Socio-economic determinants of the adoption of agricultural contracts: Case of cashew farmers in North-Eastern Benin

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ABSTRACT

This study aims to analyze the adoption of agricultural contracts in This study aims to analyze the adoption of agricultural contratcts in Northeastern Benin, precisely in the communes of Tchaourou and N'Dali. The data collection was conducted on a sample of 144 producers (including 72 adopting farmers and 72 non-adopters) from the questionnaire. The information obtained was analyzed from the STATA 13 software. The analysis of the determinants of the adoption of agricultural contracts was based on a binary logistic regression model. Thus, the adoption of agricultural contracts by cashew producers is determined by variables such as: the age of the producer, the number of schooling years, the size of the household, the agreement on the quantity of nuts to be delivered under contract, the appreciation of the solidarity guarantee and the assessment of the risks presented by agricultural contracts. These determinants have a positive influence on the adoption of agricultural contracts by cashew producers, with the exception of the producer's assessment of the joint and several guarantee and the producer's assessment of the risks posed by agricultural contracts.

Key words: Determinants, adoption, agricultural contracts, cashew.

INTRODUCTION

The agricultural sector provides essentially food security and livelihood in Benin, with 70% of the population earning their income from agriculture [1]. This sector is of paramount importance for the strengthening of the Beninese economy as it contributes an average of 32.7% to Gross Domestic Product (GDP), 75% to export earnings, 15% to state revenue. [2].

Despite its importance, it nevertheless knows several handicaps that slow it down. Beninese agriculture is highly dependent on low levels of input use, mechanization, training and organization of all players in the value chain [3]. For this purpose, farmers suffer on the one hand from a lack of knowledge about production techniques and have limited access to inputs [4]. On the other hand, in addition to considerable transaction costs [5] that these producers face, they also have insufficient access to information on market opportunities [6]. The cashew producers hardly escape these obstacles because they are subjects. In addition to the constraints listed above, they also face difficulties with access to land and access to credit, as the time of entry into production of trees after planting exceeds one year [7].
The cashew sector is an important source of income for Benin. Cashew accounted for 8% of the total value of exports in 2008, 7% of agricultural GDP and 3% of national GDP [8]. Moreover, it generates income for planters as well as for other actors in the sector (traders, processors, exporters, etc.) and for the State [9].

One of the options developed by the cashew producers to meet the challenges they face is adoption of agricultural contracts. According to [10], the agricultural contract by offering producers a guaranteed market, credit and technical assistance, could enable them to open up to the markets. The agricultural contracts represent today a significant and growing form of agricultural organization to the point [11] believes that it affects 15% of agricultural production in developed countries. [12] In addition, the results of the case studies of [13] indicates that all producers under agricultural contract experience improved yields (15 to 20%) and technical knowledge. Other benefits of the contracts were related to the ability to facilitate financing, financial guarantees for producers and investments as well as long-term

planning. Contracts, because of the benefits they offer, can be a good method to lower costs and increase revenues [14].

However, some producers remain reluctant to adopt this innovation. Contractualization has advantages as well as disadvantages. Contract farming offers many opportunities for farms, but it also carries many risks, especially for small producers [12]. According to [15], small producers under contract are exposed to risks of indebtedness and loss of autonomy. This partly explains the reluctance of some producers.

This study investigated the factors that influence the adoption of agricultural contracts in cashew production in North-Eastern Benin.

MATERIAL AND METHODS

Study zone

The communes of Tchaourou and N'Dali are located in the North-East of the Borgou department. The commune of Tchaourou is limited to the North by the Municipalities of Parakou, Pèrèrè, and N'Dali, to the south by the Commune of Ouèssè, to the East by the Federal Republic of Nigeria and to the West by the communes of Bassila and Djougou and covers an area of 7256 km^2 . The commune of N'Dali is limited to the North by the communes of Bembérèké and Sinendé, to the south by the communes of Parakou and Tchaourou, to the East by the communes of N'Dali and to the West by those of Djougou and Péhunco and covers an area of 3748 Km^2. Due to their geographical situation, the two municipalities benefit from a Sudanese-type climate with a mean rainfall varies between 1100 and 1200 mm/ year. The main soil types of these municipalities are tropical ferruginous. These communes are characterized by a savanna zone of tree and shrub type. These populations practice farming as their main source of income.

Methodological approach

To carry out this research, two (02) communes have been selected in North-Eastern Benin. These communes were chosen because of their important contribution to the cashew production of the department to which they belong. Four (04) villages (Gbéyèkèrou, Guinirou, Sirarou and Ouénou) were retained in the two communes because of the large number of cashew producers that they shelter. One hundred and forty-four (144) producers were surveyed, seventy-two (72) producers per municipality. This sample is composed of adopting cashew producers (50%) and non-adopters (50%) of agricultural contracts. The sample was randomly constructed to give all producers the same probability of being selected.

The data collected relates not only to the characteristics of the producers, but also to the assessment of the characteristics of the agricultural contracts made by the producers. This information was collected using structured interviews based on a questionnaire.

Statistical analysis of the data

The choice of adoption of a technology is dichotomous. That is, the explained variable can only take two modalities [16]. This is because the producer decides whether or not to adopt agricultural contracts.

In this study, the analysis of the factors determining the adoption of agricultural contracts was carried out using a regression model that makes it possible to predict the decision of a cashew producer to adopt or not the contracts proposed to him.

The adopter is defined as the producer who accepts and actively participates in agricultural contracts. The decision to adopt is considered a dependent variable of a qualitative nature in a regression whose value is 0 (for the non-adopter) or 1 (for the adopter). It depends on the characteristics that present the adopter and contracts. From the literature review, four types of models are commonly used to analyze the decision to adopt an agricultural innovation. These are mainly linear regression models, the Logit model, the Probit model, and the Tobit model.

Here, the Logit model was used to specify the relationship between the probability of adopting agricultural contracts and the determinants of it. This model was chosen because it is often used in many technology adoption studies for convenience [17]. The logistics function provides a quantitative analysis of the process of adopting agricultural innovations [18]. In addition, the Logit model maintains the estimated probability between 0 and 1.

[19] present the model by the following equation:

$$E(Yi) = P(Yi) = \frac{e^{\alpha+\beta Xi}}{1+e^{\alpha+\beta Xi}}$$

When the producer does not adopt agricultural contracts, the probability becomes for this purpose:

$$P(\text{no-adoption}) = 1 - P(Yi) = \frac{1}{1+e^{\alpha+\beta Xi}}$$

Or:

P (Y): The probability for an individual i to adopt the contract; P (Yi) = 1 if the technology is adopted and 0 if the technology is not adopted.

e: The exponential function

Yi: the variable explained; the adoption of contract farming

β : The vector of the parameters to estimate whose sign allows the interpretation of the results

α : The constant

Xi : characteristic of the individual i; it represents the vector of the explanatory variables

With

$$X = \beta_0 + \beta_1 \text{Age} + \beta_2 \text{Sex} + \beta_3 \text{Mena} + \beta_4 \text{ActifM} + \beta_5 \text{Sup} + \beta_6 \text{AnSco} + \beta_7 \text{Exp} + \beta_8 \text{AccQte} + \beta_9 \text{ACoSo} + \beta_{10} \text{ARS}$$

Where, ***Age*** = The age of the producer, ***Sex*** **=** Producer sex, ***Mena*** = Household size, ***ActifM*** = The number of agricultural household assets, ***Sup*****=** Area planted**,** ***AnSco*** = The number of years of schooling, ***Exp*****=** Experience in cashew production, ***AccQte*** = Agreement on the

quantity of nuts to be delivered under contract, ***ACoSo*** = The assessment of the joint and several guarantees, and ***ARS*** = Risk assessment of agricultural contracts.

Presentation of the variables included in the model

The variables included in the turned regression model include two types of variables: the explained variable e and the explanatory variables.

The variable explained

The dependent variable is the use of cashew producers contract agricultural. This dichotomous qualitative variable is ***ADOP*** encoded. This variable is 0 for the non-adopting producer and 1 for the adopting producer.

The explanatory variables

The explanatory variables introduced in the empirical model are: the age of the producer ***(Age)***, producer sex ***(Sex)***, household size ***(Mena),*** the number of agricultural household assets ***(ActifM)***, area planted ***(Sup),*** the number of years schooling (***AnSco***), experience in cashew production (***Exp***), agreement on the quantity of nuts to be delivered under contract (***AccQte***), the assessment of the joint and several guarantees ***(ACoSo)*** and the assessment of the risks of agricultural contracts ***(ARS).***

The reasons for incorporating them into the regression model are of various kinds.

Age: Age is a variable expressed in number of years. The relationship between the age of the producer and the decision to adopt is unclear in the literature [20]. Some studies identify age as a determinant and others do not. This variable was introduced into the model to see if it influences the adoption of contracts. The age would have a positive or negative effect on the adoption of this innovation.

Sex: This variable indicates the sex of the producer. It takes the value 1 if the producer is a woman and 0 if no. Most cashew plantations are passed from father to son and very few women have them. However, on the basis of sociodemographic characteristics, those who possess them are willing to adopt agricultural contracts. The variable "sex" would have a positive effect on the adoption of this innovation.

Mena: The household size is often mentioned in the literature as an essential variable in the adoption of new technologies [21]. This is the number of people who make up the household. The size of the household is a source of labor and allows the producer to increase his production under contract. It would be positively related to the adoption of this innovation.

ActfM: This variable represents the number of farm assets in the producer's household. The number of assets would have a positive effect on the adoption of agricultural contracts because the production of cashew requires a requirement in terms of labor.

S***up***: The area planted is a variable that can influence the adoption of innovations in agriculture. Producers with large acreage have significant need for funding for the maintenance

of their plantation. This variable would therefore have a positive effect on the adoption of agricultural contracts.

AnSco: This variable indicates the number of years of schooling the producer successfully. The number of years of schooling may be a determining variable in the adoption of agricultural contracts. A positive sign would be expected. This sign is justified by the fact that the most educated producers would generally be willing to adopt the contracts compared to less educated producers.

Exp: Producer experience is a variable that could influence the adoption of innovations in agriculture. The producer is assumed that more gains experience, the more it tends to adopt agricultural contracts. A positive sign would be expected from this variable.

AccQte: This variable indicates the producer's assessment of the agreement on the quantity of nuts to be delivered under contract. It takes the value 1 if the quantity seems to him suitable and 0 if not. The producer is looking for profit, this variable positively influence the adoption of contract farming.

ACoSo: This variable, which refers to the producer's assessment of the joint and several guarantee, would have a positive or negative influence on the adoption of agricultural contracts because the producers incorporating this system form an entity jointly and severally liable for their debts. According to producers, this variable could influence the adoption of agricultural contracts. It takes the value 1 if the producer has a bad appreciation of the joint surety and 0 if not.

ARS: The producer's assessment of the risks of agricultural contracts is a determining variable in the adoption of this innovation. This variable is set to 1 if the producer notes significant risks to agricultural contracts, and 0 if not. Since most producers develop risk aversion [22] a negative sign would be expected from this variable.

Table 1 presents a summary of all the variables introduced into the model with their expected sign.

Table 1: Summary of model variables and expected signs

Variables	Type of variables	Description	
Adoption	Qualitative	Dependent variable: 1 if contracts are adopted and 0 if no	
Explanatory variables of the model			Expected sign
Age	Quantitative	Number of years of farm manager	+/-
Sex	Qualitative	Producer's gender: 1 if the producer is a woman and 0 if no	+
Household size	Quantitative	Number of people who make up the household	+
Number of farm assets in the household	Quantitative	Number of farm assets in the household	+
Area planted	Quantitative	Area planted	+

Number of years schooling	Quantitative	Number of years schooling of the producer.	+
Experience	Quantitative	Number of years of experience in cashew production	+
Agreement on quantity	Qualitative	Agreement on the quantity of nuts to be delivered under contract: 1 if the quantity seems appropriate to him and 0 if not	+
Appreciation of the joint and several guarantee	Qualitative	The assessment of the joint and several: 1 if the producer has a good appreciation of the solidarity guarantee and 0 if no	+/-
The assessment of the risks	Qualitative	Assessment of the risks of agricultural contracts: 1 if the risks are high , and 0 if not	-

Source: *Document Search Results (2017)*

RESULTS

Characteristics of the producers surveyed and appraisal of agricultural contracts

In the study area, cashew is mainly a male activity. 96.50% of producers surveyed are men. This trend is also observed by considering the two groups of producers with 93.05% of adopting men and 100% of non- adoptive men . In general, the average age of respondents is 43 years, with an average of 47 years for adopters and 39 for non-adopters. The adopters are therefore older than the non-adopters, which explains very well the fact that they are more experienced than the latter (adopters : 14 years old experience ; not adopting : 11 years of experience). Moreover , it is true that in the study area an average household has 09 people and 05 agricultural workers we find that the size and number of farm assets of households are higher for adopting producers. On average, households of adopting producers have 10 persons with 06 agricultural assets while among non-adopting producers there are 08 persons per household with 06 agricultural assets. The level of education of the respondents is very low in the study area and this according to the two groups of producers. Overall, the shadow of average years of schooling is 2.88 years (± 5.1 5). This means that producers have averaged the class CP (Preparatory Course) in formal education. However, non-adopting producers (4.69 years) are more educated than adopting producers (2.5 years) . In the study area, producers have different assessments of the characteristics of the contracts in which they participate. For all producers only 4 7.91% are a good assessment of the agreements about the amount of nuts deliver under contract. It is rather the adopting producers who find these agreements (adopters: 81.94% ; not adopting : 13.88%). In addition, agricultural contracts require for the most part a joint and several guarantee, something generally badly perceived by the producers. Generally, 59.03 % of producers have a bad appreciation of the joint and several guarantee. This trend is also observed among non-adopting producers (93.05 % of producers). On the other hand, adopting producers appreciate this clause of agricultural contracts (75 % of producers). Contracts, like many innovations in agriculture, present risks to cashew farmers (risk of debt, loss of autonomy, etc.). The majority of producers surveyed (52.78 %) perceive high risks in the adoption of agricultural contracts with 90.28 % of non- adopting producers against only 5.28 % of adopting producers .

Table 2 presents the statistics of the variables characterizing the interviewed and their assessment of agricultural contracts.

Table 2 : Statistics of variables characterizing the respondents and appraisal of agricultural contracts.

Variables		adopting		Not adopting		Together		Statistical tests
		Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	
Quantitative variables								
Age (years)		38.96	13.189	38.96	13.189	42.86	14.402	-3.367 **
Experience (years)		14,15	5,791	11.24	6.765	12.69	6,443	-2.779 *
Size of households		10.28	4,943	8.51	4,675	9.40	4.875	-2.200 **
Agricultural assets		5.67	2,838	4.26	2,495	4.97	2,754	-3.150 ***
Area planted		4.53	3.42	4.00	3.02	4.26	3.23	-0.999
Number of years of schooling		2.50	3.26	4.69	5.58	2.88	5.15	0.888
Qualitative variables								
Producer sex (%)	Man	84.72		88.88		86.80		0.546
	Wife	15.28		11,12		13,20		
Quantity Agreement (%)	Suitable	81.94		13.88		47.91		68.945 ***
	Not suitable	18.06		86.12		52.09		
Appreciation of the joint and several guarantee (%)	good	75		6.95		40.97		68.942 ***
	bad	25		93.05		59.03		
Risk assessment (%)	low	84.72		9.72		47.22		81.251 ***
	Raised	15.28		90,28		52.78		

*** = significant at 1% ; ** = significant at 5% and * = significant at 10%.

Source: *Survey Results (2017)*

Estimation of the logistic regression model

Table 3 presents the results of the estimation of the logistic regression model performed.

Table 3: Estimation of the logistic regression model

Adoption	**Coefficients**	**Standard Error**	**z**	**Prob**
Age	0.760	0.42	1.77	0,076 *
Sex	-1.227	1,195	-1.03	0.304
Household size	0.169	0.142	1.19	0.236
Number of farm assets in the household	0.311	0.214	1.45	0,146
Area planted	-0154	0.164	-0.94	0.346
Number of years of schooling	0.226	0.116	1.94	0,052 *

Experience	-0.023	0.756	-0.32	0.751
Agreement on quantity	3,088	0.935	3.30	0.001 ***
Appreciation of the joint and several guarantee	-3.337	1,169	-2.85	0.004 ***
Risk assessment	-5.579	1,406	-3.97	0.000 ***
Logistic regression	Numb er of observation = 144 Wald chi 2 (10) = 156.06 Prob > chi2 = 0.0000 Log pseudolikelihood = -21,781573 Nickname R2 = 0.7818			

*** = Significant at 1% ; ** = Significant at 5% ; * = Significant at 10%
Source: *Estimation Results*

The regression model binary logistics carried out to analyze the determinants of the adoption of agricultural contracts is globally significant at a threshold of 1% (p = 0.0000 <1%). Variables such as age of the producer, the number of years of schooling, agreement on the quantity of nuts to be delivered under contract, the appreciation of the producer of the surety and the appreciation of the producer of the risks of agricultural contracts influences positively the adoption of agricultural contracts by producers, with the exception of the appreciation of the producer of the surety and the producer's assessment of the risks posed by the agricultural contract.

The variables in the model that are not significant are: the sex of the producer, the size of the household, the number of farm assets in the household, the area planted by the farmer, and experience in cashew production.

DISCUSSION

The age of the producer: Age has a positive and significant effect at the 10 % threshold on the adoption of agricultural contracts by producers. So, the more the producer is aged, the more likely it adopts the contract's agricultural. It is therefore deduced that producers acquire with time the experience that allows them to be open to innovations. Thus, they are willing to accept new systems of contracts on cash crops. This allows them to have significant income to support the households in their care.

The number of years of schooling of the producer: The variable "number of years of schooling " has a positive and significant effect at the 10% threshold. Thus, the more educated the producer, the more willing he is to adopt agricultural contracts. This result is similar to those obtained by other adoption studies and is justified by the fact that the level of education increases the sense of adopting innovation, skill and ease of appraising new technologies [23].

Moreover, according to the theory of human capital, education positively influences the adoption of technologies in the sense that it increases the capacity of discernment of the producer. The instruction makes the producer more apt to assimilate the new concepts [24].

The appreciation of the agreement on the amount of nuts to be delivered under contract
The coefficient for the variable "agreement on the quantity of nuts to be delivered under contract" is also positive and this variable has a significant effect at the 1% threshold on the adoption of agricultural contracts by producers. This confirms the work of [25] which led to the conclusion that the agreement on the quantity of product to be delivered under contract is a determining variable the adoption of agricultural contracts by rice producers.

In fact, the loan contracted corresponds to a quantity of cashew nuts to be paid at the end of the production. The producer is in search of profit, he must then make sure to have a satisfactory income before deciding to contractualize his production. In addition, the agreement on the quantity of nuts to be delivered under contract allows the contracting producers to make a better estimate of their production in terms of area to be planted in order to respect the clauses of the contract but also to meet the needs of their households.

Producer's assessment of the risks of agricultural contracts: The Producer's assessment of the risks of contract farming has a negative and significant effect at 1% on adoption of agricultural contracts by producers.
The adoption of new technologies requires a certain level of risk associated decision on the choice of innovations [22] . The negative effect of this variable is explained by the fact that producers are conservative; that is, they remain attached to their old forms of financing. They develop an aversion to risks that makes them reluctant in the adoption of agricultural contracts. According to [15], small producers under contract are exposed to risks of indebtedness and loss of autonomy. The risks of agricultural contracts are related to the producer's fear of not being able to repay the credit obtained. After analyzing the information collected, the probability of not repaying the loan contracted is high in the event of a fire in the cashew plantations but also when the maintenance credit is not granted in time. The non- repayment of the loan contracted can also be due to climatic factors, in particular the gales of violent winds causing the blooming at the time of flowering.

The producer's assessment of the joint and several guarantee: The producer's assessment of the joint and several guarantee has a negative and significant effect at a level of 1% on the adoption of agricultural contracts by cashew producers.
Indeed, the joint and several guarantee is a personal security allowing to provide the guarantee of the execution of a contract by a third person if the signer does not do it. The joint guarantee, as mentioned by the clauses of the contract does not facilitate the adoption of agricultural contracts by producers, because producers do not appreciate the fact of being responsible for the debt of other producers members of the grouping. However, in order to have access to the credit necessary for the maintenance of their plantation, the producers must be organized into a

group. Producers integrating this system form for this purpose an entity jointly and severally liable for their debts.

CONCLUSION

Agricultural contracts provide a means for cashew farmers to invest in their plantation. It emerges from this study that the adoption of these contracts is determined by its own characteristics as well as those of the adopters. These are the age, the number of years of schooling, the agreement on the quantity of nuts to be delivered under contract, the assessment of the producer of the joint surety and the producer's assessment of the risks posed by the agricultural contracts. These variables positively influence the adoption of agricultural contracts by producers, with the exception of the appreciation of the producer of the surety and the appreciation of the producer of the risks of agricultural contracts. Thus, the adoption of contract farming is much more favorable for older producers, better educated and those approving the amount of nuts to be delivered under contract. On the other hand, the solidarity guarantee imposed by the clauses of the agricultural contracts and the risks presented by these contracts limit their adoption by the cashew producers. Promoters of agricultural contracts must act on these determinants in order to have their innovation adopted.

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