DOI: 10.5281/zenodo.10209981

Farmer's perception of development opportunities of cacao agroforestry in growing cocoa-producing districts of Uganda.

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ABSTRACT

Cacao farming in Uganda has been rapidly expanding over the past 20 years, as shown by exports growing from 2.130 metric tons (MT) of commercial cocoa in 2001, to 35.000 MT in the year 2020. Most of the national production is still dominated by Bundibugyo district, where the majority of the country's estimated 80,000 – 100,000 smallholder farmers are located. The high demand for Uganda's cocoa driving a rather high and steady farm-gate price for the product, has triggered the interest of many new farmers in several other districts. Farmers that have been devoted to coffee and staple-crop production are now starting to plant cacao in different proportions in a mixed/intercrop design on their farms. Though the contribution of these "pioneer farmers" to national production is still minor, the new cacao-planted areas are quickly expanding with a growing number of farmers experimenting cacao cultivation each year. The trend draws heavily on both farmers' experiences in other perennial crops - mainly coffee, and Uganda's long experience on cocoa - derived mainly from the Bundibugyo experience - with established cocoa cropping practices and crop associations promoted by extension services. This combination arouses some interesting opportunities for development of novel and efficient context-related cacao cropping systems combining cacao with other crops or trees in cacao-based agroforestry systems.

In the framework of the "Market Access Upgrade Program" (MARKUP), two surveys were conducted in Uganda to explore (i) the characteristics of the current cocoa production sector, (ii) its potential for development and (iii) the agronomical innovations experimented on farms. One of the main objectives of the survey was to assess the variety of cropping practices used by cocoa farmers, in both historical cocoa production areas and more recent "pioneering" areas, looking for opportunities to support the development of the production sector based on economically and environmentally sustainable cropping systems and management practices.

This paper presents some of the salient results produced from this survey. Firstly, (i) the present situation of cocoa farming in Uganda is described through a typology of cocoa-farms and farms commencing a cacao activity. Secondly, (ii) a summary of the actual agroforestry practices found in those various farms-types is presented. Finally, (iii) the results from a consultation of farmers on SWOT analysis, about the development of cocoa components on their farms, are discussed. The results reveal some interesting insights into various innovative agronomic strategies deployed by smallholder farmers experimenting cocoa production in Uganda.

Keywords: Uganda, Agroforestry, Cropping practices

1. Objectives

In Uganda, cocoa was introduced by the British colonial government in 1901 but significant commercial cocoa production started in the early 60's. Pioneer cocoa farms were established in the central region around Kampala and later spread in many parts of the country where elevation, slope and rainfall allowed the crop to grow, including the remote area of Bundibugyo valley (Development and Management Consultants International, 1988; Gopaulchan et al., 2019). But the economic boom of Uganda's cocoa started in the late 90's and early 2000, with a rapid expansion of cocoa gardens in the district of Bundibugyo, allowing national production to jump from 2 130 MT in 2001, up to 44 500 MT in 2021 (Jones & Gibbon, 2011; Ntale, 2020). This fast growth of cocoa production in Bundibugyo district has led to an overall improvement of incomes of Bundibugyo farmers triggering a

DOI: 10.5281/zenodo.10209981

new boom of cocoa adoption and growing in many other districts of the country. Various districts in South-Western, North-Western and Central Regions now have many coffee and food-crop farmers experimenting cacao cropping. Some have henceforth switched from their usual staple crops to cacao. Many farmers are rehabilitating and rejuvenating their old abandoned cocoa trees and plantations to benefit from the ongoing cocoa boom (Ntale, 2020).

This study was conducted for the "Market Access Upgrade Program" (MARKUP), which included a component of activities on Ugandan coffee and cocoa sector. The aim of the program was to implement Small and Medium Enterprises (SME's) training and assistance around some key topics related to quality of the product, increasing value-addition, improving access to finance and developing export and investment opportunities. In the scope of the Market Access Upgrade Programme (MARKUP), a first survey was conducted in 2019, with the objective to perform a diagnosis of Ugandan cocoa production sector. It relied on both gathering of existing knowledge and studies previously held by various stakeholders, as well as primary information from cocoa producer, collected through interviews with a representative sample of farmers (Ntale, 2020).

In the course of MARKUP Project, a second survey was conducted in 2021, with the objective of exploring the characteristics of cocoa cropping systems in the different cocoa producing regions of Uganda, and assessing the potential for supporting cocoa agroforestry development. The survey was designed by CIRAD, and field interviews were conducted by the private company Shoreline Services Limited. The data analyses and synthesis of the results was made by CIRAD (Wibaux & Saj, 2022), in collaboration with the National Coffee Research Institute of Uganda (NaCORI-NARO). Two specific objectives of the study are presented in this article:

(a) Assessing the opportunities for development of cocoa production in districts where cocoa is grown,
(b) Investigating interesting strategies or practices around diversified farming systems and agroforestry-like management of the crop.

2. Methodology

The first survey conducted for MARKUP in 2019 relied on a sample of 385 farmers from three of the main cocoa producing regions of Uganda: South western (districts of Bundibugyo, Ntoroko and Kasese districts); North western (districts of Kibaale, Hoima and Kagadi districts); and Central (districts of Mukono and Buikwe districts). The sample distribution was calculated in order to balance gender and age of selected farmers, as well as distribution of the sample between the three regions.

Our complementary survey used a subsample from these 385 farmers already interviewed once. The resampling of farms aimed at selecting specific types of farms. It was performed through a cluster analysis on the whole population using the Hierarchical Classification Analysis (HCA) method. The segregating variables are presented in table 1.

Table 1: Variables and modalities used in HCA analysis

Variable	Modality	N	Frequency
Main source of household income	Cocoa Farming	196	64%
	Other-crops	93	30%
	Not Agriculture	18	6%
Most important cash-crop	Cocoa	235	77%
	Coffee	65	21%
	Other Crops	7	2%
Yearly cocoa production of the farm	A (0-99 Kg)	88	29%
	B (100-499 Kg)	124	40%
	C (500-999 Kg)	45	15%
	D (> 1.000 Kg)	50	16%

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The HCA allowed us to identify 6 groups of farmers with distinct characteristics regarding farm components and strategies toward cocoa production. For the purpose of our study, we chose to focus on 3 specific groups of cocoa farmers, which corresponded to (i) small cocoa farmers with diversified farms and low cocoa production, (ii) big and medium farms specialized in cocoa production, and (iii) cash-crop farmers with growing cocoa activities. This sub-sample included 216 farmers. The sample distribution in the different studied districts of Uganda is presented in table 2.

The data collection consisted in a set of direct questions asked to the interviewed farmers, as well as categorical and numerical data collected from direct observations during field visits of the cocoa plots in each farm. It was conducted from March until May 2021, and analysis of data was performed during the second semester of 2022, using mostly descriptive and exploratory analysis, such as MCA (Multiple-Components Analysis), PCA (Principal Components Analysis) and ANOVA (Analysis of Variance), with the help of XLSTAT (version 2022.5.1.1385; Addinsoft 1995-2023), and RStudio (Rstudio version 2022.12.0+353; 2009-2022 RStudio, PBC) software.

The survey also included a SWOT (Strength, Weakness, Opportunities and Threats) analysis, targeting farmers who were increasing the cocoa component in their farms, in order to collect their opinions towards the development of cocoa farming. The subsampling of farmers for this component of the survey excluded the district of Bundibugyo (main cocoa producing district) and relied on two main criteria's: (i) the selected farmers already produced cocoa as significant components of their farms (productive cacao trees of over three years old); (ii) they had recently been planting more cacao (presence of seedlings of less than three years old). The resulting sample population for the SWOT analysis was 62 farmers.

The structure of the questionnaire was built around the method of SWOT analysis, in order to collect the farmer's opinions on four main topics: (i) interest: "why are you interested in cocoa production?" ; (ii) advantages: "what are the main advantages of cocoa compared to other cash-crops, like coffee?"; (iii) constraints: "what are the main constraints of cultivating cocoa compared to other cash-crops?"; (iv) threats: "What are the main risks when you plant cocoa?". Answers were grouped in key topics and differences in responses between districts were analysed using the Fisher method.

Table 2: Samples of farmers interviewed for the complementary survey.

Region	**N**	**district**	**n**
South western	91	Bundibugyo	58
		Ntoroko	14
		Kasese	19
North Western	37	Hoima	16
		Kagadi	9
		Kibale	12
Central	88	Buikwe	18
		Mukono	70
		Total	**216**

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3. Results

3.1 Characteristics of Ugandan cocoa farms

The observation of farm characteristics data (figure 1, table 3) shows strong variations between districts in terms of farm strategy, farm size and cacao plots features. Size of the farms are rather variable in our sample, ranging from 1 up to 51 cultivated acres, with significant differences between districts. In average, farms are rather small, especially in western districts of Bundibugyo and Kasese, where most of the Ugandan cocoa is produced. Regarding the cacao components of the farms, cacao plots are rather small, with an average of 1.7 acre per farm (around 6800m^2), with significant variations between districts, Hoima being the district with the smallest cacao plots, opposed to Mukono where biggest plots were found.

Analysis of relative size of the cacao plots to the whole farm size reflects the reliance strategy of farms to cacao. In the visited farms an average of 50% of the cultivated area is dedicated to cacao. Much lower ratios are found in Kibaale and Hoima (20% and 23% respectively), and the highest are found in Ntoroko and Bundibugyo (69% and 36%, respectively), where cultivation of cocoa is most developed. It is interesting to note that the relative size of cacao plots is rather constant within districts, meaning that farmers from each district are prone to adopting homogeneous farming strategies toward cocoa.

The age of cocoa crop and productivity levels of the farms also brings interesting insights into each district history of growing cocoa, as well as farm strategies of developing cocoa components. In particular, all the farms visited in the districts of Ntoroko, Kibaale and Kagadi had been recently planted with cacao, but there was a notable difference in the investment toward cocoa between Ntoroko, where cocoa occupies an average of 69% of the farms, and the two other districts of North-Western Region, where only 20 and 34% of the farms have been devoted to cocoa.

Regarding cocoa production, the distribution of farms in production classes is closely related to both age (Khi2 test, $p<0.001$) and area (ANOVA, $p<0.05$) devoted to cocoa. Due to important outliers in data collected during direct interviews with farmers, we were unable to analyse and compare income estimates for both cocoa and other farm products.

Table 3: Farm characteristics in different sampled districts (*Tuckey's comparison test at $p < 0.01$: mean values followed by same letter are not significantly different)

district	Average share of farm area under cocoa*	Age of cocoa crop			Yearly farm cocoa production (kg. $year^{-1}$)			
		4-10 years	11-15 years	>15 years	0 - 100 kg	100 – 500 kg	500 - 1 000 kg	> 1 000 kg
Bundibugyo	63% ^{D}	15%	27%	57%	-	29%	24%	47%
Kasese	39% ^{AB}	58%	18%	24%	-	95%	5%	-
Ntoroko	69% ^{CD}	100%	-	-	-	57%	36%	7%
Hoima	23% ^{A}	37%	30%	33%	6%	94%	-	-
Kagadi	34% ^{AB}	100%	-	-	22%	78%	-	-
Kibaale	20% ^{A}	100%	-	-	-	83%	17%	-
Buikwe	37% ^{A}	25%	38%	37%	-	72%	6%	22%
Mukono	52% ^{BC}	23%	23%	53%	-	46%	31%	23%

DOI: 10.5281/zenodo.10209981

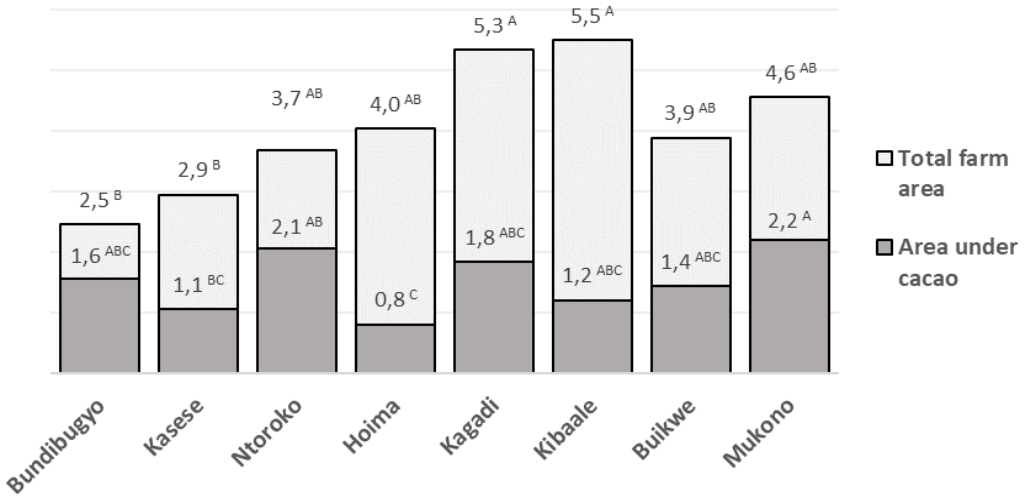


Figure 1: Mean Area (Acres) of average farm cultivated land and land under cacao in each district. Means with different letters are significantly different at $p < 0.05$ according to Tuckey's HSD.

3.2 Agroforestry knowledge and practices of cocoa agroforestry in Uganda

The main objective of the survey was to assess the level of adoption of agroforestry in farms developing cocoa production, and conduct an inventory of the agroforestry practices that are being experimented. Results from the consultation around agroforestry knowledge are presented in table 4. It appears that agroforestry is widely adopted in every district; almost all surveyed farmers were aware of the concepts of agroforestry and acknowledged the benefits of agroforestry practices for cacao cropping. Results from the interviews significantly differed between districts, but results show that farmers acknowledged the overall benefits of agroforestry, especially the benefits from shading, water use and fertilization. The most cited constraints were the use of space, the fall of branches and the negative effects on pest and diseases. It is interesting to note that the negative effect of agroforestry on cocoa yield was only raised by 13% of farmers.

Table 4: Results from consultation of farmers around agroforestry concepts

Positive answers to questions "opinion on agroforestry "	Do you know about agroforestry?	99%
	Have you thought about associating cocoa with other tree crops or forest trees?	94%
	Do you think agroforestry could be an interesting system in your farm?	97%
Quoted "Benefits from agroforestry"	Less heat on the crops	80%
	Fertilization of the soil	61%
	More water in the soil	47%
	Less weeding	39%
	Various agricultural products	8%
	Less pests and diseases	6%
Quoted "Constraints of agroforestry"	Less space for crops	51%
	Fall of branches	51%
	More pests and diseases	48%
	No light for crops	22%

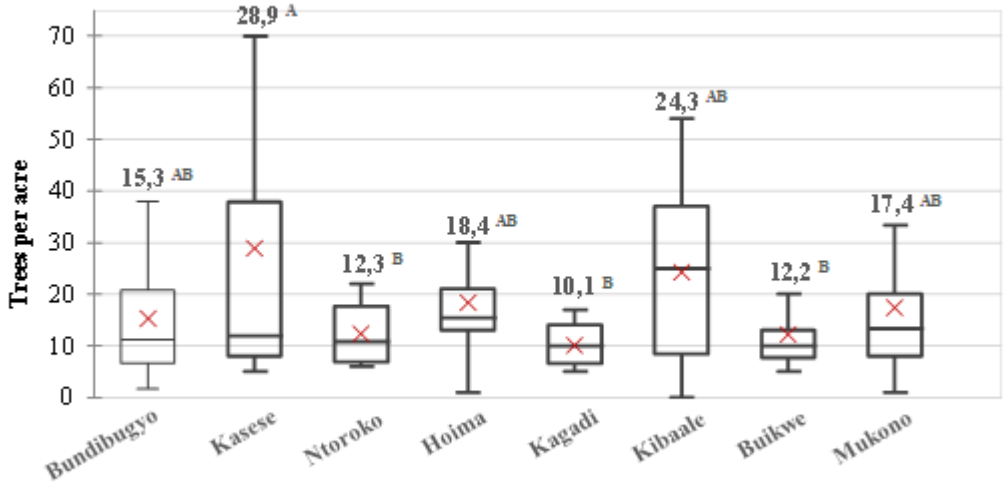
DOI: 10.5281/zenodo.10209981

Less yield for the crop	13%

During the survey, interviewers also visited cocoa plots in each farm and conducted inventories of the associated trees surpassing the cocoa strata. Results from the inventories are presented in figure 2 and table 5. The average density of associate trees found in cacao plots was 17.2 trees/acre (42.5 trees.hectare^{-1}). The densities differ between districts, with the lowest observed in Kagadi (10 trees/acre, or 23 trees/ha), and the highest in Kasese (29 trees/acre; or 71 trees/ha). Intra-district variability is also high for most districts, with coefficients of variations ranging between 67% in Ntoroko and 140% in Kasese.

The tree densities observed in Ugandan cocoa plots (42.5 ± 16 trees/ha) are close to the common cocoa cropping systems in western Africa's biggest producing countries, such as Ghanaian wet (34 ± 24 trees/ha) or dry (49 ± 33 trees/ha) climatic areas of cocoa production, or Centre of Côte d'Ivoire (36 ± 8 tree/ha in young cocoa plots, up to 60 ± 27 trees/ha in plantation over 50 years old). However, these tree densities are rather low in comparison with more traditional cocoa agroforestry production systems, such as traditional cacao agroforests in Cameroon (126 ± 42 trees/ha) (Bisseleua et al., 2007), or Brazilian Cabruca (106 ± 28 trees/ha) (Rolim & Chiarello, 2004). We may clarify that only the number and species of trees were inventoried, and we don't have data on the size or age of those trees.

Diversity of tree species found during the study is presented in table 5. The results show that four species, namely Musizi (*Maesopsis eminii*), Jackfruit (*Artocarpus heterophyllus*), Avocado (*Persea americana*) and Mango (*Mangifera indica*), are widely found in every district with constant high frequencies, except in Kasese. Some districts show high adoption rates of particular species, like Musanbya (*Markhamia lutea)* and *Terminalia sp.* in Bundibugyo, or *Acacia sp.* in Kasese. The overall diversity of associated tree species found in each district is also variable, especially in Kasese and Ntoroko were inventories showed higher levels of diversity. However, level of diversity found in the overall sample is quite low, with only 17 species or genus identified from visits of 216 cocoa plots (number of actual species may be slightly higher, as vernacular names are sometime used for different species). As a comparison, a study in Cameroon conducted over 150 cocoa farms recorded 192



different shade species (Saj et al., 2017), while a study conducted on 86 farms in Ghana counted 90 species (Asare & Anders, 2016).

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Figure 2: Box plots for densities of Associated trees in cacao plots of studied districts (Number of trees per acre). Means with different letters are significantly different at $p < 0.05$ according to Tukey HSD.

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Table 5: List of associated-tree species found in cacao plots and frequencies of use in each district

Tree Name	Buikwe	Hoima	Kagadi	Kasese	Kibaale	Mukono	Ntoroko	Bundibugyo	ALL DISTRICTS
Musizi (*Maesopsis eminii*)	89%	69%	67%	68%	83%	99%	93%	90%	**87%**
Jackfruit (*Artocarpus heterophyllus*)	94%	69%	67%	37%	92%	97%	100%	78%	**85%**
Avocado (*Persea americana)*	67%	100%	100%	53%	67%	71%	86%	61%	**74%**
Mango (*Mangifera indica)*	100%	75%	78%	37%	75%	69%	57%	27%	**69%**
Musambya (*Markhamia lutea*)	22%	56%	22%	5%	33%	19%	-	69%	**21%**
Mugavu (*Albizia coriaria*)	-	-	11%	21%	8%	17%	29%	-	**14%**
Mutuba (*Ficus natalensis*)	-	-	-	47%	-	4%	29%	14%	**10%**
Acacia (*Acacia sp.)*	-	-	-	68%	-	-	14%	29%	**9%**
Mvule (*Milicia excelsa*)	11%	-	22%	5%	-	10%	14%	-	**9%**
Oranges (*Citrus sp.)*	11%	-	11%	16%	-	7%	-	-	**7%**
Papaya (*Carica* papaya)	6%	-	-	5%	8%	10%	-	-	**6%**
Eucalyptus (*Eucalyptus sp*.)	-	6%	-	16%	-	-	14%	-	**4%**
Guava (*Psidium guajava)*	-	-	-	21%	-	-	-	-	**3%**
Mahogany (*Khaya sp.*)	-	-	-	5%	-	-	14%	17%	**2%**
Ebony (*Diospyros sp.)*	-	-	-	5%	-	-	7%	12%	**1%**
Entasesa (*Prunus Africana*)	-	-	-	-	-	-	14%	17%	**1%**
Terminalia (*Terminalia sp.*)	-	-	-	-	-	-	-	42%	**-**

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3.3 SWOT analysis on cocoa farming in Uganda

Main results from the SWOT analysis are presented in figure 3. The overall responses to the SWOT questionnaire were quite homogeneous within all sampled districts. For each topic, one or two responses were highly quoted by farmers, indicating strong common feelings about the SWOT of cocoa farming, regardless of geography and related regional differences.

On the side of "Interests" and "Advantages", the high selling price of cocoa, the long-lasting harvest season and the opportunity to diversify the farms sources of incomes appear to be recognized as the main motive for farmers investing in cocoa. Some farmers quoted the "success" of Bundibugyo's cacao farming industry, which appears to be decisive in the current boom of cocoa farming in the other districts that were visited during this survey. Also, the most quoted topic for the question on interest for cacao was "legacy for children", which suggests an overall long-term approach inherent in development of cocoa component in farms (Jagoret et al., 2011).

On the side of constraints and risks, fear of pests and diseases outbreak and price fluctuation is high, whereas main constraints are more tied to lack of practical experience and support.

Apart from those main common answers raised by the survey, some more specific results were highlighted by the Fisher analysis, which indicates differences in responses from farmers of different districts. These results reveal some regional differences in perception of cocoa farming SWOT, especially between south western districts of Ntoroko and Kasese, and the rest of the sampled districts. Farmers from the two south-western districts appear to be much more concerned about climatic and biological risks, but on the other hand they value cocoa as less hazardous than other districts, probably from their knowledge of Bundibugyo's experience of benefits from cacao. They also seem to value existing technical support as both an opportunity and a limit, which is expressed by their perception of lack of support. In open comments to questions around constraints and threats, the risk of farmers being "exploited" was quoted several times, by farmers belonging to various districts, which indicates their fear of being deceived by buyers.

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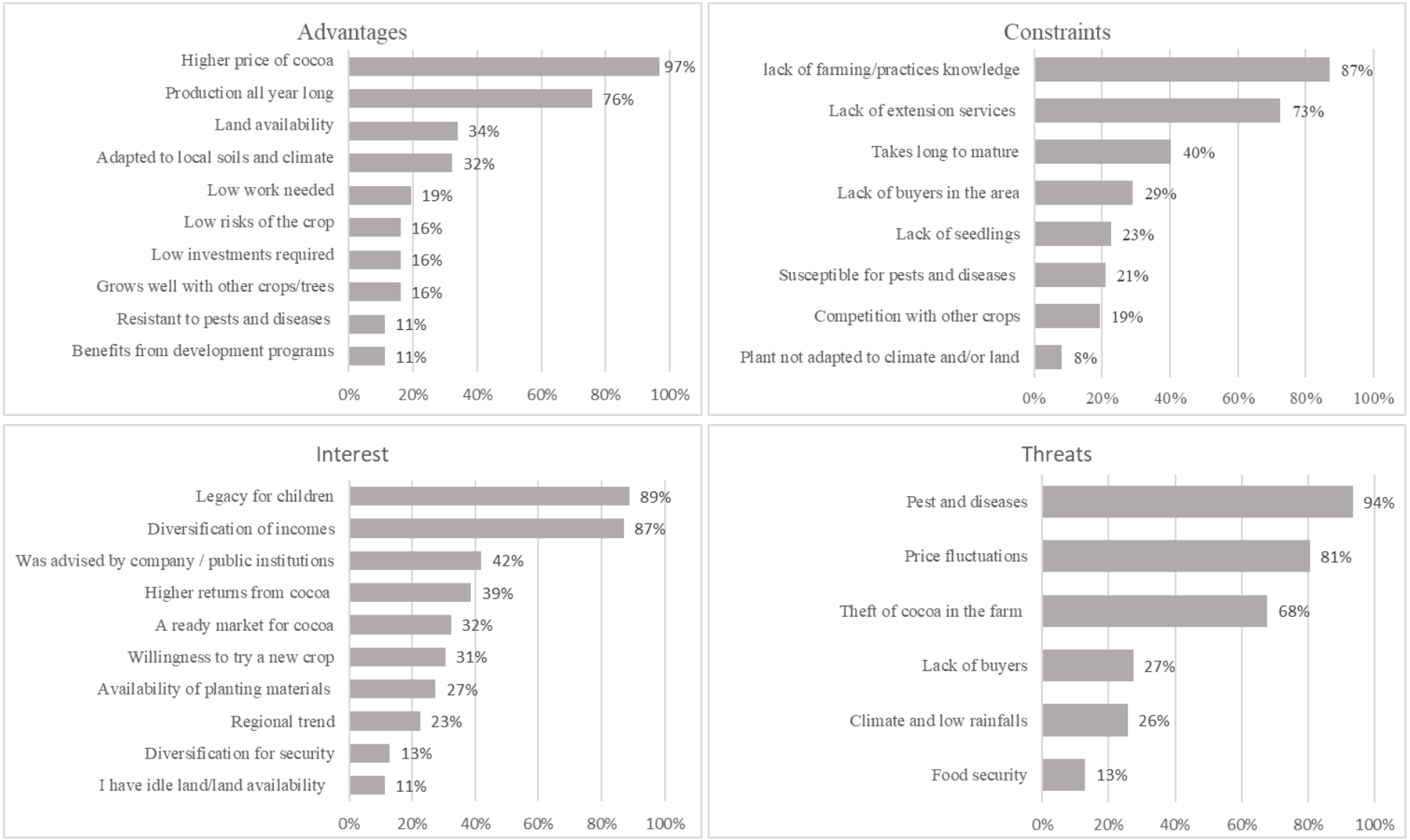

Figure 3: Results from SWOT questionnaires: frequencies of main topics quoted in farmer's answers

DOI: 10.5281/zenodo.10209981

4. Conclusions

The objective of this survey, conducted in various cocoa-producing districts of Uganda, was to perform a diagnosis of the opportunities for cocoa farming expansion, as well as describing the main farm strategies on development of their cocoa component, evaluate the inclination of farmers to adopt agroforestry practices and prospect for innovative agroforestry practices. The target of the survey was a sample of small, medium and big farms specialized, or specializing in cocoa, and cash-crop farms with developing cocoa components.

It appears that farmers are developing cocoa components in mixed-farming systems in all the sampled districts, relying on both cash-crops (mainly coffee and vanilla) and food production for self-consumption. Despite the fact that cocoa is often declared as the main source of revenue, it seems that most farmers act cautiously and maintain various sources of food and incomes in their farms. It appears as a good strategy, considering that the commercial cocoa sector out of Bundibugyo is rather recent and still subjected to agronomical, environmental or market risks.

Regarding the potential for supporting adoption of agroforestry cropping systems, it appears that agroforestry is already prevailing in all sampled districts. Farmers show both theoretical knowledge about benefits and constraints of agroforestry, as well as practical knowledge on spatial arrangement, selection of shade-species and management of agroforestry systems. However, the diversity of trees species found in the cocoa plots is rather low, considering the size and geographic distribution of the sample. The interviews seem to indicate that the choice of associate tree species derives from the habits and recommendations for coffee production, which were replicated for cocoa (Gram et al., 2018). Additionally, the wide adoption in every district of Musizi (*Maesopsis eminii*), which has been promoted as the adequate shade specie for cocoa (https://naads.or.ug/crop/seeds/cocoa/), seems to acknowledge the strong influence of official recommendations on farmers. The fact that farmers show strong experience of agroforestry, willingness to experiment different shade species with cocoa and proneness to follow official recommendations, represents an advantageous context for development of efficient agroforestry systems. However, the high number of farmers mentioning a lack of technical support on agronomical management is problematic. The field visits tend to confirm the lack of rational agronomic management of the cocoa trees, with uneven spacing of trees, sometimes way too distant form each other. This situation is critical, as bad experience from farmer's experimenting cocoa cropping can sometime discourage other farmers, and incorrect management practices, when maintained for too long, can persist and become hard to rectify (Aneani et al., 2012; Mercy et al., 2015). Training on agronomical management of cacao trees and plots might be more urgent than support on agroforestry management.

With regard to the SWOT survey, which focused on farms developing their cocoa component, we expected more noticeable differences between district and farmers. The responses were quite homogeneous, with large majority of farmers from all districts and belonging to all kind of farms quoting the same few key points. These data are however interesting as they reflect the priorities to be addressed by support services. One of the most interesting result though, is the large rate of quotation of "Legacy for children" as the main interest for cocoa. This answer reflects a common long-term vision of the investment in cocoa planting, and support the potential for farmer to be interested in associating cocoa with slow-growing but highly valuable timber species, or endemic species that may contribute to biodiversity conservation, as well as service trees that provide long-term benefits to the crop. This is another favourable element of context for supporting development and promotion of highly sustainable agroforestry systems.

5. Recommendations

Monitoring the emergence of new or developing cocoa farms is essential, in order to make sure that the development of the sector relies on implementation of sustainable and adequate agricultural practices and management systems. Today, considering the increasing sanitary, environment and economic pressure that cocoa farmers are facing throughout the world, agroforestry appears as a

rational management strategy for smallholder farmers, who need both flexible and resilient agricultural systems. Ugandan farmers seem to acknowledge this opinion and widely adopt agroforestry management for cocoa cultivation. However, the diversity of associated trees surveyed in this study is rather low, with only few species planted at high frequencies in most districts. Improving and sharing knowledge on tree species adapted to the association with cocoa, as well as their benefits and criteria for successful establishment and maintenance may be beneficial to cocoa farmers.

According to the responses collected in the SWOT analysis, supporting the diffusion of good agricultural practices appears to be the top priority raised by farmers. Disseminating existing knowledge on cocoa cropping, as well as providing farmers the adequate means for starting or extending their cocoa activity (selected cacao germplasm, access to inputs, access to buyers) would be the top priorities.

Acknowledgements

This study was conducted by CIRAD, through a consultancy for the "EU-EAC Market Access Upgrade Programme" (MARKUP), financed by European Union (EU) and implemented by International Trade Centre (ITC).

We want to thank the National Coffee Research Institute of Uganda (NaCORI-NARO) for their active collaboration on the study. We also kindly thank the Ugandan farmers who took the time to answer the questionnaires and agreed to let us visit their farms.

References

Aneani, F., Anchirinah, V. M., Owusu-Ansah, F., & Asamoah, M. (2012). Adoption of Some Cocoa Production Technologies by Cocoa Farmers in Ghana. *Sustainable Agriculture Research*, *1*(1), Art. 1. https://doi.org/10.5539/sar.v1n1p103

Asare, R., & Anders, R. (2016). Tree diversity and canopy cover in cocoa systems in Ghana. *New Forests*, *47*(2), 287-302. https://doi.org/10.1007/s11056-015-9515-3

Bisseleua, D. h. b., Vidal, S., & Herve, B. (2007). Plant biodiversity and vegetation structure in traditional cocoa forest gardens in southern Cameroon under different management. *Biodiversity and Conservation*, *17*(8), Art. 8. https://doi.org/10.1007/s10531-007-9276-1

Development and Management Consultants International. (1988). *A Baseline survey on cocoa production in selected Districts of Uganda*. ADC/IDEA Project Uganda.

Gopaulchan, D., Motilal, L. A., Bekele, F. L., Clause, S., Ariko, J. O., Ejang, H. P., & Umaharan, P. (2019). Morphological and genetic diversity of cacao (Theobroma cacao L.) in Uganda. *Physiology and Molecular Biology of Plants*, *25*(2), Art. 2. https://doi.org/10.1007/s12298-018-0632-2

Gram, G., Vaast, P., van der Wolf, J., & Jassogne, L. (2018). Local tree knowledge can fast-track agroforestry recommendations for coffee smallholders along a climate gradient in Mount Elgon, Uganda. *Agroforestry Systems*, *92*(6), 1625-1638. https://doi.org/10.1007/s10457-017-0111-8

Jagoret, P., Michel-Dounias, I., & Malézieux, E. (2011). Long-term dynamics of cocoa agroforests: A case study in central Cameroon. *Agroforestry Systems*, *81*(3), Art. 3. https://doi.org/10.1007/s10457-010-9368-x

Jones, S., & Gibbon, P. (2011). Developing Agricultural Markets in Sub-Saharan Africa: Organic Cocoa in Rural Uganda. *Journal of Development Studies*, *47*(10), 1595-1618. https://doi.org/10.1080/00220388.2011.579107

DOI: 10.5281/zenodo.10209981

Mercy, A., Aneani, F., Ofori, S., & Branor, P. F. (2015). Analysis of Farmers Adoption Behaviour of CRIG Recommended Technologies as a Package: The Case of Some Self-Help Cocoa Farmer Associations in the Eastern Region of Ghana. *Agricultural Sciences*, *06*(06), Art. 06. https://doi.org/10.4236/as.2015.66059

Ntale, C. (2020). *Uganda Sector Analysis: Cocoa Production, Supply and Demand*. MARKUP-Market Access Upgrade Program.

Rolim, S. G., & Chiarello, A. G. (2004). Slow death of Atlantic forest trees in cocoa agroforestry in southeastern Brazil. *Biodiversity and Conservation*, *13*(14), 2679-2694. https://doi.org/10.1007/s10531-004-2142-5

Saj, S., Durot, C., Mvondo Sakouma, K., Tayo Gamo, K., & Avana-Tientcheu, M.-L. (2017). Contribution of associated trees to long-term species conservation, carbon storage and sustainability: A functional analysis of tree communities in cacao plantations of Central Cameroon. *International Journal of Agricultural Sustainability*, *15*(3), Art. 3. https://doi.org/10.1080/14735903.2017.1311764

Wibaux, T., & Saj, S. (2022). Report on complementary surveys on topics of agroforestry and food-security in Ugandan cocoa farms [CIRAD Consultancy for ITC]. MARKUP-Market Access Upgrade Program