Contract Farming Preferences of Smallholder Rice Producers in Benin: A Stated Choice Model Using Mixed Logit

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Summary

In developing countries, smallholder farmers face many constraints including lack of information, and lack of access to credit and markets. To overcome these constraints, smallholder farmers can engage in contract farming. However, contract farming needs to meet farmers' preferences in order to be sustainable. This study aimed to analyze rice farmers' preferences for contract farming in Benin. Stated choice data were collected from 574 rice farmers. To account for heterogeneity, data were analyzed using a mixed logit model. Producers preferred contracts with seven major attributes: short term, payment on delivery, collective selling, agreement on quantity, no provision of credit, application of the market price, and no control by the partner. However, there was heterogeneity in the contract preferences of rice farmers. The study suggests that these differences and the preferred attributes are important in the design of best-fit contract farming models by agribusiness firms and policy-makers.

Résumé

Préférences des petits producteurs de riz pour les contrats agricoles au Bénin: un modèle de préférences déclarées basé sur le modèle «mixed logit»

Dans les pays en développement, les petits producteurs font face à plusieurs contraintes dont le manque d'information et le manque d'accès au crédit et aux marchés. L'agriculture contractuelle constitue une solution pour surmonter ces contraintes. Cependant, les contrats agricoles doivent satisfaire aux conditions des producteurs pour être durables. Cette étude vise à analyser les préférences des producteurs du riz concernant la conclusion de contrats agricoles au Bénin. Les données sur les préférences déclarées ont été collectées auprès de 574 producteurs de riz. Pour tenir compte de l'hétérogénéité, les données ont été analysées avec un modèle «mixed logit». Les producteurs préfèrent les contrats avec sept principaux attributs: une courte durée, un paiement à la livraison, une vente collective, un accord sur la quantité, pas de provision de crédit, une application du prix du marché et aucun contrôle de la part du partenaire. Cependant, il y a une hétérogénéité dans les préférences des producteurs. L'étude suggère que les différences, de même que les attributs préférés, sont importants pour le développement de meilleures formes de contrats agricoles par les sociétés de l'agrobusiness et les décideurs politiques.

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Introduction

In sub-Saharan African (SSA) countries, the agricultural sector is becoming increasingly market oriented and private-sector led. The sector is characterized by a large number of small-scale farmers who face considerable market constraints, including poor market information, restricted access to credit and modern inputs, and high transaction costs arising from weak market integration. Neither market information nor markets themselves are accessible to the rural poor and farmers capture little of the value that they create. In addition, market risk in terms of fluctuating prices is a great problem that concerns smallholders in SSA countries. Contract farming is seen as a potential solution to overcome these constraints for resource-poor farmers. In contract farming, the buyer and the producer commit in advance to exchange the product. In addition, the buyer can provide credit, inputs, monitoring, or is directly involved in part of the production process. Contract farming has been claimed to have a positive impact on local economies by improving the welfare of rural households (3, 5, 9, 21, 39). Several authors have found that participation in contract farming improves farmers' income (6, 39). In addition, contract farming has the potential to substitute for the government in the wake of neo-liberal reforms in the agrarian sector: as the state disengages from the provision of inputs, extension services, credit, and price support, private firms can enter to fill those roles, and may do so more efficiently. However, the literature also documents several problems affecting contract farming performance: high default rate, biased terms, delayed payments, cheating, and lack of compensation for crop failure (22, 41).

Linking farmers, processors, and marketers through contract farming in SSA has become an important challenge to positively impact the economic well-being of small-scale farmers. It is not surprising, therefore, that the agribusiness sector is currently being encouraged to engage in contract farming, and producers of food and non-food crops are responding to this institutional approach in many parts of SSA. Although contract farming is common in cash crops in developing countries, it is limited in food crop production such as rice.

This is because subsistence crops receive less research and development and less private-sector investment than cash crops. In addition, contract farming typically spontaneously emerges with high value crops such as fruits and vegetables and less for low-value crops such as staples (42).

However, as a result of decreasing performance of the cotton sector since the mid 2000s, Benin's new national agricultural policy includes the promotion of food crops such as rice. In fact, rice is among the six priority crops in the agricultural policy. Accordingly, rice sector has gained importance for both government and private-sector. In rice value chains, farmers, traders, processors, and inputs dealers can use various types of contract farming to respond to market failures. Different models of contract among value-chain stakeholders may work differently depending on the context (crop, institutions, entry point in the value chain, *etc.*). However, to be viable and sustainable, contract farming needs to benefit each party. Small-scale farmers will not engage in any contract farming if it does not meet their preferences. Both farmers and contractors will consider the risk–return trade-offs of each model of contract. Farmers' choice may also depend on their attitudes to risk and their financial positions. Although empirical studies in developing countries provide diverse analyses of the participation and welfare effects of contract farming, the existing literature does not address farmers' preferences for particular contract terms and attributes. While the main motivation of smallholders to enter into contract farming is to resolve market failure, a closer look at participation decisions may show how different contract attributes are evaluated. Smallholders' acceptance of a contract can be improved by better aligning contract terms and attributes with farmers' preferences. This paper addresses this question by analyzing the preferences of rice farmers for contract farming in Benin using a stated choice approach.

Our contribution to the literature on contract farming is three-fold. First, with the exception of Abebe *et al.* (1), existing literature pays surprisingly little attention to the design of contract farming directly from farmers' perspective. Our study explicitly focused on smallholders' preferences for contract farming design attributes using a stated choice approach.

Stated preference is a research technique in which information about decision-makers' preferences is elicited by using different hypothetical situations. The stated choice method provides the opportunity to estimate demand for contract attributes that may not exist in the real market. Second, previous studies on contract farming have focused heavily on the income and broader welfare effects, as well on individual-specific characteristics, as key determinants for participation. Yet, the effect of different contract design attributes on smallholders' contract choice has received little attention, especially for food crops such as rice. Third, there is a general assumption in the literature that farmers are risk averse, and that their motivation to participate in contract farming is primarily to manage output price risks (13, 36). Consequently, contractors tend to design contracts with pre-fixed price. However, contract design is a complex process involving many trade-offs (11), and farmers may have different risk preferences for the different contracts. This may lead to heterogeneity in farmers' preferences for contract farming. Therefore, heterogeneity in farmers' preferences for contract farming was here clearly modeled by using a mixed logit model. A number of studies of choice experiment have recently preferred the mixed logit model (4, 12, 23) to the traditional Multinomial Logit Model (MNL) due to the latter's shortcomings, especially the assumption of Independence of Irrelevant Alternatives (IIA). In many cases the IIA assumption is violated and the results of the MNL are biased. The main objective of the present study was to explore the relative importance of different contract design attributes that could differentially affect the motivation of smallholders to participate in contract farming. Better information on farmers' preferences and heterogeneity in preference can be used by agribusiness firms to design better contracts and by policy-makers in developing an enabling institutional environment.

Methods

Estimation of stated preference for contract farming

In order to elicit rice farmers' preferences for contract farming, the choice modeling approach with heterogeneity was used. Choice models are based on Lancaster's (31) theory of consumer choice, where individuals derive utility from the different characteristics a good possesses, and McFadden's (34) random utility theory, providing the econometric rational of choice experiments. Following Lancaster (31), attributes have been defined as characteristics of a good.

The random utility theory states that consumer preferences are latent and unobservable (10). The value of utility of an individual n associated with participation in contract farming j, U_j, can be expressed as a function of two components: an observable systematic component V_j, and a random component ε_j which represents the unobservable part. The utility function is given by equation I:

$$U_j = V_j + \varepsilon_j \qquad (I)$$

The systematic V_j of the utility is presumed to be a function of various predictors that can be formulated as a regression function (7) given by equation II:

$$V_j = \beta X_j \qquad (II)$$

where β is the vector of parameters to be estimated and X_j is the vector of covariates. If ε_j is independently and identically distributed, the probability that the contract $_j$ is chosen from the set of J potential contracts (and dropping reference to individual n for simplicity) is the standard multinomial logit model (MNL) and can be expressed by equation III:

$$P_j = \frac{exp(\beta X_j)}{\sum_{j=1}^{J} exp(\beta X_j)} \qquad (III)$$

with P_j is the probability that the contract $_j$ is chosen from the set of J.

The MNL has been a fundamental basis for the analysis of discrete choice for many years. However, because of several shortcomings of the MNL, especially its inherent assumption of independence of irrelevant alternatives (IIA), researchers have developed a variety of alternative models. In addition, the MNL does not allow for unobserved preference heterogeneity, while is well known that farmers' preferences do exhibit substantial heterogeneity. To avoid IIA assumption and take into account unobservable preference heterogeneity in β, one commonly used method is the random coefficient specification of the mixed logit model (MXL), which extends the MNL model in equation IV (35):

$$P_j = \frac{exp\left[(\beta + \omega) X_j\right]}{\sum\limits_{j=1}^{J} exp\left[(\beta + \omega) X_j\right]} \qquad (IV)$$

where β is the vector of mean attributes in the population, ω is the difference between the mean and individual attributes, and X_i is the vector of covariates. The parameters of the MXL can be estimated with simulated maximum likelihood (35). Unlike the traditional logit model, two sets of parameters are estimated in the MXL: the β parameters which represent the coefficient of the mean attributes and the parameters representing the coefficient of the standard deviation of the attributes. The significance of the ω parameters will show whether there is heterogeneity of preference in the data. Empirically, this model has been used in a number of studies of choice experiment (4, 12, 23). Based on this model, the generalized multinomial logit (GMNL) was introduced by Fiebig *et al.* (17). The GMNL enables accounting for both preference and scale heterogeneities. However, Greene and Hensher (20) show that, in the absence of scale heterogeneity, GMNL is equivalent to MXL. In addition, failure to account for scale heterogeneity may not be of such great empirical consequence in behavioral outputs such as direct elasticity and willingness to pay. Using both Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC),[1] the MXL model fits the empirical data analyzed in this paper better than did MNL, GMNL, and conditional logit (CL).

In the MXL, an independent normal distribution is assumed for each of the coefficients, such that each coefficient can take a negative or positive sign around the estimated mean and standard deviation. These estimates provide information on the proportion of individuals that give positive or negative values to an attribute (43). These proportions are given by equation V:

$$100 \times \Phi\left(- \beta_k / \omega_k \right) \qquad (V)$$

where Φ is the cumulative standard normal distribution and β and ω are the coefficients of mean and standard deviation of the kth attribute, respectively.

The approach was to first estimate the MNL and CL models with fixed parameters. Then, using the same determinants, we estimated the MXL model to avoid the assumption of fixed parameter. Goodness of fit using information measures (AIC and BIC) was assessed on the basis of the maximum likelihood value (15, 20). In addition, a test of significant of all coefficients of the standard deviation (ω in equation IV) was performed using likelihood chi-square test.

Method of data collection and variables

Two methods exist for data collection on farmers' preferences: a method based on revealed preference and a method based on stated preference (30). The revealed preference method is used in real situations or conditions experienced by consumers. The questions are therefore asked to the respondents, who reveal what they did. In contrast, surveys based on stated preferences are based on a hypothetical situation. In this case, each respondent must declare a choice they would make if they were confronted with it in reality (16). The use of stated preference method has increased significantly in agricultural and agro-food economics, environmental and resource economics, health economics, trade and marketing since the mid 2000s (32, 33). Stated preference method has the advantage of testing the farmers' preferences before introducing a new product or new institutional mechanism such as new contract farming. So, stated preference was used in this study to analyze which types of contract farming were more likely to be adopted by farmers.

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[1] AIC= 2k – 2ln(*L*) and BIC= k ln (*n*) – 2ln(*L*), where k is the number of parameters in the model, *n* is the sample size, and L is the maximized value of the likelihood function for the estimated model. The lower the value of AIC, the better the model is.

The data were collected in the southern and central parts of Benin (Figure 1). These areas have been used for studies on rice production because of their importance for rice production in the country. The study focused on a sample of rice-farming households selected randomly in the rice sector development hubs in the southern and central parts of Benin. From a list of household head names, 10 households were randomly selected per village for a total of 30 villages. Using the computer-assisted personal interview (CAPI) technology, two household members (husband and wife) were interviewed in 2014, to analyze intra-household and gender differentiation in contract farming preferences. Due to missing data for some variables of 7 households, 574 rice farmers (293 men and 281 women)[2] were included in this analysis. Data were collected through a structured questionnaire comprising two parts: the first to collect socioeconomic and demographic characteristics of producers, and the second focused on experimental choice of contract farming for rice production.

Attributes and attribute levels (values) that might be important for farmers and which may influence the contract between rice producers and other rice value-chain actors in the real world were selected. Previous surveys and focus groups were used to choose potential contract attributes and attribute levels. The definitions of the explanatory variables and attribute levels as well as the expected sign are given in Table 1.

In total, nine attributes were selected (Table 1)[3] as follows.

Length of contract: Longer-term contracts (more than one cropping season) help to overcome holdups and moral hazard problems. Farmers can be rewarded for agreeing to longer-term contracts through more favorable repayment terms (such as cheaper inputs or reduced rates of interest) (19). However, due to the lack of trust and the risk of losing autonomy, it is hypothesized that farmers will prefer short-term contracts (one cropping season).
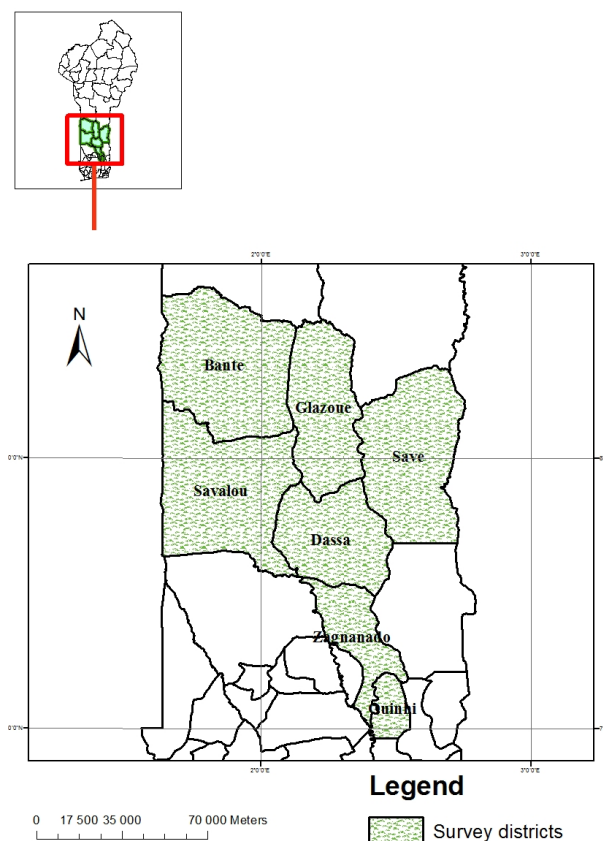
Source: Own design.

Figure 1: Map of the survey area in Benin Republic.

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[2]There are 12 male headed households in which the household head was not married or has divorced. Therefore, there were 12 households in which women could not be interviewed.
[3]Nine attributes selected for this survey can be considered as acceptable as an average of 7 is suggested in the literature (14).

Table 1
Description of variables.

Attribute	Values	Expected sign [a]
Length of contract	0 = One cropping season 1 = Long term (two or three cropping seasons)	–
Credit provision	0 = No 1 = Yes	+
Contract with group of producers	0 = Individual 1 = Group	–
Control over production activities	0 = No 1 = Yes	–
Agreement on quantity	0 = No 1 = Yes	+
Time of reaching agreement	0 = Before sowing/planting time 1 = After sowing/planting time	–
Timing of payment	0 = Immediately after delivering 1 = Two weeks after delivering	–
Product quality specification	0 = No 1 = Yes 2 = Yes with premium	(reference) [b] – –
Rice price	0 = Market price 1 = 10% less than market price 2 = 10% more than market price	(reference) [b] – +

[a]Reference point is 0; [b] Two binary variables are included in the regression.

Granting of credit
Market failures, especially the unavailability of production credit, limit the adoption of innovations and also restrict farmers' access to inputs, technology, and information (29). Contract farming is seen as an institutional mechanism to allow farmers to have access to credit and other production inputs (26). The need for credit may motivate farmers toward contract farming (11, 28). It is hypothesized that farmers will prefer contract farming that provides credit for the purchase of production inputs.

Type of organization
Farmer organizations can help producers commercialize their products at high price (8, 25, 44). However, uncertainty about the performance of organizations may discourage farmers from using them for commercialization. In addition, there are also associated costs for monitoring the actions of participant producers (37, 38). Thus, it is hypothesized that farmers will prefer selling individually instead of through organizations.

Control over production activities
Control or supervision is desirable for the contractor to monitor the production process to be sure that producers are following the agreement. With control, the contractor has the advantage of checking the quality of inputs and key farm management practices (45). Monitoring of activities can also help farmers to get technical advice from the contractor. However, farmers may feel a loss of autonomy with excessive control. Thus, it is hypothesized that farmers will prefer no control of their production activities by the contractor.

Agreement on quantity
When farmers produce under contract, quantity is usually pre-established with buyers (28). In the case of a food crop such as rice, farmers need to plan for self-consumption and for selling. Therefore, farmers are expected to prefer to have an agreement on market quantities with the buyer. Agreement on the quantity will help the farmer in planning and efficient allocation of production resources.

Time of reaching agreement
Reaching agreement before planting time will help the farmer plan the season, especially if the crop is not only for sale but also for subsistence as is the case for rice. Therefore, farmers are expected to prefer to establish a contract with the buyer before planting time (41). In addition, contractors may also prefer to reach agreement before planting time to be able to specify the quality of the product (e.g. the variety).

Timing of payment
In contract farming, contractors usually pay some time after the produce is delivered. This represents uncertainty on the part of farmers, especially when they do not trust the buyer (40, 41). In addition, due to lack of access to credit, smallholder farmers are in need of cash for household expenditure. Thus, it is expected that farmers prefer cash and immediate payment as in spot markets.

Product quality specification

The desire for high (specific) quality attributes increases the contractor's willingness to engage in contract farming and pay a high price (18, 24). In turn, farmers can potentially obtain higher prices for quality products. However, given the uncertainty of farmers about meeting quality standards, we hypothesize that smallholder farmers will prefer contracts without quality requirements.

Rice price

Price volatility is one source of uncertainty that may affect smallholders' decision to participate in contract farming. Different price options may entail different risks and rewards (27). If a contract specifies a fixed payment ex ante, farmers only bear the production risk while the firm takes all the market risk. By accepting a lower price, farmers in effect agree to pay a risk premium. However, the motivation for farmers to adhere to the contract is driven by resource provision and price incentives (11). Thus, it is expected that farmers will not prefer lower price than on the spot market.

The first seven attributes have two levels and the last two attributes have three levels (Table 1)[4]. A combination of attributes and their levels involves a total of 1152 alternatives (2^7 x 3^2).

Given that it is impossible to evaluate such a number of contracts in reality, a fractional orthogonal design was used to select potential contracts for evaluation by rice farmers (32). Sixteen hypothetical contracts were selected. The 16 alternatives were divided into four groups each comprising five choice alternatives. The first four in each group were taken from the 16 orthogonal alternatives selected. The fifth in each group is the "no contract farming" option.

Results and discussion

Experience with contract farming

Results showed that the practice of contract farming for rice production is not well developed in the study area. Among the rice producers interviewed, only 7.5% and 8.9% of women engaged in contract farming with different buyers (millers, parboilers, and traders) for rice in 2011 and 2012, respectively (Table 2). These values were also low for men: 9.7% in 2011 and 10.7% in 2012. The adoption rate of contract farming was even lower in 2013. This can be explained by the fact that existing contract farming models are not compatible with resource-poor farmers' preferences.

Therefore, there may be a need to develop new schemes adapted to the socioeconomic conditions of resource-poor farmers. Alternatively, one could explain the low proportion of farmers engaged in contract farming by reduced interest of buyers. However, this is less plausible for two reasons. First, the number of farmers declining the offer of engagement in contract farming increased from 55% to 65% during the period of 2011 to 2013 (2). Second, the number of medium-scale millers in the area also increased during this period (two new medium-scale millers established in the survey area during that period).

Most contract farming models in the survey area are characterized by oral agreements with buyers, credit supply (in-kind or in cash), and price, quantity, and quality agreements. Only 8.85% of existing contractual arrangements are written (2). The agreement on price, quality, and quantity is made in 23%, 77%, and 40% of farming contracts, respectively (2). In addition, Arouna *et al.* (2) found that 60% of farming contracts are made through producer organization, which reduces the transaction cost and the associated risk for both producers and partners.

Table 2
Distribution of agricultural producers engaged in contract farming, 2011–2013.

	2011		2012		2013	
	Number	Percentage	Number	Percentage	Number	Percentage
Male (n = 293)	29	9.7	32	10.7	24	8.1
Female (n = 281)	21	7.5	25	8.9	16	5.7
Total (n = 574)	50	8.6	57	9.8	40	6.9

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[4]For data analysis, each of two attributes was transformed into dummy variables. For each of the multi-level variables, three dummy variables were created. To avoid multi-correlation problem, two dummy variables were included and one dummy is used as reference.

Estimation of model for rice farmers' preference for contract farming

Four models (multinomial logit, MNL; generalized multinomial logit, GMNL; conditional logit, CL; and mixed logit, MXL) were tested during the analysis. Using information criteria (AIC and BIC), the MXL model gave best fit with the empirical data (Table 3). In addition, the coefficients of standard deviations of MXL for men and women were large and significant. This result confirmed the presence of heterogeneity in preferences for contract farming among rice farmers in Benin. However, scale heterogeneity did not exist in the data. Therefore, the MXL model was more robust than the GMNL model, and thus produced better-quality estimations.

Results of the MXL estimation for men and women are presented in Table 4.

Table 4 is divided into two parts: the top part presents the coefficients of the average of all attributes and the bottom part are the coefficients of the standard deviation of attributes. Estimation of the MXL for men confirmed that, with the exception of two attributes (agreement on quality with a premium and fixing a price more than market price), the coefficients of the average of all attributes were statistically significant. Similar results were obtained for women: the coefficients of the average of nine attributes were statistically significant. In both models, the variables for which the coefficients were statistically significant were: long-term contract, contract with farmer organization, agreement on the quantity to be delivered, timing of contract agreement, credit provision, agreement on quality, agreement on monitoring of production activities by the contractor, timing of payment to farmers, and agreement on rice price less than market price.

The test of significant of all coefficients of the standard deviation (in equation IV) rejected the null hypothesis of all coefficients are together equal to zero for both men and women. The coefficients of standard deviations showed that there was heterogeneity in preference of men for four attributes: credit provision, quality agreement, fixing a price less than market price, and timing of payment to farmers. For women, the coefficients of standard deviations were significant (i.e. showing the heterogeneity of preference) for the same four attributes like men plus monitoring of production activities by the contractor. These results, which are in agreement with literature on the preferences of smallholder farmers (10, 23, 28), confirmed heterogeneity in the contract preference of rice farmers and showed that the preference was somewhat different for male and female rice producers. The sign of the coefficient indicated how an attribute influenced rice farmers' decisions to participate in contract farming. The price is often the first parameter discussed in a contract between two parties. The contracts with market price were preferred by 89% of men and 93% of women over a contract with price less than market price.

Indeed, the coefficient of the attribute on fixing a price less than market price is negative and significant at the 1% level for both men and women. Fixing a price equal to market price in a contract with the buyer increased the probability of farmers entering into a contract by 96%. Fixing a price equal to market price will allow the rice farmer to receive the same price for their rice via the contract as on the spot market and to reduce the uncertainty associated with changes in the market price at delivery time. The mean and standard deviation of the attribute "price less than market price" indicated that a contractual agreement with the fixing of price less than market price was considered as positive attribute by only 11% of the men and 7% of the women. Conversely, an agreement on a price more than market price seemed not to be an incentive for farmers to engage in contract farming (the coefficient was not statistically significant). In existing contract farming in the survey area, farmers accept price less than market price when the buyers offer credit.

A contractual agreement with a duration of two or three cropping seasons had a significant negative effect on the probability of rice farmers' participation compared with short-duration contract. This implies that rice farmers prefer short-duration contracts, specifically a contract for each cropping season. This preference could be explained by the fact rice farmers are risk averse. By engaging in short-duration contracts, farmers will have the option to withdraw from the contract at the end of each season if the contractor does not fulfill the agreement or if the conditions of the farmer change.

Contrary to our expectation, the coefficient of the attribute of provision of credit was negative and significant for both men and women. This means that credit had a negative effect on adoption of contract farming by rice farmers. However, preference heterogeneity existed for this attribute for both men and women: 14% wanted access to credit, while the other 86% did not. Farmers not wanting credit could be explained by the fact that rice farmers are not used to taking credit from a contractor (2). Alternatively, it may be because rice production in the survey area is mainly rainfed, which is subject to high climatic risk. In addition, high interest rate may also explain why credit is less attractive for rice farmers. One could also suspect that the buyer may oblige farmers to use the credit for purchasing a fixed brand or dose of inputs, but this was not confirmed by this survey. Rice farmers may be risk averse and avoid taking credit for an activity that is strongly related to climatic variability.

However, due to the importance of credit, especially to guarantee the quality of paddy rice, it is important to find conditions under which rice farmers would be willing to take credit for contract farming.

Table 3
Akaike and Bayesian Information Criteria of different models.

	Men				Women			
	MXL	CL	GMNL	MNL	MXL	CL	GMNL	MNL
AIC	1365.3	2259.9	2223.3	3236.5	1142.7	2047.1	2107.7	2899.0
BIC	1472.1	2326.7	2336.8	3316.6	1248.9	2113.4	2220.5	2978.6

AIC, Akaike Information Criteria; BIC, Bayesian Information Criteria; CL, conditional logit; GMNL, generalized multinomial logit; MNL, multinomial logit; MXL, mixed logit.

Table 4
Estimation of the mixed logit model for men and women.

Variable	Estimation for men			Estimation for women		
	Coef.	Std err.	Marginal effect	Coef.	Std err.	Marginal effect
Long-term contract	−0.71**	0.24	−0.03	−1.14***	0.35	−0.04
Contract with farmer organization	1.82***	0.24	0.00	2.44***	0.36	0.00
Agreement on quality with a premium	30.54	0.12+E05	0.63	36.75	0.19+E05	0.64
Agreement on quantity	1.49***	0.38	0.01	2.19***	0.54	0.01
Engagement of contract before sowing/planting	−0.85**	0.36	−0.01	−0.94**	0.48	−0.01
Fixed a price more than market price	29.86	0.74+E04	0.25	34.49	0.17+E05	0.21
Credit provision	−1.03***	0.34	−0.05	−2.27***	0.48	−0.08
Agreement on quality	1.61***	0.35	0.08	2.89***	0.45	0.11
Control by the partner	−1.46***	0.28	−0.01	−2.70***	0.42	−0.01
Immediate payment	2.51***	0.43	0.01	2.22***	0.48	0.01
Fixing a price less than market price	−2.94***	0.67	−0.04	−3.50***	0.71	−0.04
Random variable		Level of heterogeneity				Level of heterogeneity
Credit provision	0.94***	0.39	0.86	2.11***	0.48	0.86
Agreement on quality	1.36***	0.35	0.88	1.20***	0.37	0.99
Control by the partner	0.33	0.42	1	−0.99***	0.35	0,003
Immediate payment	1.89***	0.41	0.81	1.82***	0.45	0.89
Fixing a price less than market price	2.36***	0.64	0.89	2.39***	0.54	0.93

Number of respondents: 293	Number of respondents: 281
Number of observations: 5860 (293×5×4)	Number of observations: 5620 (281 × 5 × 4)
Log likelihood = −668.58	Log likelihood = −555.38
Prob >chi² = 0.00	Prob >chi² = 0.00
LR chi² (df = 5) = 49.96***	LR chi² (df=5) = 44.17***
AIC = 1365.32	AIC = 1142.75
BIC = 1472.14	BIC = 1248.90

** $p < 0.05$; *** $p < 0.01$.

One condition might be the introduction of agricultural insurance.

Agricultural insurance may help farmers to reduce the climatic risk and encourage them to take credit for rice production. In contrast, 14% of farmers considered that access to credit represents a guarantee that the partner will pay for their production. The access to credit in the contract would help them to reduce the financial constraints to the acquisition of quality inputs.

Contract with a group of producers had a positive and significant effect on the probability of rice farmers' participation compared with the individual contract. This is consistent with the findings from empirical studies (25, 44).

This suggest, perhaps, that the collective contract would allow farmers to organize themselves to better meet buyer demand, to improve their bargaining power, and to provide assistance to resolve contractual issues. On the other hand, group contracts allow agribusiness firms and other buyers to reduce the transaction cost and the problem of moral hazard. The agreement on quality was positive and significant at 1%. There was, however, heterogeneity among respondents in attitudes toward an agreement on quality. Agreement on quality was considered positive by 88% of men. Contrary to a priory expectation, the agreement on quality with a premium price was not statistically significant. This result might reflect the fact that the farmers are willing to respect the quality of rice recommended by the partner even if they do not receive a price bonus for doing so. The agreement on the quantity of rice to be delivered also appeared to be an important aspect for all farmers, as indicated by the coefficient of the variable "agreement on the quantity," which was positive and significant at 1% level. This suggests that fixing the quantity allows farmers to better estimate their production in terms of area to sow to meet their contractual arrangement, but also household food needs. This idea is also supported by other findings (28).

As expected, results of the model showed that the farmers preferred a contract that did not require monitoring of activities by the partner. This would mean that producers feel technically competent to produce high-quality rice without supervision. Preference heterogeneity existed for this attribute only for women: control was valued positively by only 0.3% of women. This means that 0.3% of the women think that control and monitoring by the contractor may help them to deliver the required quality of paddy rice.

Rice farmers preferred contracts under which they would receive their money with no delay, i.e. the contractor will pay upon receiving the product – the attribute specifying immediate payment after delivery had a positive and significant effect on the probability of agreeing a contract. However, there was heterogeneity among respondents in attitudes toward this attribute.

Although 81% of men and 89% of women attached a positive value to direct payment after delivery, about 11% of women and 19% of men may accept a delay of a payment to about two weeks after delivery. Rice production requires a lot of financial resources. Producers are mostly small-scale farmers with low financial means, so the cash payment allows them to meet their needs. In addition, direct payment would avoid the risk of debt and conflict. This result corresponds to the findings of Blandon *et al.* (10) who reported smallholders' preference for a cash payment as in a spot market.

Conclusion

The study analyzed rice farmers' preferences among different contract attributes, with the aim of identifying those attributes that would promote farmers' participation in production and commercialization of rice under contract. In terms of motivation, this study showed that rice farmers generally preferred contracts under the following terms: short-term contract (one season), payment on delivery, contract with a group of producers, agreement on quantity and quality, no provision of credit, application of the market price, engagement of contract before sowing operations, and no governance by the partner. These results showed that agribusiness firms and other buyers should base their pricing strategy of contract farming on the spot-market trends to reduce problems of extra-contractual sales and moral hazard. On the other hand, contract farming can successful be implemented through farmer organizations allowing agribusiness firms and other buyers to reduce per-unit transaction costs. However, it may be relevant to study the perception of agribusiness firms toward contract design attributes that smallholders considered more important. Furthermore, there was heterogeneity in the preference of men and women for certain attributes of contract farming. Men showed heterogeneity for: provision of credit, quality agreement, fixing a price less than market price, and timing of payment to farmers. Women's preferences showed heterogeneity for: monitoring of production activities by the contractor, provision of credit, quality agreement, fixing a price less than market price, and timing of payment to farmers. The study suggests that these attributes of contracts and these differences need to be taken into account in the design of best-fit contract farming by agribusiness firms and policy-makers for rice sector development in sub-Saharan Africa.

Acknowledgements

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