analysis of questionnaire data (attached pdf files)

3.0. The integration of beekeeping into cashew orchards

3.1. Productivity of honeybee colonies in cashew orchards

An average of 20.7 kg and 13.7 kg of honey was produced per colony per season in Ghana and Benin respectively (Table 2). Table 3 shows a similar trend for beeswax production in colonies: 1.4 kg for Ghana

and 0.92 kg per colony for Benin. Propolis production as shown in Table 4 was also higher for colonies in Ghana than in Benin (0.37 kg and 0.26 kg respectively)

Table 2: Honey production of hives in cashew orchards in Ghana and Benin

Colony No.	Ghana (kg)	Benin (kg)	REMARKS
1.	23.5	4.2	
2.	35.5	0	The harvest of the colony in Benin was stolen
3.	0	28.8	The colony in Ghana absconded
4.	10.5	11.2	
5.	35.5 + 15	7.5	2 harvests were carried out in Wenchi, Ghana within the study period
6.	0	6.5	The colony in Ghana absconded
7.	16.5	13.9	
8.	8.5	24.1	
Total	**145**	**96.2**	
Mean	**20.7**	**13.7**	
RANGE	**8.5-35.5**	**4.2-28.8**	

Table 3: Beeswax production of hives in cashew orchards in Ghana and Benin

Colony No.	Ghana (kg)	Benin (kg)	REMARKS
1.	1.6	0.28	
2.	2.4	0	The harvest of the colony in Benin was stolen; hive was burnt
3.	0	1.93	The colony in Ghana absconded
4.	0.7	0.75	
5.	2.4+1.01	0.5	
6.	0	0.44	The colony in Ghana absconded
7.	1.1	0.93	
8.	0.57	1.62	
Total	**9.78**	**6.45**	
Mean	**1.4**	**0.92**	
RANGE	**0.57-1.6**	**0.28-1.93**	

Table 4: Propolis production of hives in cashew orchards in Ghana and Benin

Colony No.	Ghana (kg)	Benin (kg)	Remarks
1.	0.3	0	No harvest in Benin
2.	0.4	0	The hive was burnt in Benin
3.	0	0.2	No harvest in Ghana
4.	0.25	0.2	
5.	0.45+0	0.25	
6.	0.4	0.3	
7.	0.35	0.3	
8.	0.45	0.3	
Total	**2.6**	**1.55**	
Mean	**0.37**	**0.26**	
RANGE	**0.25-45**	**0.2-0.3**	

3.2. Effects of the integration of beekeeping on raw cashew nuts (RCN) yields of orchards

Table 5 shows the results of effective pollination activities of honeybee colonies in the experimental orchards. An average of 9.1 kg/tree and 4.2 kg/tree was recorded for orchards with and without bee colonies respectively in Ghana. There were similar yield increases in Benin (6.75 kg/tree with bees and 2.16 kg/tree without bees). The indication is that the presence of honeybees in orchards improves RCN yields to up to 102.2 % in Ghana and 212.5 % in Benin (Table 5 & 6; Fig. 1 & 2).

The Result of Effective Pollination of a Cashew Panicle (32 fruits counted)

Table 5: RCN Yields of cashew Trees in Ghana (kg/tree)

ORCHARD LOCATION	WITH BEE COLONIES (KG/TREE)	WITHOUT BEE COLONIES (KG/TREE)	% YIELD INCREASE
KRANKA	11.3	5.2	117.3
TANOBUASE	12.1	3.8	218.4
WENCHI	6.96	3.99	74.4
BADU	6.0	3.9	75.0
TOTAL	**36.36**	**16.89**	
MEAN	**9.1**	**4.2**	**116.7**

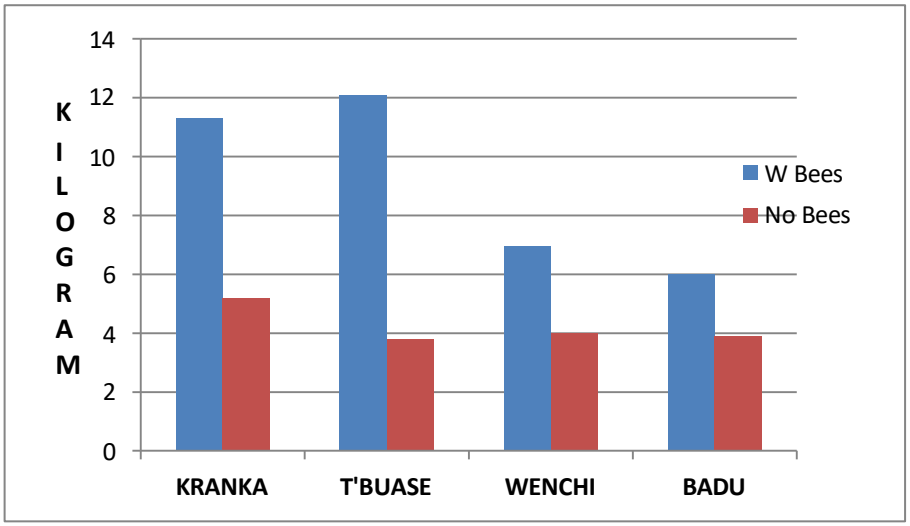


Figure 1: RCN Yields in Cashew Orchards in Ghana With and Without Honeybee Colonies (2012/2013 Season)

Table 6: RCN Yields of cashew orchards in Benin (kg/tree)

ORCHARD LOCATION	WITH BEE COLONIES (KG/TREE)	WITHOUT BEE COLONIES (KG/TREE)	% YIELD INCREASE
Ouesse	13.8	3.15	337
Tchaourou	7.01	3.1	126.3
Parakou	2.3	0.8	182.5
Bassila	3.9	1.6	144.6
TOTAL	**27.01**	**8.65**	
MEAN	**6.75**	**2.16**	**212.5**

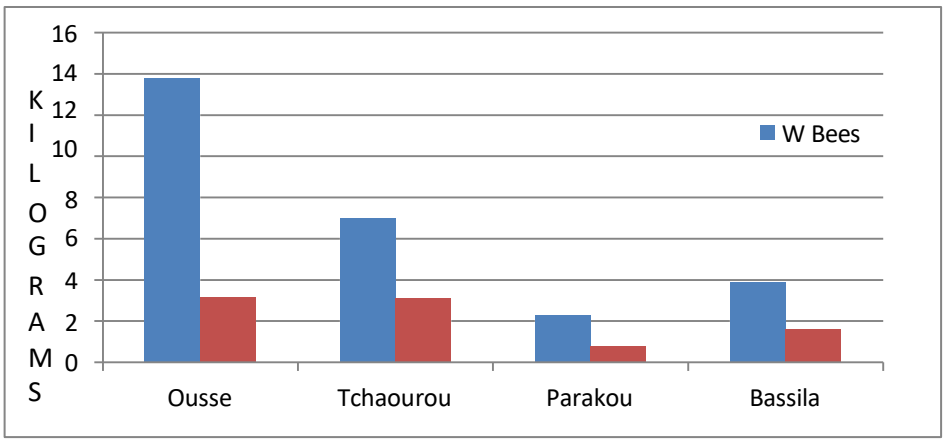


Figure 2: RCN Yields in cashew orchards in Benin with and without honeybee colonies (2012/2013 season)

3.3. Effect of honeybee integration on the quality of RCN in orchards

The presence of honeybee colonies in orchards did not affect RCN quality significantly as measured by the weight of 200 nuts sampled in the same growing area (Fig.3 & 4)

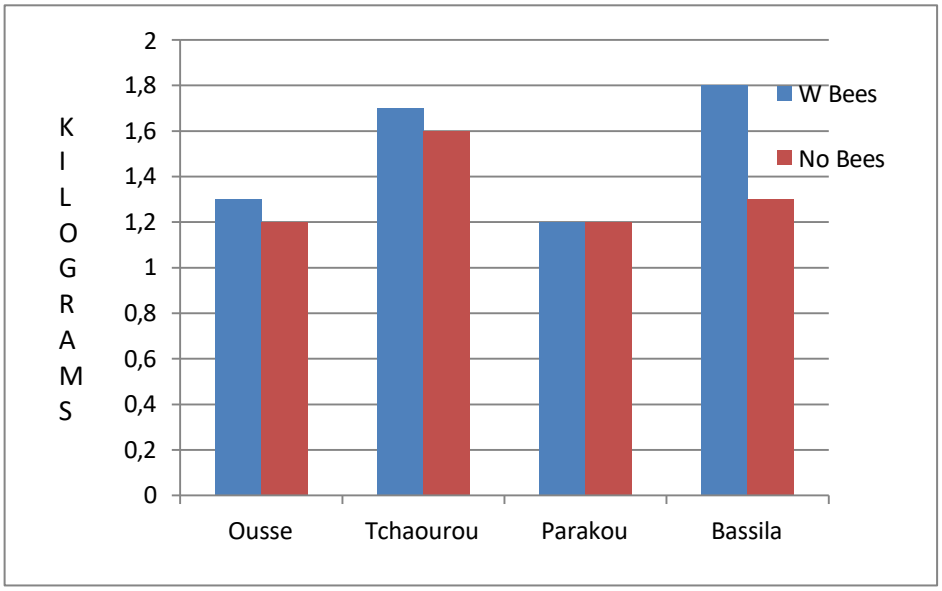


Figure 3: RCN quality in orchards with and without honeybee colonies in Benin (2012/2013 season)

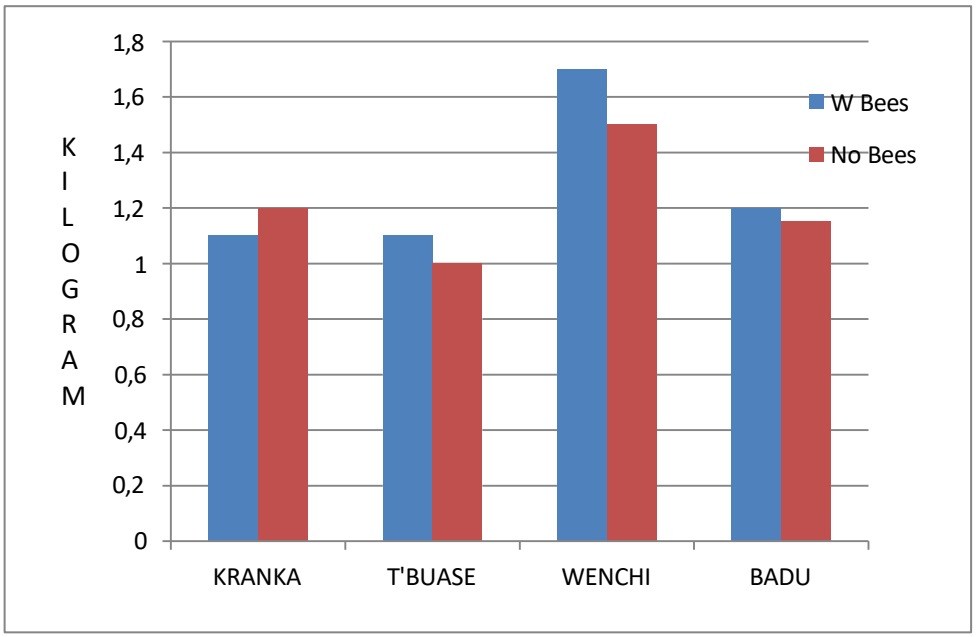


Figure 4: RCN quality of orchards with and without honeybee colonies in Ghana (2012/2013 season)

4.0. Discussion

The study has established that the incorporation of beekeeping into cashew plantations and farms will improve the productivity (yield) and income levels of farmers in two ways: the sale of hive products (honey, beeswax and propolis) and also increased nut yields as a result of effective pollination activities of worker honeybees. The baseline rate of incorporation has been established as two colonies per hectare of orchard. This means that a cashew farmer with 5 ha orchard could operate an apiary of 10 honeybee colonies.

However this number could be increased gradually depending on the availability and richness of additional forage resources within the cashew ecosystem and the presence of nearby apiaries. It was observed during the study that workers of honeybees sometimes will collect cashew apple juice for honey production in the hive. It must be noted that honeybees do not depend entirely on the cashew trees for forage. Other flowering plants in the nearby vegetation provide additional forage resources especially during the off flowering period of the cashew trees (June to October). In effect these other forage sources sustain bee colonies in the cashew ecosystem. Again, the honeybee, *Apis mellifera adansonii* is not the only bee pollinator of cashew flowers. However large numbers of honeybee workers on the farm (over 70,000 from the 2 colonies for 1 ha) ensured that every receptive hermaphrodite flower was visited and fertilized to produce fruits. It must be noted that a single cashew tree at a time produces about 767 flower panicles of which 63-67 are hermaphrodite (male and female structures in one) and 250-400 male flowers. All the hermaphrodite flowers must be visited by pollinators to effect fertilization for fruit set*. Several other bee species including stingless bees and small solitary bees also contribute to the effective pollination of cashew flowers. Studies conducted in several cashew producing countries such as Brazil and India have attributed low yields of orchards to inadequate pollination. The notable significant higher RCN yields recorded in farms with honeybee colonies are in line with other studies conducted in India. Reddi (1987) found out that between 25 and 72 % of cashew flowers were not pollinated in nature because of pollinator limitation and stated that an increase of 157.8 % was possible if flowers received adequate pollen [α] The significant higher yields recorded on farms in Ghana over Benin is attributed to low species numbers of other bees recorded in orchards in the cashew belt of Benin. Many stingless bees that were found in orchards in Ghana were absent in Benin.

An enterprising farmer could additionally cultivate shade loving crops (e.g. ginger and *Aframomum melegueta)* under the cashew trees to improve the farm income. Domestic animals such birds, sheep and goats on the farm will also add to family wealth and improve health.

However there is the need to upgrade the knowledge capacities of beekeepers in both countries in the management of apiaries, especially in the cashew production system. Current methods of harvesting and processing of quality hive products must be upgraded. Improvement and availability of appropriate but effective beekeeping equipment such as extractors for honey and beeswax must be a consideration for effective management.

*****Bigger, M. 1960. *Selenothrips rubrocinctus* Giard and the floral biology of cashew in Tangayika. *East Africa Agricultural Journal*. **25**,229-234.

[α] Reddi, E. U. B. 1987. Under-pollination: a major constrain of cashew nut production. *Proceedings, Indian National Science Academy*. **B 53**, 249-51.

4.1. The Declining RCN yields during the 2011/2013 seasons in Ghana and Benin

Total RCN yields recorded on farms in the two countries in 2013 were below the figures of the previous years (Fig.5, Appendix 2).

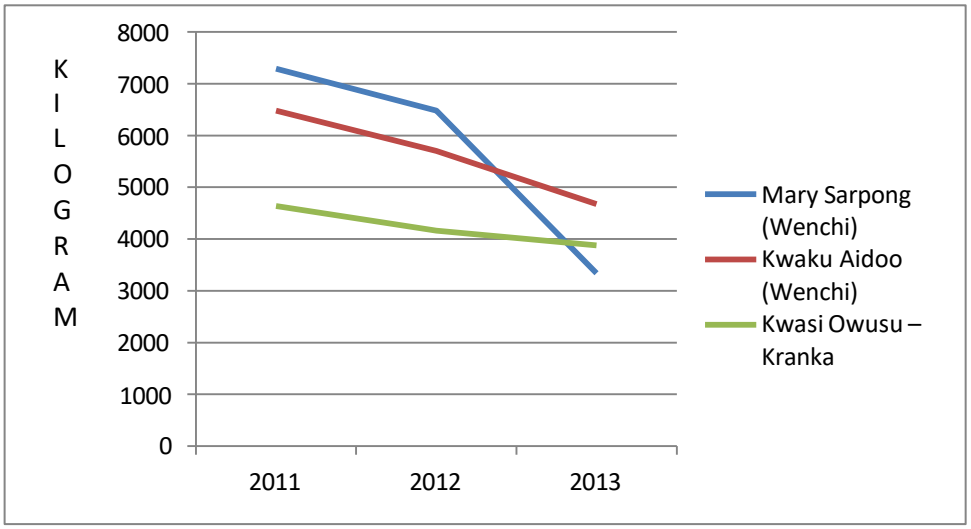


Figure 5: Declining RCN production on three farms in Ghana (2011-2013).

Most farmers complained of reducing production figures and attributed the trend to unfavourable climatic conditions. In Benin the long nut collection season was truncated in March, 2013 when a rain storm accompanied by very strong harmattan winds destroyed flowers and immature fruits. By the end of March, 2013 the nut collection season had ended on most farms in Benin. However the season in Ghana extended to early June.

5.0. Conclusions and recommendations

Cashew farmers should be encouraged to additionally cultivate shade loving crops under the cashew trees to improve farm income. Ginger and black pepper have great potentials in the cashew farming system. Again domestic animals such birds, sheep and goats on the farm will also add to family wealth and improve health.

However there is the need to upgrade the knowledge capacities of beekeepers in both countries in the management of apiaries, especially where honeybees are introduced into the cashew production system. The seasonal beekeeping cycle and its specific management activities are not well understood by many beekeepers. Pests of bees in and outside the bee hive must be controlled to avoid absconding of colonies. In recent times stocking of new bee hive with natural swarms is becoming difficult. There is therefore the need to expose beekeepers to other methods of colony multiplication. Another area of improvement is hive product processing and handling. Beekeepers should be upgraded to harvest and process high quality products which are highly demanded by consumers.

Improvement and availability of appropriate but effective beekeeping equipment such as extractors for honey and beeswax must be a consideration for the production of quality products. The basket used in honey extraction in both countries exposes the honey to unhygienic conditions in some situations. An

improved system using a food grade plastic drum or bucket could be adopted. The current situation where many beekeepers in both countries throw away empty combs without processing them into beeswax could be turned around with a simple steam wax extractor. The boiling water extraction method is cumbersome and labour intensive. The cost of bee hive construction is becoming more expensive in both countries because good wood is unavailable. In Benin the cost of a concrete hive could be reduced with the introduction of sawdust into the concrete mixture. This will also reduce the over 90 kg hive to a weight that will be easy to handle. Beekeepers in both countries should be introduced to alternative locally available hive building materials that are cost effective. Hive entrances that are placed in the middle makes colony manipulation difficult. Beekeepers should construct hives with entrances at their far ends.

Protective clothing is essential in honeybee management. The veil which protects the beekeeper's face is most important. Beekeepers in Benin could adopt the veils used in Ghana for effective protection of the face.

Stealing of hives and hive products is becoming a challenge to many beekeepers and must be considered seriously. Beekeepers in both countries keep permanent apiaries so systems where hives and colonies are locked up to make them inaccessible to intruders need development.

The realization of the great benefits of integrating beekeeping into cashew production can only become possible if adoption procedures take into consideration the recommended management systems generated by this study, one of which is 'the Master Beekeeper Model' (Appendix 3). Beekeepers that will operate these models need to be upgraded in the management of honeybee colonies in cashew orchards. A well- developed production manual in addition to the availability of standard equipment made by trained and commissioned fabricators could support their operations. The study has therefore provided answers to some important questions cantered around the beekeeping-cashew integration (Appendix 4).

Contact

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June, 2013

Appendices

Appendix 1: Productivity of Honeybee Colonies in Cashew Orchards in Ghana and Benin in the 2011-2013 Season (kg/hive/season)

COLONY NO.	HONEY		BEESWAX		PROPOLIS		REMARKS
	Ghana	Benin	Ghana	Benin	Ghana	Benin	
1.	23.5	4.2	1.6	0.28	0.3	0	
2.	35.5	0	2.4	0	0.4	0	
3.	0	28.8	0	1.93	0	0.2	
4.	10.5	11.2	0.7	0.75	0.25	0.2	
5.	35.5 + 15	7.5	2.4+1.01	0.5	0.45+0	0.25	
6.	0	6.5	0	0.44	0.4	0.3	
7.	16.5	13.9	1.1	0.93	0.35	0.3	
8.	8.5	24.1	0.57	1.62	0.45	0.3	
Total	**145**	**96.2**	**9.78**	**6.45**	**2.6**	**1.55**	
Mean	**20.7**	**13.74**	**1.4**	**0.92**	**0.37**	**0.26**	
RANGE	**8.5-35.5**	**4.2-28.8**	**0.57-1.6**	**0.28-1.93**	**0.25-45**	**0.2-0.3**	

Appendix 2: Production Figures of Experimental Farms in Ghana (2011 – 2013)

NAME OF FARMER	FARM SIZE (HA)	TOTAL RCN YIELDS (KG)			RCN YIELDS PER HA			2013 YIELD /TREE	REMARKS
		2011	2012	2013	2011	2012	2013		
Mary Sarpong (Wenchi)	9.3	7290	6481	3342	783.87	697	359	5.2	No bees
Kwaku Aidoo (Wenchi)	7.9	6480	5700	4675	820	721.52	592	6.96	With bees
Monastry (Tanobuase)	44.3	50000	43000	???	1128.68	970.65	844	12.1	With bees
Effah Kwame – Nkronza-	2.9	4000	3564		1379.33	1228.9			
Kwasi Owusu – Kranka	5.2	4640	4160	3880	892.3	800	746	11.3	With bees

Appendix 3: Beekeeping Models: Management of Honeybee Colonies in Cashew orchards

a. Cashew farmer-beekeeper model

FEATURE OF MODEL	RESOURCES REQUIRED/CAPACITY BUILDING					
	UPGRADING/TRAINING	ESTIMATED COST OF EQUIPMENT (US$) - 2013			TOTAL OUTPUT/YR OF MODEL	MAIN ISSUES
			UNIT COST	TOTAL COST		
1 Cashew farmer with 10 hives **Upgraded to 20 hives in 2nd and 3rd year**	1. Aapiary management 2. Harvesting, processing and packaging	10 hives 10 stands 10 hive locks 2 bee suits 1 smoker 2 hive tools 2 wellington boots 2 Harvesting containers 2 Honey storage containers 1 Drum crusher drainer 1 Steam wax extraction 1 Modified kitchen/processing room	45.00 10.00 10.00 50.00 30.00 5.00 10.00 15.00 15.00 100.00 300.00 100.00 **TOTAL**	450 100 100 100 30 10 20 30 30 100 300 100 **US$ 1,370.00**	Income from 1 colony =US$ 104.13. 10 colonies will give **US$ 1041.30** In Benin **US$ 692.00**	1.The farmer must have some experience in beekeeping

b. The Master Beekeeper (MB) model

FEATURE OF MODEL	RESOURCES REQUIRED/CAPACITY BUILDING					
	UPGRADING/ TRAINING	ESTIMATED COST OF EQUIPMENT (US$)			TOTAL OUTPUT/YR OF MODEL	MAIN ISSUES
			UNIT COST ($)	TOTAL COST		
1 beekeeper with 50 hives **To manage 50 farmers with 5 hives each=250** **Total no. of hives=300** **To work with 2 assistants ('Technicians')** **Upgrading in 2nd or 3rd year** **5 additional hives per farmer** **Total hives=550**	1.Management of Apiaries/ Cashew farm 2.product harvesting, processing and handling 3.Market development 4.Farmers to be given orientation on the presence of bees on farms	2 motor bikes 1 light truck 300 hives 300 metal stands 300 hive locks 30 swarm boxes 4 bee suits 3 smokers 3 wellington boots 3 hive tools 1 processing house 2 tank crush drainer 1 honey press 50 Honey storage containers 50 Harvesting buckets 1 steam wax extractor	1000 10,000 45 10 10 20 50 30 10 5 3,000 100 600 15 15 300 **TOTAL**	2000 10,000 13,500 3,000 3,000 600 200 90 30 15 3000 200 600 750 750 300 **US$ 38,035.00**	Ghana 300 colonies will give **US$ 31,278.00** In Benin **USD 20,760.00**	1. Sharing of harvest between MB and farmers 2.Salary/benefits of assistants

c. The co-operative/beekeeper association model

FEATURE OF MODEL	RESOURCES REQUIRED/CAPACITY BUILDING					
	UPGRADING/ TRAINING	ESTIMATED COST OF EQUIPMENT (US$)			TOTAL OUTPUT/YR OF MODEL	MAIN ISSUES
			UNIT COST ($)	TOTAL COST		
100 farmers with 5 hives each = 500 **1 Technician to manage 20 farmers =100 hives** **5 Technicians involved** **Upgrading in 2nd/3rd year** **5 additional hives per farmer** **Total hives=1000**	1.Intensive training of technicians in both theory and practical beekeeping 2.short management training of a supervisor or persons in charge of the project 3.Farmers to be given orientation on the presence of bees on farms	5 motor bikes 1 light truck 500 hives 500 metal stands 500 hive locks 50 swarm boxes 6 bee suits 5 smokers 6 wellington boots 6 hive tools 1 processing house 2 tank crush drainer 1 honey press 100 Honey storage containers 100 Harvesting buckets 1 steam wax extractor FARMER'S PACKAGE 1 bee suit 1wellington boot	1000 10,000 45 10 10 20 50 30 10 5 3,000 100 600 15 15 300 50 10 **TOTAL**	5000 10000 22500 5000 5000 1000 300 150 60 30 3000 200 600 1500 1500 300 50 10 **US$ 56200.00**	In Ghana 500 colonies will give **US$ 52,130.00.** In Benin **US$ 34,600.00**	Payment of Technicians' salary 2.Contributions of members to the Co-op

d. The NGO/company model

FEATURE OF MODEL	RESOURCES REQUIRED/CAPACITY BUILDING					
	UPGRADING/ TRAINING	ESTIMATED COST OF EQUIPMENT (US$)			TOTAL OUTPUT/YR OF MODEL	MAIN ISSUES
			UNIT COST ($)	TOTAL COST		
200 farmers with 5 hives each = 1000 **1 Technician to manage 100 hives each (20 farmers)** **10 Technicians, 1 supervisor involved** **Upgrading in 2nd/3rd year** **5 additional hives per farmer** **Total hives=2000**	1. Intensive training of technicians in both theory and practical beekeeping 2. short management training of a supervisor or persons in charge of the project 3. Farmers to be given orientation on the presence of bees on farms	11 motor bikes 1 truck 1000 hives 1000 metal stands 1000 hive locks 100 swarm boxes 11 bee suits 10 smokers 11 wellington boots 11 hive tools 1 processing house 2 tank crush drainer 2 honey press 200 Honey storage containers Harvesting buckets 1 steam wax extractor FARMER'S PACKAGE 1 bee suit 1wellington boot	1,000 10,000 45 10 10 20 50 30 10 5 5,000 100 600 15 15 300 50 10 **TOTAL**	11000 10000 45000 10000 10000 2000 550 300 110 55 5000 200 1200 3000 15 300 50 10 **US$ 98,790.00**	In Ghana 1000 colonies will give **US$ 104,260.00**. In Benin **US$ 69,200.00**	1.Benefit arrangement between NGO/Company and farmers

Appendix 4: Overview of Key Questions addressed by the study

Key questions and answers:

Cashews:

1. How many bees do you need per ha of cashew farm for effective pollination?
   A maximum of two (2) bee colonies per ha.

2. How much increase in yield would be expected per ha?
   Between 117 and 212 % increase in RCN production

Income

3. How much income is expected from (i) Honey (ii) Wax (iii) Propolis/ ha of farm

Bee Product	Ghana		Benin	
Honey	41.4 kg	US$ 174.32	27.48 kg	US$ 82.44
Beeswax	2.8 kg	US$ 14.74	1.64 kg	US$ 46.00
propolis	0.74 kg	US$ 19.47	0.5 kg	US$ 10.00
Total		US$ 208.53		US$ 138.44

4. What input is needed for this income and what is the expected total output
   2 bee hives
   2 hive stands
   1 smoker
   1 bee suit
   1 pair of gloves
   1 pair of wellington boots
   1 hive tool
   2 harvesting buckets
   2 honey jelly cans (20 l)
   The expected output for Ghana is US$ 208.53 and Benin US$ 138.4. However the equipment listed above with the exception of the hives and stands could be used for more than just 2 bee colonies.

Cashew apples

5. Cashew apples are fodder for bees. What is the interaction of apples and bees?
   Honeybee workers collect cashew apple juice as additional source of sugars and also water. The sugars are used in honey production.

6. What are the inter-relationship between how much apples are consumed by bees and final output of these bees in terms :
   I. Productivity of the cashew trees
      Contribute to the overall well-being of the bee colony; may distract workers from pollinating cashew flowers.

II. Production of honey,
Contribute to the production of honey, apple juice contains fructose and the bees convert this to produce honey.

III. Production of beeswax and
No direct relationship; however bees are sustained by honey and can secrete wax for comb building.

IV. Production of propolis by these bees?
Not related directly; ingestion of honey provide energy for propolis collection.

Organizational

7. Who owns bee keeping structures currently?
   Beekeepers (cashew farmers or other crop farmers) in Ghana operate individually and have 100 % ownership of structures.
   About 80 % of beekeepers in Benin are in associations and 90 % of the structures they operate are individually owned; 10 % is owned by the associations.

8. Who are the managers of these facilities?
   In Ghana beekeeping facilities are 100 % managed by individual beekeepers. However in Benin about 20 % of the beekeepers manage their own operations; 80 % are in associations which have had funding support in training and equipment through NGOs. Beekeeping Technicians of these NGOs organize harvesting of honey from the bee hives of farmers.

9. What is their knowledge, skills regarding beekeeping?
   Very basic beekeeping knowledge; in-depth colony management and product processing and handling are lacking

10. Do they need specific training regarding the subject? Where are the gaps?
    There is great need for upgrading in colony management and product processing, packaging and marketing

11. How much productivity increase is expected from bee-pollination of cashew trees?
    An increase from 2.16-6.75 kg/tree in farms with bees in Benin; in Ghana from 4.2-9.1 kg/tree

12. How can we use bee keeping to measure productivity?
    That cashew orchards with adequate populations of honeybees (2 colonies/ha) will boost make for effective pollination of trees resulting in between 116.7 and 212.5 % increase in RCN production

13. What kind of strategy would be more effective?
    Farmers could be supported to develop apiaries close to their orchards (2 colonies/ha). In some cases the cashew farmers can be trained to manage his/her bee colonies. However in most cases Master Beekeepers, NGOs and companies could be commissioned to manage the apiaries on behalf of farmers (see details of operating models)

14. What is a reasonable scale in projecting a business plan for beekeeping?
    An apiary size of between 5 and 10 beehives per farmer

15. What is the nature of existing beekeepers? What are their capacities? What are the dynamics within the groups?

Many beekeepers operate up to 10 hives on individual basis; about 80 % of beekeepers in Benin work in associations that had received some kind of support from development agencies

16. What kind of equipment can be used by Farmers Based Organizations and cooperatives, SMEs and large scale beekeepers?

    Additional bee hives
    Centrally located processing and handling facility equipped with extractors storage and packaging containers.
    Appropriate transportation means to gather unprocessed honeycombs from members to the central Honey House.
    Note: Details of equipment needed to operate various levels of beekeeping are spelt out in Appendix 3.

17. What are the opportunities and cost of operation per model?
    Demand for bee products (honey, beeswax and propolis) is high in both the local and international markets. Prices are very good and farmers when organized can take advantage of these opportunities (Ref to details in Appendix 3).

18. What skills and capacities do the current beekeepers have?
    Beekeepers have attended short start-up workshops to produce only one bee product, honey. They are however organized into associations

19. What are their success factors?
    They manage to produce and supply honey into the beekeeping value chain

20. What are their challenges?

i. They lack adequate knowledge on Colony management in terms of pest and diseases which lead to absconding.
ii. They lack knowledge in proper processing methods of bee products and also lack access to appropriate processing equipment.
iii. They lack knowledge in good methods of producing and processing beeswax and propolis. A steam wax extractor could enable beekeepers produce quality beeswax for additional income.
iv. Demand for bee products is high in both internal and external markets. However beekeepers in both countries have not accessed these potential markets because their hive products are poor in quality and marketing is poorly organized.
v. Good quality packaging material for honey and other hive products are difficult to access. In Benin for example honey is packaged in recycled 1 l alcohol bottles. Different volumes of food grade plain.
vi. Plastic or glass jars are not available. Consumption of local honey could increase if products are of high quality and well presented. Export market demand top quality products also.

Appendix 5: Profiles of some stakeholders and collaborators in Ghana and Benin

a. Centre For Integrated Tropical Apiculture (CIAT) Benin

Mr. Sarki Yantannou, Parakou

- The leading beekeeper in Parakou, promoter of beekeeping with farmers, cashew farmers
- Has established an impressive beekeeping centre showcasing bees and beekeeping.
- He manages 50 hives on a 10ha bee forest with a conference / training and exhibition centre and
- Has a team of technical officers who are in the communities and spearheading promotion activities. These are trained by him to advance beekeeping with the local people and are the leaders from farmer groups.
- Develops project proposals and seek funding on behalf of farmers.
- Hives promoted; the cement hive, zinc cylindrical hive and bottle stand.

A typical farmer package/community:

Year 1: 10 Cashew farmer member group
1 Technician
10 Hives each and other equipment donated
1 Processing house

Year 2: 10 more new beekeepers with 10 hives. The 10 old beekeepers are given additional 10 hives each total 300 hives.

Comment

CIAT could look into bulk purchasing of honey from beekeepers for packaging and sale. This could address the problem of honey marketing facing beekeepers.

b. Academy Nactariale Education Et Culture (ANEC), Benin

Operational area: Djougou

Core areas: beekeeping, education and culture

Beekeeping components:

- 10 groups (between 27-30 members)
- Farmers buy their own hives and other equipment
- One technician helps set them up and also helps with management
- ANEC buys the honey for packaging @ CFA 1200.00-1300/litre.
- Packages into 0.5l, 1l bottles

Source of funding: its own resources.

c. Wenchi farm institute, Ghana

- A centre for the basic training of beekeepers in the area.
- The brain behind the beekeeping section of the institute left.
- One Mr. Tempuri has taken over but lacks capacity and resources
- Must be upgraded with knowledge in beekeeping.
- He has only a personal smoker, a bee suit and some hives.
- Uses his kitchen for processing his honey; beeswax processing faulty
- However beekeeping workshops are not supported by the institute.

d. Ofuman agricultural centre, Ghana

Mr. Thomas Ahima (first best farmer, Ghana)

- Production of cashew, cocoa, teak, vegetables with irrigation facilities,
- Has infrastructural facilities for processing grains, storage etc.
- He used to operate a graduate attachment /internship programme for agricultural graduates,
- Has organized and formed an association of cashew farmers with over 100 members
- Has a Peace Corps volunteer supporting a beekeeping project based on the farm sponsored by Peace Corps Ghana providing training and equipment.
- Has some old hives and has been harvesting and processing honey;
- Uses a solar extractor for processing honey (this device overheats the honey)

e. Ghana Permaculture Institute, Techiman Ghana

Mr. Paul Yeboah

- Operates in Techiman and Nkoranza
- Developing a demonstration centre in Nkoranza.
- The centre organizes farmers into moringa production (leaf powder, oil and soap) for the export markets in the UK and South Africa.
- Promotes good agriculture practices e.g. mixed cropping, mixed farming etc.
- Also in beekeeping and has organized beekeepers into an association with 1000 members
- Planning to export their honey to the UK- the Lush co. Ltd.
- The beekeepers lack capacity in training especially in quality production of honey, beeswax
- Exploring the use of cement in hive constructing since wood has become expensive and unavailable.

Appendix 6: Questionnaire items for cashew farmers in Ghana and Benin

Promoting Competitiveness of African Cashew Farmers

The African Cashew Initiative (aci)

Questionnaire Items for the Study of Beekeeping and the Cashew Production System in Ghana and Benin

OCTOBER, 2012

CASHEW FARMERS

INTRODUCTION AND CONSENT

Hello and thank you for talking to us. We are working with the African Cashew Initiative (ACi), a program that is intended to increase the income of households growing and harvesting cashew nuts. This program is funded by GIZ, the German technical cooperation agency. We would like to ask you some specific questions about your cashew farming activities and/or bee keeping. This information is important to know as it will tell us how to improve the success of projects meant to support cashew farmers in local communities. These questions form part of a study by the African Cashew initiative which is aimed at finding out how beekeeping relates to the productivity of cashew trees and impacts farmer income.

The interview will take about 10-15 minutes. The data provided in the survey may be summarized in the report that we will prepare; this report will be shared with ACi and its partners, including companies that grow, process and purchase cashews in a consolidated or aggregated manner without specific mention of your organization. Your participation is completely voluntary. If you have any questions about the survey, you may contact the ACi office in Accra, Sunyani (Ghana), or Parakou & Natitingou (Benin).

A. Farmer's personal data

1. Name……
2. Address ……
3. Town/village…….
4. District & Region ……..
5. Sex:
   Male [ ]
   Female [ ]
6. Age:
   a) 18 – 25yr [ ]
   b) 26 – 35yr [ ]
   c) 36 – 45yr [ ]
   d) 46 – 55yr [ ]
   e) 56 – 65yr [ ]
   f) 66yr & above [ ]

7. Educational background
   a) Up to basic (JSS) [ ]
   b) High school (SSS Level) [ ]
   c) Teacher's Cert. [ ]
   d) University Cert/Dip. [ ]
   e) University Degree [ ]
   f) Non-formal Ed [ ]
   g) Others please specify……

B. Farmer's cashew orchard

8. How big is your farm?
   a) <2 ha [ ]
   b) 3-5 ha [ ]
   c) 6-10 ha [ ]
   d) 11-20 ha [ ]
   e) Over 20 ha [ ]

9. How old is your farm?
   a) 0-5yrs [ ]
   b) 6-10yrs [ ]
   c) 11-20yrs [ ]
   d) More than 20yrs [ ]

10. Which of these best describe land area bordering your cashew farm?
   a) Food crop farms [ ]
   b) Forest lands [ ]
   c) Natural fallow lands [ ]
   d) Neighbour's cashew farm [ ]
   e) Other fruit tree farm [ ]
   f) Others, specify [ ]

11. Do you **at this time** intercrop your farm with other crops?
   a) Yes [ ]
   b) No [ ]

12. If yes, list the food crops.
   a) ……
   b) ……
   c) ……
   d) ……
   e) ……

13. Name any crop you **<u>can grow under your cashew trees now</u>** to bring additional income?
    a) ……
    b) ……
    c) ……
    d) ……
    e) ……

14. Do you keep animals on your farm?
    a) Yes [ ]
    b) No [ ]

15. If yes, list the animals.
    a) ……
    b) ……
    c) ……
    d) ……
    e) ……

16. Do you spray your trees with chemicals pesticides?
    a) Yes [ ]
    b) No [ ]

17. If yes name the chemicals……..

18. Why do you spray your cashew trees?
    a) Against insect attack of flowers [ ]
    b) Against insect attack on fruits & nuts [ ]
    c) Against insect attack on leaves [ ]
    d) Against fungal attack [ ]
    e) Others, specify…….

19. Do you apply any fertilizer to your trees?
    a) Yes [ ]
    b) No [ ]

20. If yes, name the fertilizer…….

21. Which month of the year do you observe first flowering on your trees?
    a) August [ ]
    b) September [ ]
    c) October [ ]
    d) November [ ]

e) Others, specify [ ]

22. Which month do you collect your first nuts from your farm?
    a) November [ ]
    b) December [ ]
    c) January [ ]
    d) February [ ]
    e) March [ ]
    f) Others, specify [ ]

23. Which month do you collect the last nuts from your farm?
    a) April [ ]
    b) May [ ]
    c) June [ ]
    d) July [ ]

24. How many months do you collect mature seed nuts from your farm?
    a) 2 months [ ]
    b) 3 months [ ]
    c) 4 months [ ]
    d) 5 months [ ]

25. How many (full) bags of nuts do you harvest in a year?
    a) 1-2 bags [ ]
    b) 3-4 bags [ ]
    c) 5-6 bags [ ]
    d) 7-10 bags [ ]
    e) Others, specify……

26. How frequent do you pick nuts from your farm within the season?
    a) Every 3days [ ]
    b) Every week [ ]
    c) Every 2weeks [ ]
    d) Every 3weeks [ ]
    e) Others, specify ……..

27. Do you dry the nuts before selling?
    a) Yes [ ]
    b) No [ ]

28. How long do you dry your nuts?
    a) 1-3 days [ ]
    b) 4-7 days [ ]

c) Up to 2weeks [ ]
d) Others, specify [ ]

29. What do you do with the fruits/apple from your farm?
a) Leave them on the farm [ ]
b) Sell them fresh in the market [ ]
c) Process them into fruit drink [ ]
d) Process them into alcohol [ ]
e) Others, specify……

30. Do you process the nuts before sale?
a) Yes [ ]
b) No [ ]

31. If yes, into what form?
a) Raw cracked nuts [ ]
b) Cracked & roasted nuts [ ]
c) Others, specify……

32. How much do you sell a kilogram of raw cashew nut? ……

33. Are you paid promptly for your produce?
a) Yes [ ]
b) No [ ]

34. If not, when are you paid?……

C. Beekeeping integration

35. Do you keep bees in your farm?
a) Yes [ ]
b) No [ ]

36. If yes, why do you keep bees in your farm?
a) To harvest honey [ ]
b) To harvest honey and beeswax [ ]
c) For the bees to pollinate my cashew flowers [ ]
d) For pollination and hive products [ ]
e) To scare away people from collecting my nuts [ ]
f) Others, specify ……

37. Where is your apiary (site for your hives)?
a) In the middle of my cashew farm [ ]

b) At the outskirt of my cashew farm [ ]
c) In a forest near my cashew farm [ ]
d) In a forest far away from my cashew farm [ ]
e) In somebody's farm far away from mine [ ]
f) Other places, specify ……

38. How many cashew farmers are in this community? ……

39. How many of them also keep bees on their farms? ……

40. Are there people in this community/area who keep bees only?
a) Yes [ ]
b) No [ ]

41. How many are they? ……

42. How did you learn to keep bees?
a) Beekeeping school [ ]
b) Training workshops [ ]
c) From school days [ ]
d) From parents/friends [ ]
e) From agricultural agents [ ]
f) Others, specify……

43. If (a) and/or (b), how long was your training?
a) 1-2 weeks [ ]
b) 1-2 months [ ]
c) 1 year [ ]
d) Others, specify ……

44. How many hives do you have?
a) 1-5 [ ]
b) 6-10 [ ]
c) 11-20 [ ]
d) 21-50 [ ]
e) Others, specify ……

45. How many of your hives have bees in them? ……

46. What type of hive do you use?
g) Kenyan top bar hive [ ]
h) Saltpond hive [ ]

i) Langstroth frame hive [ ]
j) Basket hive [ ]
k) Log hive [ ]
l) Clay pot hive [ ]
m) Others, specify .....

47. Which other equipment do you use in your beekeeping?
a) Metal stands [ ]
b) Wooden stands [ ]
c) Bee suits [ ]
d) Smoker [ ]
e) Hive tool [ ]
f) Honey press [ ]
g) Refractometer [ ]
h) Centrifugal extractor [ ]
i) Stainless steel tanks [ ]
j) Plastic drums [ ]
k) Others, specify .....

48. How much did you buy your beekeeping equipment above?
a) Bee hives .....
b) Metal stands .....
c) Wooden stands .....
d) Bee suits .....
e) Smoker .....
f) Hive tool .....
g) Honey press .....
h) Refractometer .....
i) Centrifugal extractor .....
j) Stainless steel tanks .....
k) Plastic drums .....
l) Others, specify .....

49. Who owns this equipment that you use for your beekeeping?
a) Myself [ ]
b) Members of my group [ ]
c) Others, specify .....

50. If (b), how many members are in the group?
a) 2-5 [ ]
b) 6-10 [ ]
c) 11-20 [ ]

d) 21-50 [ ]
e) Others, specify ……

51. Are they all cashew farmers?
a) Yes [ ]
b) No [ ]

52. Does your group have officers and a constitution?
a) Yes [ ]
b) No [ ]

53. Do you meet regularly as a group?
a) Yes [ ]
b) No [ ]

54. How many times do you harvest from your hives in a year?
a) One (1) time [ ]
b) Two (2) times [ ]
c) Three (3) times [ ]

55. Which months of the year do you harvest from your hives?
a) September-November [ ]
b) December-February [ ]
c) March-April [ ]

56. Which products do you harvest from your hive?
a) Honey [ ]
b) Beeswax [ ]
c) Propolis [ ]
d) Pollen [ ]
e) Royal jelly [ ]
f) Others, specify ……..

57. How do you process your honey combs into liquid honey?
a) Use of honey press [ ]
b) Use of centrifugal extractor [ ]
c) Use of solar extractor [ ]
d) Crashing and draining [ ]
e) Squeezing with my hands [ ]
f) Others, specify ……..

58. Do you process your empty combs into beeswax?

a) Yes [ ]
b) No [ ]

59. If yes how do you process the empty combs into beeswax?
a) Use of boiling water [ ]
b) Use of steam extractor [ ]
c) Use of solar extractor [ ]
d) Others, specify .....
e) I do not process for beeswax [ ]

60. How many kg/litres of the hive products above do you produce in a year?
a) Honey .....
b) Beeswax .....
c) Propolis .....
d) Pollen .....
e) Royal jelly .....
f) Others, specify .....

61. On the average how many gallons of honey do you get from one hive per harvest?
a) 1 gallon [ ]
b) 2 gallons [ ]
c) 3 gallons [ ]
d) 4 gallons [ ]
e) 5 gallons [ ]
f) Others, specify .....

62. How do you sell your hive products?
a) sell bulk to packers [ ]
b) sell bulk to industry [ ]
c) package and retail to community members [ ]
d) package and sell to shops and supermarkets [ ]
e) Others, specify .....

63. What are the selling prices of your hive products?
a) Honey .....
b) Beeswax .....
c) Propolis .....
d) Pollen .....
e) Royal jelly .....
f) Others, specify .....

64. Do you add value to your hive products?

a) Yes [ ]
b) No [ ]

65. If yes list your value added products
a) ……
b) ……
c) ……
d) ……
e) ……
f) ……

66. Is there any beekeeping extension support for your operation?
a) Yes [ ]
b) No [ ]

67. How does the beekeeping extension system operate?
a) Regular monthly visits [ ]
b) Regular quarterly visits [ ]
c) Occasional visits [ ]
d) My visit/call to the extension officer [ ]
e) Training workshops [ ]
f) Others, specify ……

68. What are your major challenges/problems in keeping bees?
a) Availability of training opportunities [ ]
b) Availability of extension support system [ ]
c) Availability and cost of equipment [ ]
d) Absconding of colonies [ ]
e) Stealing of the harvest [ ]
f) Diseases and pests affecting the bees [ ]
g) Lack of good marketing opportunities [ ]
h) Others, specify ……