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CASHEW NUT-BASED PRODUCTION SYSTEMS IN TOGO: AGRICULTURAL PRACTICES, CONSTRAINTS, AND IMPROVEMENT LEVERS

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Abstract: This research aims to characterize cashew nut production systems in Togo and identify intervention axes to increase productivity. The method is based on a survey of 384 cashew producers in the main production areas. The results showed that 96.5% of the producers are men, and cashew plantations are mostly owned (79.9%) by indigenous peoples. The average age of producers is 48.15±11.60 years, and most farmers (91%) field is less than three (03) hectares. More than 79% of orchards are obtained by directly sowing and are rarely fertilized (6.3%). Intercropping is frequently practiced and lasts on average 3,24 ± 3,04 years. Cashew nut yields are negatively affected by the long duration of intercropping, labor costs, and the long time between two harvests. Three major groups are distinguished among cashew producers, and ease of access to land is the factor that best discriminates them. Cashew nut yields remain low and average 345 kg/ha. Economic and technical constraints remain the main problems encountered in the field. Thus, the levers for improving cashew nut productivity are the strengthening of contract farming, strengthening of extension services and a better organization of the actors of the sector.

Keywords: *Cashew, cropping systems, production constraints, levers for improvement, Togo*

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Introduction

Cashew cultivation plays an essential role in the Togolese economy, helping to increase the income of many producers (MAEH, 2017). It is practiced in four of the five economic regions and is the fourth most most important cash crop in Togo (DSID, 2015). Abandoned around the 1990s, cashew production has seen renewed interest among producers in recent years. Indeed, in three years' production has increased from 6000 tons in 2015 to 20000 tons in 2018. During the same time, the planted area grew from 18527.45 hectares to 65000 hectares (DSID, 2015; Ricau, 2019). Given this importance, cashew nuts are listed as a promising sector and are featured prominently in various development programs and projects, including the National Agricultural, Food Security, and Nutritional Investment Program. However, yields remain very low, 390 kg/ha (DSID, 2015), which is the productivity of 3.9 kg per tree much lower than the potential productivity of 10 to 15 kg per tree (Azam-Ali & Judge, 2001). This low productivity makes most producers vulnerable. The interventions of government and researchers are also limited due to the absence of sound scientific knowledge on cashew production systems. Indeed, very few studies are devoted to cashew nuts in Togo and even less to the characterization of production systems. However, all interventions aimed to improve cashew productivity require an in-depth knowledge of farming practices and the main constraints faced by producers. It is crucial in boosting cashew nut production in Togo. As a result, this study aims to characterize the various cashew tree orchard management systems and identify intervention axes to improve productivity in Togo.

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Research Methods

Study area: The research was conducted in three ecological zones (Figure 1) of Togo from March to June 2019. Togo is a country in West Africa located between latitudes 6° N and 11° N and longitudes 0° E and 2° E (DIC, 2007).

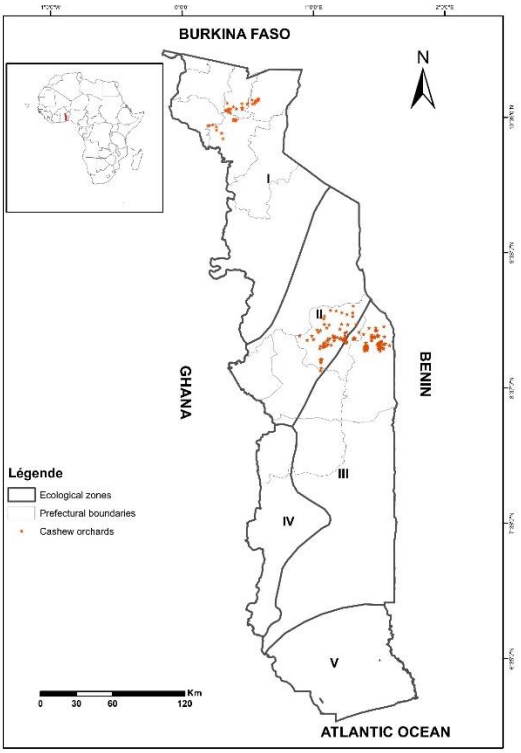

Figure 1. A study area map with cashew plantation geographical coordinates

Togo is surrounded by Ghana at the west, the Benin Republic in the East, Burkina-Faso at the north, and the Atlantic Ocean at the south, with a total coverage area of 56000km^2 stretched over 600 km along the meridian 1 (North-south), and 50 km along the east-west (Djaman et al., 2017). These ecological zones I, II, and III (Figure 1) include a Sudanese-type climate with a monomodal regime and a well-defined dry season lasting 5 to 6 months. Average annual rainfall ranges from 1001 to 1300 mm (Djaman et al., 2017). The study area contains various soil types, a predominance of eroded soils with more or fewer cuirasses for ecological zone I (Akpagana & Bouehet, 1994), stony to rocky soils for ecological zone II and lateritic soils for ecological zone III (Brunel et al., 1984).

Sampling method

The sample size was determined using the Dagnelie (1998) method:

$$\mathbf{n} = \frac{(\mathbf{z})^{\mathbf{2}}\, \boldsymbol{p}(\mathbf{1}-\boldsymbol{p})}{\boldsymbol{d}^{\mathbf{2}}}$$

Where: n is the number of producers to be surveyed, z is the confidence level according to the normal distribution, p is the proportion of people involved in cashew nut production and, d is margin of error of the estimate. For this study, margin of error is set at 5%, corresponding to 95% confidence level, corresponding to z=1.96. Given the lack of statistics on the proportion p of people involved in cashew production, the value 0.5 was chosen (Lwanga & Lemeshow, 1991). On this basis, 384 producers were selected for this study.

Data collection

Data were collected through a semi-structured survey from 384 producers. Validating questionnaire using a pre-survey was conducted among 20 cashew nut producers in the Sotouboua Prefecture. In each locality, the surveyed producers were randomly selected. The questionnaire covered socio-economic characteristics, production factors, techniques and systems of production, constraints, and possible solutions. Each plantation's geographical coordinates were recorded using a GARMIN OREGON 750 GPS.

Data analysis

The collected data were entered into Cspro 7.2 software and then exported into an Excel spreadsheet. R software was used to perform descriptive statistics and multivariate analysis, specifically principal component analysis (PCA) and hierarchical clustering analysis (HCA). The PCA was used to highlight the relationships between variables and HCA to highlight the significant groups of producers. The SAS JMP Pro Statistical Discovery 14 software was used to perform a textual analysis of the different constraints related to cashew nut production and the approaches to solving them.

Results And Discussion

Socio Socio-economic background

Table 1 shows the socio-economic characteristics of producers surveyed. These results indicate that 96.5% of cashew nut producers are men and 79.9% are indigenous. This predominance is explained by the multi-year nature of cashew production, which mobilizes land over a long period, and the limited availability of land for women. Indeed, in most African societies, tradition and customary rules restrict women's rights to land ownership (Saïdou et al., 2007) or to inherit land from their lineage (Klassou, 2002). According to Ingram et al. (2015), cash crops are generally considered to be men's crops. These findings corroborate those of Balogoun et al. (2014) who demonstrated that in Benin 81.34% of cashew producers are men. The predominance of indigenous people in cashew nut production is a social fact. In many settings, establishing perennial

crops is a means of asserting ownership of the land. Thus, non-natives in some localities are not allowed to produce perennial crops (Saïdou et al., 2007).

Table 1. Socio-economic characteristics of cashew farmers

Variable	Modality	Percentage (n=384)
Sex of cashew producers	Male	96.5
	Female	3.5
Age of cashew producers (years)	[20-35]	9.6
	[35-50]	48.2
	≥ 50	42.2
Origin of cashew producers	Natives	79.9
	Immigrants	20.1
Marital status of cashew producers	Single	4.4
	Married	94.8
	Divorced	0.5
	Widow(er)	0.3
Household size of cashew producers	< 2	1.4
	[2 – 4]	5.1
	[4 – 9]	4.8
	≥ 10	45.5
Land area under cashew (ha)	< 1	25.1
	[1 – 3]	65.9
	[3 – 5]	7.9
	≥ 5	1.1
Plants age	< 5	10.3
	[5 – 10]	38.3
	≥ 10	51.8
Membership of a cashew producer group	Yes	42.1
	No	54.6

More than 48% of producers are between 30 and 50 years old and are mostly married (94.8%) with an average age of 48.15±11.60 years. Cashew nuts are an important source of income in old age, which explains the interest of older producers (Balogoun et al., 2014). These results are similar to those of Wongnaa (2013) who found that 74.3% of cashew producers in Wenchi (Ghana) are 41 years and older.

The majority of producers (65.9%) surveyed exploit land size between 01 ha to less than 03 ha for cashew production but 42.1% of producers belong to cashew producer groups. This situation is explained by the difficulty to access production factors (land, labor, and capital). Access to land through inheritance results in the crumbling of the parent's fields, by his or her sons (Klassou, 2002). More than 42% of farmers are organized into cashew producer groups. This level of organization is the result of the Togolese government's cashew nut sector revival policy.

Cashew Technic production

Table 2 presents the importance of the different farming practices adopted by the producers.

Table 2. Repartition of farming practices among cashew producers

Variable	Modality	Pourcentage (n=384)
Sowing methods	Direct sowing	79.9
	seedlings transplant	17.0
	Both	3.0
Pest management	Yes	34.8
	No	65.2
Fertilization	Yes	6.3
	No	93.7
Intercropping	Yes	64.3

	No	35.7
Planting density	≤ 100 plants/ha	18.4
	> 100 plants/ha	81.6

Direct sowing is the main cashew seeding method. It is practiced by 79.9% of producers against 17% for seedlings transplanting and 3% for both. The choice of direct sowing is explained by its ease and lower cost compared to transplanting (Dendena & Corsi, 2014). According to the producers, plants grown seeds placed directly in the field are more resistant to water deficits. Indeed, according to Ohler (1979), direct seeding allows the plant to naturally develop its root system, especially the taproot, and thus to better resist water deficit. Moreover, the root system of cashew is very delicate and transplanting presents a high risk of damaging it, especially when it is done at a late stage (Dendena & Corsi, 2014).

Fertilization of orchards is very little practiced by producers (only 6.3%) although fertilization is known to have positive effects on cashew nuts production (O'Farrell et al., 2010). This is because of a lack of resources, a lack of a fertilization formula, and a lack of knowledge.

Intercropping is frequently practiced (64,3% of producers) and lasts on average 3,24 ± 3,04 years. This choice was explained by a permanent concern of producers to diversify their production and to protect themselves from a bad harvest and an unexpected drop in selling prices. This association also facilitates field weeding and a rapid return on investment. field weeding and a rapid return on investment. Several crops are associated with cashews. The choice of the crop to be associated is above all a preference of the producer and not a technical choice, hence the associations cashew-cowpea or cashew-cotton which are not recommended because of the common bio-aggressors that they share.

In 81.60% of the cases, producers adopt stand densities higher than 100 plants per hectare with an average of 192.53±112.30 plants per hectare. For them, a high density is synonymous with a good yield. This has been confirmed in some cases, particularly at young ages (Nayak et al., 2020). However, as the plants develop when silvicultural practices such as pruning and thinning are not practiced, yield decreases due to competition for light (Balasimha & Yadukumar, 1993) or nutrients.

Factors influencing cashew nut production

The principal component analysis highlights the nature of the relationships between yield and the various factors in the study (Figure 2). The two dimensions of the PCA summarize 53% of the information of which 26.99% for the first dimension and 26.1% for the second dimension.

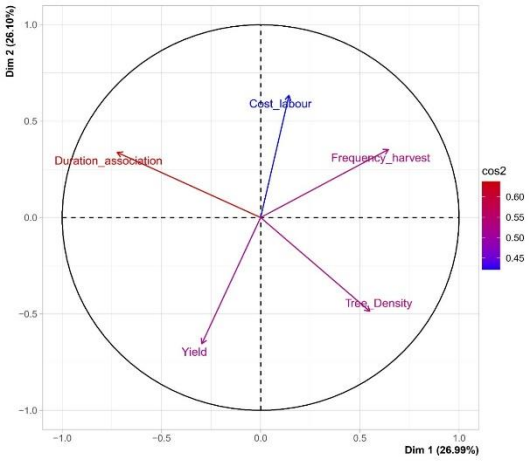

Figure 2. Projection of cashew nut yield and variables on the two-dimensional factorial plane

The first dimension is positively related to harvest frequency and tree density and negatively related to association duration. Axis 2 or the second dimension is positively related to labor costs and negatively related to yield. Cashew nut yield is negatively correlated with labor costs, harvest frequency and, duration of association. These results were because, in the areas surveyed, labor is paid in kind (harvesting). On the other hand, a long time between two harvests affects fruit quality and exacerbates the problem of theft and damage caused by transhumance. The negative correlation between the duration of association and yield was because, in the agroforestry system, producers have a greater tendency to favor annual crops over cashew trees and carry out pruning or very severe thinning to allow annual crops to benefit from the light. In addition, some annual crops such as cotton and cowpea are host plants for cashew pests.

The hierarchical clustering (HCA) on the first four dimensions of the principal component analysis (PCA), which summarizes more than 86% of the information, reveals three major groups of producers (Figure 3).

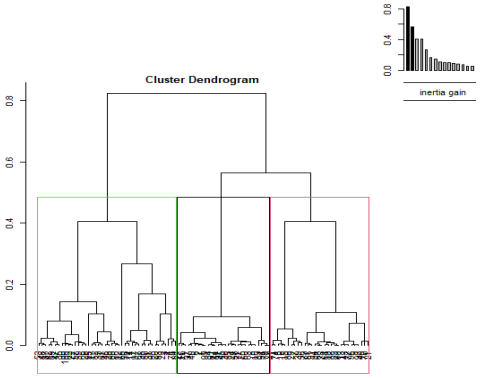

Figure 3. Hierarchical classification of cashew nut producers according to their farming practices and their socio-economic characteristics.

The first class is made up of producers whose cropping association lasts the longest and has the lowest stand densities. This is the group of producers least organized in cooperative groups and the land they farm was rented. The second group of producers has the highest yields and the highest planting densities. They have an average length of association and labor costs compared to the other two classes. The third and final class brings together producers with the highest labor costs and a long time between two harvests. They are heirs to the orchards they exploit and combine cashew with other crops for a shorter period. They have average yields overall. One of the fundamental variables that discriminate between producers in Togo is access to land. Depending on the availability of land, producers decide whether or not to combine cashew with other crops. The duration of the association also depends on this. Other variables are the difference in the yield, labor costs, and the frequency of harvesting.

Constraints and levers for improving cashew nut productivity

This study reveals an overall low cashew nut average yield (345.27±184.74 kg/ha) which is highly variable from one producer to another. Several constraints were identified, mainly economical, technical, and institutional. Table 3 presents the importance of approaches to solving the different identified constraints. Thus, the participatory diagnosis identified pre-financing (28.46%), minimum guaranteed price (12.73%), technical support (11.24%), input credit (10.99%), and improved plant material (8.36%) as priorities.

Pre-financing, identified as the first lever for improving productivity shows that most producers are smallholders and have very few resources to pay for farming activities. The almost permanent fluctuation of prices is a hindrance to the development of the sector, hence the need to guarantee a minimum price for the beginning of each season. These findings support those of Sanyang & Kuyateh (2018) in Gambia, who demonstrated that low price and price fluctuations are among the serious problems threatening cashew nut production.

Table 3. Importance level of cashew production constraint improvement levers

Term	Occurrence	Percentage
Economics constraints		
Pre-financing	228	28,46
Guaranteed minimum price	102	12,73
Input credits	88	10,99
Guarantee markets	28	3,50
Small equipment and tools	81	10,11
Techniques constraints		
Extension	90	11,24
Improved plant material	67	8,36

Contract farming, as demonstrated by (Sriboonchitta & Wiboonpoongse, 2008) would thus be a better way to improve this situation. Indeed, contract farming would guarantee a minimum price, access to input credit and, solve the problem of market outlets.

Because the revival of large-scale cashew nut cultivation in Togo is relatively new, the majority of producers are neither informed nor trained in new production techniques; thus, there is a need to strengthen extension services to producers as well as research in the sector. These results are similar to those of Kolliesuah et al. (2020) who consider insufficient extension services, the quality of plant material and, the problem of bio-aggressors as major causes of the decline in cashew production in Togo in the coming years. The low level of importance given to irrigation by producers is explained by the fact that for producers, irrigation is only useful for the establishment of the orchard. However, water deficit remains a real problem.

Conclusions

Cashew nut cultivation is a high-potential activity in Togo and constitutes a significant source of income for rural households. The cultivation practices adopted by producers vary from one producer to another. However, cashew nut production in Togo is largely characterized by a low level of adoption of good cultural practices in general and, more specifically, seedlings transplanting, canopy management techniques, and soil fertility management.

The low adoption of seedlings transplanting due to the high risk of loss of young cashew seedlings during the dry season the first year limits the use of improved plant material, which is typically derived from grafting in nurseries. All this results in low productivity. Three main groups of producers are encountered in Togo and access to land is the first factor of dissimilarity. The strengthening of contract farming and quality extension services for better adoption of good agricultural practices remain some of the major challenges to be taken up for a better cashew production in Togo.

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