

# DETERMINANTS OF PARTICIPATION IN CONTRACT FARMING AMONG SMALLHOLDER MAIZE FARMERS IN NORTH-WESTERN NIGERIA

Buhari Nazifi<sup>✉</sup>, Yusuf Ibrahim Hussaini

Federal University Dutsin-ma, Department of Agricultural Economics, Katsina, **Nigeria**

## ABSTRACT

**Background.** Smallholder farmer's market participation, through contract farming arrangements has been receiving much attention in sub-Saharan Africa, as a measure towards increasing commercialization and specialization in essential crops value chains.

**Material and methods.** Using a sample of 361 randomly sampled maize farmers, the study identified factors influencing smallholder maize farmer's decision and extent of participation in contract farming in north-western Nigeria. Descriptive statistics and Craggs double hurdle model were used for data analysis.

**Results.** Maize farmers (51.8%) were found to be participating in the contract farming (CF); An average age of maize farmers involved in contract farming is 39 years; with over 20 years of farming experience and an average farm size of 2.46 hectares. On the other hand, those not involved in contract farming have an average age of 37 years, 18 years farming experience and an average farm size of about 2.16 hectares. Furthermore, the number of years of contract farming awareness, access to credit, extension services, and agricultural training had positive and significant ( $p < 0.05$ ) effect on maize farmers' decision to participate in contract farming. The significant factors ( $p < 0.01$ ) influencing the extent of contract farming participation are; farm size, farming experience, access to credit, duration of contract agreement, contract farming experience, and side-selling.

**Conclusion.** Inadequate requisite land, lower prices offered by firms and untimely distribution of inputs were identified as major constraints affecting smallholder maize farmers participation in CF. Therefore, taking proactive measures regarding these factors such as creating more CF awareness through extension workers by relevant investors and agencies will promote contract farming participation among smallholder farmers.

**Key words:** contract farming, double hurdle, maize, Nigeria

## INTRODUCTION

Smallholder farmers produce most of the maize consumed in Nigeria, however their output potential is low with 1.5 tons per hectare which is about 20% of the average yield in developed nations. This is due to challenges such as limited access to modern production technologies; poor access to credit facilities; poor

access to extension service; small-land holding and poor access to market (Mgbenka and Mbah, 2016).

Subsistence food crop production cannot improve rural incomes without market-oriented production systems. This requires an intensification of agricultural production systems, increased commercialization and specialization in essential crops value chains (Adetola *et al.*, 2014). Smallholder farmer's market participation,

✉ [buharinazifi6@gmail.com](mailto:buharinazifi6@gmail.com)

through contract farming arrangements have received much attention in sub-Saharan Africa (SSA) as a measure towards increasing commercialization and specialization in essential crops value chains (Armah *et al.*, 2010).

Contract farming is one of the first steps in the transition from subsistence to commercial agriculture as an intermediate sector between the agricultural and manufacturing sector. It is also basically an arrangement that established agreement between processing/marketing firms and smallholder farmers for production and supply of food and commercial crops base on predetermine future quality and price (Bellemare and Novak, 2017). Models of contract farming play major role on welfare of smallholder farmers through increasing output growth in agricultural sector by delivering better technology, coordinating producer's and consumer's market along with strong grass-root linkages (Iro, 2016).

In developing countries contract farming is mostly promoted by private sector with little support from public institutions. In Nigeria, there are few emerging evidences of contract farming (Fawole and Thomas 2014; Iro, 2016; Oluesegun, 2016; Miet and Vande, 2017). The existing ones are mostly owned by the private companies/individuals as out-grower schemes and few by the Government such as presidential anchor borrower program lunched by federal Government of Nigeria in 2016 (Oluesegun, 2016).

The most notable companies involved in out-grower schemes for maize in north-western Nigeria; include, Bunkasaman, Manomalinks, Olam, WACOT, Babbangona and Afex-Agra. These firms operate using various contract farming models that are usually in the form of centralized, nuclear estate, multipartite, informal and intermediary models; however CF models provide services to the farmers that include access to credit; extension service, agricultural production inputs; training on good agronomic practices, farm supervision, storage facilities, and ready markets for harvested crop. Despite these benefits, smallholder farmers have not been consistent with their participation with CF schemes (Olomola, 2010; Ofuoku and Agbamu, 2016). Therefore contract farming arrangement in developing countries has explicit and implicit barriers to entry that tend to excluders and motivate smallholder farmer's participation.

Previous studies in developing countries identified socio-economic and farm related characteristics features that derived smallholder farmer's participation

in CF (Swain, 2012; Issa & Chrysostome 2015; Pandey, 2016; Ntaganira *et al.*, 2017; Rondhi *et al.*, 2020). In Nigeria few studies identified the benefits of farmers' participation in contract farming with little emphasis on factors influencing farmers' decision and extent of participation in CF (Gabriel *et al.*, 2017; Miet and Vande, 2017; Akanbi *et al.*, 2019).

Olomola (2010) assert that designing effective mechanisms and institutional arrangements to increase productivity and sustain the growth of agriculture through contract farming cannot be overemphasized. Hence, Knowledge of these drivers of farmer's participation affects government and relevant agencies in making policies, legislative framework and programs on contract farming arrangement. Thus, in an attempt to promote CF participation by smallholder farmers in north-western Nigeria. This study identified socio-economic, institutional and contract portfolio factors that influence decision and extent participation in Maize CF scheme so as to enhance the strategies adopted by potential investors and relevant agencies towards their policy decision on improving contract farming.

### **Econometric Approaches to Contract Farming Participation**

Heckman two-stage models, Double-hurdle model, and Tobit model have been used to examine crop farmer's market participation (Komárek *et al.*, 2010). The modeling approach presumes that the participation and sales volume decisions are made simultaneously and hence factors that affect the participation decision and the sales volume decision are the same. Hence, this model is prone with the limitation that it assumes that the same set of parameter and variables determine both the probability of market participation and the level of transaction. Tobit model also assumes that zero values traded are because of rational choice, although it may be due to a prohibitive entry barrier that is limiting market entry (Komárek *et al.*, 2010). Tobit model is also limited in the sense that we observe it only if it is above or below some cut off level hence, it underestimates the intercept and overestimate the slope. Tobit seems also to conceal some information on that, it tends to combine both the direct and partial effects of the explanatory variables on the dependent variables (Makhura, 2001).

A two-step model relaxes the Tobit model assumption by allowing different mechanisms to

determine the discrete probability of participation and level of participation. These models allow for separation between the initial decision to participate and the extent of participation. Heckman two-stage model was developed by Heckman (1997) and has been used extensively to correct for biases arising from sample selection. This model assumes that the missing value of dependent variable implies that the dependent variable is unobserved (not selected). Heckman's model first uses probit regression with all variable data to estimate the probability of contract farming participation. Then the inverse Mills ratio, computed from the probit regression, is used with other explanatory variables to help explain variances to the continuous, non-zero dependent variable. This model is also not appropriate for this study because there are restrictions regarding the elements of explanatory variable in each decision stage and assumption of incidental truncation in some dependent variables (Komárek *et al.*, 2010).

In the double hurdle model, an output market decision is a two-step decision process; this is based on the assumption that household makes two separate decisions; one involves the decision to participate in the contract or not and secondly the extent of participation. The model estimation involves a Probit regression to identify factors affecting the decision to participate in the contract farming using all sample populations in the first stage, and a truncated regression model on the participating households to analyze the extent of participation, in the second stage. According to Burke (2009), the double hurdle model is useful because it allows a subset of the data to pile-up at some value without causing a bias in estimating the determinants of the continuous dependent variable in the second stage; hence you can obtain all the data in the remaining sample for the participants. Hence, the Craggs double hurdle model was chosen to determine the decision to participate and extent of participation in contract farming among smallholder maize farmers.

## MATERIAL AND METHODS

### Study Area

The study was conducted in north-western part of Nigeria specifically Kano and Kaduna States Nigeria where maize production is pre-dominant and there

exists evidence of contract farming operations by firms such as BababbanGona Bunkasa Manoma and manoma links etc. The local government in the states where there was evidence of maize contract farming in Kaduna state include Soba, Kubau, Furu, Lere and Igabi local Government while in Kano state the local governments includes Rano, Bunkure, Garunmalam, Warawa, Kura Karaye Rogo and Shanono local government.

**Kaduna State** is located between latitudes 11°32' and 09°02' north of the equator and longitudes 8°50' and 06°5' east of the Prime Meridian (Kaduna State Statistical Year Book, 1996). The State occupies an area of approximately 48,473.2 square kilometers. The entire land structure consists of an undulating Plateau, with major rivers in the State as River Kaduna, River Wonderful in Kafanchan and River Gurara. Kaduna State has 23 Local Government Areas (LGAs) it lies within the Derived Guinea Savannah zone of Nigeria; The State extends from the Guinea Savanna in the South-Central to the Sudan Savanna in the North Central. The grassland is a vast region covering the southern part of the State. There are two marked seasons in the State: the rainy (wet) season and the dry windy season. The wet season is usually from May to October with great variations in different areas of the state from 600 mm to 1500 mm. On the average, the State enjoys a rainy season of about five months. The length of the growing periods varies from 100 to 200 days. The dry season starts from November to April Temperature in the state ranges between 28°C and 34°C (NiMet, 2012). Farming is the main occupation of the people, with emphasis on the crops grown which include maize, sorghum, rice, millet, wheat, cotton, yam, cassava, pigeon pea, cowpea, soya bean and groundnut. They also grow vegetable crops like tomato, pepper, onion and carrot. Livestock is also important in the economy of the state and the livestock kept include cattle, sheep, goats and poultry.

**Kano State** is located between latitudes of 10°3' and 12°37' North and longitudes 7°3' and 9°5' East of the Greenwich meridian (Ogungbile *et al.*, 1999). Kano State is the commercial nerve center of Northern Nigeria. It has a total land area of 20,760 square kilometres with 1,754,200 hectares of fertile agricultural land, of which 86,500 is exclusively Fadama land. About 75,000 hectares is made up of grazing lands (Olofin *et*

*al.*, 2008). The State has 44 Local Government areas is the most populous state in Nigeria with a population of 9,383,682 (NPC, 2006). The dry season is usually from October to April, while the rainy season begins from April to September with an annual rainfall of 134.4 mm Kano. Farming is the main occupation of the people, with emphasis on the crops grown which include maize, sorghum. They also grow vegetable crops like tomato, pepper, onion and carrot. Livestock is also important in the economy of the state and the livestock kept include cattle, sheep, goats and poultry.

### Sampling Procedure

Multi-stage random sampling was employed for the study; the first stage was a random selection of 3 Local Government Areas (LGAs) each from Kano and Kaduna state out of LGAs with firms operating contract farming through balloting. In the second stage, 12 communities were selected from the list of CF participating communities in selected LGAs also through balloting; in the third stage 361 farmers were randomly selected systematically from the 847 list of smallholder maize farmers as obtained from extension workers across the selected communities. Table 1 show the summary of sampling procedures.

**Table 1.** Sampling summary

State	LGA	Communities	Selected Communities	Sample Frame	Sample Size
Kaduna	Ikara	10	Saulawa	62	20
			Kurmin Kogi	74	31
			Mayere	55	26
	Makarfi	8	Dorayi	62	27
			Gimba	77	37
			Awai	80	38
Kano	Bebeji	7	Alkalawa	58	25
			Damau	89	43
			Yalwa	77	28
	Rano	10	Doka	67	25
			Danhassan	60	22
			Barge	86	39
Total	6	56	12	847	361

### Method of Data Collection

Cross-sectional Primary data was used for the study; the data was collected through the use of well-structured questionnaire administered to farmers by well-trained enumerators that have better understanding of farmer's local language. The data collected includes information on farmer's socio-economic characteristics, portfolio

features of maize contract farming, and problems associated with contract farming participation.

### Double-Hurdle Model

Double hurdle model was used to measure decision and level or extent of contract farming participation. It is a parametric simplification of the Tobit model, in

which dual distinct stochastic processes define the resolution and level to participate in contract farming (Greene, 2007). Decisions and level or extent of membership in the Tobit model, are supposed to be the same. Nonetheless, Asfaw *et al.* (2011), suggested that the proclamation to participate may lead the level/intensity of participation decision and therefore the control variables in both stages may vary. In this model, both hurdles (that is the decision for participation in contact farming and the level or extent of participation) are considered. In estimating the double-hurdle model, the double-hurdle assumes that households make two sequential decisions for participating and level/intensity of contribution in a scheme like contact farming or the use of machinery. Each hurdle is habituated by the family circle socioeconomic characteristics and institutional variables. However, a diverse underlying variable is used in the double-hurdle model, to epitomize each resolution procedure. The first decision variable ( $D$ ) is 1 for farmers who have participate in maize contract farming and zero for otherwise (non-participating).

The expected utility of participating in contract farming ( $D_i^*$ ) is latent. This was evaluated with a Probit model as the first hurdle equation given as:

$$D_i^* = aZ_i + U_i \quad (1)$$

$$D_i = 1 \text{ if } D_i^* > 1, \quad D_i = 0 \text{ if } D_i^* \leq 1$$

Where,  $D_i = 1$  if the farmer participates in Maize Contract Farming and  $D = 0$  otherwise,  $Z_i$  = descriptive vector variables (farmer socio-economic characteristics /farm specific characteristics and institutional characteristics that influences the likelihood of participating in maize contract farming,  $a$  = vector of parameter estimates,  $U_i$  = error term.

The second hurdle of double-hurdle model involves an outcome equation, which uses a truncated model that determines the level/extent of participation in maize contact farming measured in terms of the size of land allocated by the farmer to produced maize under contract arrangement. Therefore, the second hurdle uses observations only from those farmers who indicated a positive value on partaking in Contract Farming. It is worth stating that the farmers' involvement in maize contract farming does not partake at the same level of participation. Hence, the extent/intensity of participation (level of participation

hurdle) in maize contract farming is projected using a Truncated Equation model given as:

$$Y_i^* = \beta X_i + \mu_i \quad (2)$$

$$Y_i = \begin{cases} Y_i & \text{if } y_i^* > 0 \text{ and } D_i^* > 0 \\ 0 & \text{otherwise} \end{cases}$$

Where,  $Y_i$  = observed response as the land size allocated for maize production measured in hectare under contract arrangement,  $X_i$  = vector of explanatory variables which are contract portfolio characteristics and demographic factors,  $\beta$  = vector of parameter estimates,  $\mu$  = error term.

The observed value of the land size allocated for maize production under contract arrangement is therefore given by:

$$Y_i = D_i Y_i^* \quad (3)$$

The error terms of the two decision models (participation model and level of participation model) are distributed as follows:

$$\sum_{v_i}^{\mu \sim N(0,1)} \quad (4)$$

The error terms and are usually assumed to be independently and normally distributed. It is assumed that for each respondent the decision whether to participate in contract farming and the decision about the participation level are made independently. The two decision processes are non-separable and thus both parts of the likelihood function must be maximized simultaneously.

The empirical model employed to determine the decision of participation in maize contract farming is specified as follows:

$$A_j = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \dots + \alpha_{11} X_{11} + \mu_j$$

$A_j$  = individual decision of participation in contract farming

$\mu_j$  = the error term

$\alpha_1, \alpha_2, \alpha_3, \dots, \alpha_n$  = the coefficient of the explanatory variables

$X_1$  = Household size

$X_2$  = Age

$X_3$  = Farm size

$X_9$  = Marital status

$X_4$  = Main occupation

X<sub>5</sub> = Cooperative membership  
 X<sub>6</sub> = Accessible road  
 X<sub>7</sub> = Access to credit  
 X<sub>8</sub> = Extension contact  
 X<sub>10</sub> = Education level  
 X<sub>11</sub> = Number of years of contract farming awareness

Z<sub>3</sub> = Farm size  
 Z<sub>4</sub> = Main Occupation  
 Z<sub>5</sub> = Access to agricultural training  
 Z<sub>6</sub> = access to credit  
 Z<sub>7</sub> = Extension service access  
 Z<sub>8</sub> = Marital status  
 Z<sub>9</sub> = Education level  
 Z<sub>10</sub> = years of contract farming awareness.  
 Z<sub>11</sub> = Nature of input disbursement  
 Z<sub>12</sub> = Transportation Responsible  
 Z<sub>13</sub> = Pricing Decision  
 Z<sub>14</sub> = Distance to collection center  
 Z<sub>15</sub> = Duration of contract  
 Z<sub>16</sub> = contract farming experience  
 Z<sub>17</sub> = Mode of Participation  
 Z<sub>18</sub> = Engagement in Side-Selling  
 Z<sub>19</sub> = Transportation cost per Bag  
 Note: Table 2 shows the description of the variable used in the model.

The empirical model employed of determining the extent of participation in maize contract farming was specified as follows

$D_j = \beta_0 + \beta_1 Z_1 + \beta_2 Z_2 + \beta_3 Z_3 + \dots + \beta_{19} Z_{19} + v_j$   
 D<sub>j</sub> = Extent of participation in contract farming (Farm size allocated for Maize Contract Farming  
 β<sub>0</sub> = constant term, V<sub>j</sub> = error term)  
 β<sub>1</sub>, β<sub>2</sub>, β<sub>3</sub>...β<sub>n</sub> = the coefficient of the explanatory variables  
 Z<sub>1</sub> = Household size  
 Z<sub>2</sub> = Age

**Table 2.** Measurements of Variables in the Model

Variable	Measurement
Participation	Decision to participation in contract farming (yes = 1 or no = 0)
Extent of participation	Land size allocated for maize contract farming (hectares)
Household size	Number Family members eating from the same pot (numbers)
Age	Age of farmer (years)
Experience	Years of experience in maize production (years)
Main occupation	Major source of income (farm = 1, non-farm = 0)
Farm size	Land size own by the famer for crop production (hectares)
Access to credit	(yes = 1 if there is access and or 0 if otherwise)
Extension contact	(yes = 1 if farmer has contact with extension agents and 0 if otherwise)
Number of years of awareness of CF	Length of time a farmers is aware of contract farming (years)
Marital status	(single = 1, married = 2, widow = 3, divorced = 4)
Education	(Religious education = 1, Primary = 2, Secondary = 3, Tertiary = 4, Adult education = 5)
Duration of contract	Months spent in contract (number)
Contract experience	Years of contract participation (years)

Mode of Participation	Participation in the contract (as individual = 1, in group = 2)
Engagement in Side-Selling	(yes = 1 if a farmer engages in side selling and = 1, = 0 if otherwise)
Transportation cost	Total transportation cost for the quantity of maize transported (naira)
Training access	(yes = 1 if farmer received training and 0 if otherwise)
Distance to collection center	Distance in (km)
Nature of inputs Disbursement	Form of input disbursement (once = 1, twice = 2, phase basis = 3 when needed = 4)
Pricing Decision	Who makes decision on the price of maize (farmer = 1, contracting firm = 2, none (market price was used) = 3)

## RESULTS AND DISCUSSION

### Socio-economic Characteristics of Smallholder Farmers

The result for socioeconomic characteristics of smallholder maize farmers is shown in Table 3, results revealed about 52% of smallholder farmers that are found to be participating in maize contract farming. An average age of maize farmers involved in contract farming (CF) is 39 years; with over 20 years of farming experience and an average farm size of 2.46 hectares. On the other hand, those not involved in contract farming have an average age of 37 years, 18 years farming experience and an average farm size of about 2.16 hectares. This is similar to what was found by Yakubu *et al.* (2019) among maize farmers in Kano state. In addition to that; majority of farmers involve in maize CF are Males (88.77%), Married (96.79%),

belongs to cooperative group (91.45%) and have farming as their main occupation (99.46%), this corroborates with the finding of Akanbi *et al.* (2019) that majority of CF were males and they belong to cooperative groups in Kwara State Nigeria. Similarly Non-CF participants majority were also found to be males and married, and also have farming as their main occupation however, only few (20.11%) of them belongs to cooperative group. Moreover, majority of the maize farmers were found to have accessible roads (85.03%) to their farms; Access to credit (71.66%) as well as access to extension service (91.44%), on the other hand non-CF maize farmers have few of them with accessible to road to their farmers (32.76%), access to credit (29.86%) and extension service (18.97%). With regards to their level of education, irrespective contract farming participation both categories of farmers have some level of formal education ranging from primary, secondary and tertiary.

**Table 3.** Socio-economic characteristics of the Maize farmers

Quantitative Variables	Contract farmers N = 187 (51.8%)				Non-Contract farmers N = 174 (48.2%)			
	Min	Max	X	SD	Min	Max	X	SD
Age (years)	18	65	39.2	9.10	18	70	37.25	11.2
Household Size	1	30	8.2	4.96	1	25	7.92	5.47
Experience	4	45	20.7	8.48	1	45	18.2	9.78
Farm Size (ha)	0.8	9.46	2.46	1.55	0.5	8	2.16	1.47
Years of CF awareness	1	7	3.72	1.4	0	7	3.27	2.36

Qualitative Variables	Frequency (%)	Frequency (%)
<b>Gender</b>		
Male	166(88.77)	144(82.75)
Female	21(11.23)	30(17.24)
<b>Marital Status</b>		
Single	5 (2.67)	16 (19.19)
Married	181(96.79)	158(90.80)
Divorced	5(0.01)	
<b>Cooperative Membership</b>		
Member	171(91.45)	35(20.11)
Non Member	16(8.55)	139(79.89)
<b>Main occupation</b>		
Farm	186(99.46)	168(96.55)
Non-farm	1(0.44)	6(3.45)
<b>Level of Education</b>		
Religious	37(19.79)	21(12.06)
Primary	46(24.60)	43 (24.71)
Secondary	51(27.27)	65(37.36)
Tertiary	25(13.37)	21(12.07)
Adult education	28(14.97)	24(13.79)
<b>Accessible road</b>		
Access	159(85.03)	57 (32.76)
No access	28(14.97)	117(67.24)
<b>Access to extension</b>		
Access	171(91.44)	141(18.97)
No access	16(9.36)	33(81.03)
<b>Access to credit</b>		
Access	134(71.66)	122(29.86)
No access	53(28.34)	52(70.11)

Note: X = mean

### Factors Determining Farmers Participation in Maize Contract Farming

The factors determining decision and extent of

participation in contract farming is presented in Table 4. The Wald statistic estimated was 364.97 and significant ( $P < 0.01$ ); this implies that the model significantly fitted the data. In other word the

independent variables included in the model were jointly important in explaining the variations in the decision of participation in contract farming and the extent of participation in contract farming. The sigma estimate representing the estimate of standard error of the model was 0.4874 and was also significant ( $P < 0.01$ ) this implies that the estimated double hurdle of the decision of participation and the extent of participation in contract farming are determined by different processes and therefore the use of double hurdle model (DHM) in place of standard Tobit model was justified.

### **A. Factors Influencing Farmer's Decision to Participate in Contract Farming**

The first hurdle of the model in Table 4 shows the maximum likelihood estimates of the Probit model of factors determining decision of participation in maize contract farming in the study area; the decision of participation was found to be significantly determined by level of education, main occupation, access to credit, access to extension services, access to agricultural training and period of contract farming awareness.

Access to extension service coefficient was found to be positive and significant ( $P < 0.01$ ) influencing participation decision. This implies that farmers that have access to extension service participate more in the contract farming. This may be because the contracting firms employed the services of extension agents in creating awareness and highlighting the importance of contract farming to farmers. This result is in accordance with that of Iro (2016) and Anim (2011) who recounted that in the Limpopo province of South Africa, extension visits were absolutely important in swaying the farmers' participation in contract farming.

Main occupation was found to be negative and significant ( $P < 0.05$ ) on influencing farmer's decision of participation in contract farming. This implies that farmers with off-farm occupation are less likely to participate in contract farming; the reason may be because they have other alternative sources of income.

Furthermore, farmer's access to credit coefficient was found to be positive and significant ( $P < 0.01$ ) on influencing decision of participation in contract farming at 1% probability level. This implies that farmers that enjoy agricultural credit services are more likely to decide participation in contract farming, as credit supply is the core aspect of contract farming.

Access to agricultural training was also found to be positive and significant ( $P < 0.01$ ) on influencing decision of farmers' participation in contract farming. This connotes that farmers that usually attend agricultural trainings are more likely to decide participation in contract farming.

In addition to that, level of farmer's education coefficient was found to be negative and significant ( $P < 0.01$ ) on decision of participation in contract farming. This implies that more formally educated farmers are less likely to decide participation in contract farming; this may be because those educated farmers mostly rely on off-farm activities as means of income, hence affecting their decision on contract farming participation. This contradicts the finding of Swain, (2012) among gherkin and paddy seed contract farmers in Andhra Pradesh, India.

Period of awareness about maize contract production was found to be positive and significant ( $P < 0.01$ ) on influencing farmer's decision of participation in contract farming. This implies that farmer's with adequate knowledge of contract farming operation is more likely to participate in the agreement.

### **B. Factors Influencing Farmer's Extent of Contract Farming Participation**

The second hurdle model in Table 4 also shows the maximum likelihood estimates of truncated regression model for the extent of participation in maize contract farming. The factor variables that significantly determine the extent of participation in contract farming were age of the farmer, farm size, farming experience, access to credit, duration of contract, access to agricultural training, contract farming experience, distance to firm collection center and side-selling by farmer.

The age of the farmers was found to be negative and significant ( $p < 0.01$ ), this implies low level of participation by old farmers, in other words level of participation in contract farming is high among youth and more active categories of farmers.

Access to agricultural training was also found to be negative and significant ( $P < 0.1$ ) on influencing level of participation in contract farming at 10% level of probability. This implies that farmers with less training on good agronomic practices participate more in contract farming. Therefore among less trained farmer's high level of participation will be expected.

**Table 4.** Factors Influencing Farmer’s Decision and Extent of Contract Farming Participation

Variables	First hurdle (Decision Model )			Second hurdle (Extent Model)		
	Coef.	Std. Error	p-value	Coef.	Std. Error	p-value
Level of education	-0.374***	0.126	0.003	-0.026	0.038	0.492
Age of maize farmer	0.031	0.024	0.198	-0.025***	0.008	0.004
Household size	0.001	0.036	0.992	0.016	0.013	0.202
Farming experience	-0.314	0.420	0.455	0.015*	0.008	0.068
Farm size	-0.248	0.248	0.318	0.433***	0.028	0.000
Main occupation	-0.728**	0.319	0.023	-0.099	0.112	0.373
Land ownership	0.043	0.141	0.749	-0.041	0.044	0.351
Access to credit	1.143***	0.390	0.003	0.329**	0.134	0.014
Extension access	2.474***	0.355	0.000	-0.063	0.186	0.733
Access to formal agric. Training	2.617***	0.398	0.000	-0.611*	0.340	0.072
Duration of awareness	0.461***	0.090	0.000	0.015	0.034	0.660
Duration of contract				0.085**	0.041	0.041
Contract farming experience				0.072**	0.036	0.042
Form of agreement				0.146	0.136	0.285
Mode of participation				-0.023	0.241	0.924
Distance to collection center				-0.024*	0.012	0.055
Transportation of harvest				-0.033	0.063	0.600
Side-selling				0.397**	0.128	0.002
Pricing decision				-0.171	0.125	0.172
Constant	-3.723496					
Sigma	0.4874***					
Wald chi2	364.97***					
LRX <sup>2</sup>	422.61***					
Log likelihood	-51.89					
Pseudo R <sup>2</sup>	0.8028					

Source: Field Survey, 2019

\*\*\*significant at 1%; \*\* significant at 5%; \* significant at 10%

Farm size own by farmers was found to be positive and significant ( $p < 0.01$ ) on influencing extent of farmer's participation in contract farming. This implies that farmers with larger farm size have high level of participation in contract farming; reason is that they have pre-requisite available land size to allocate for contract farming. This result is line with the findings of other scholars who observed the direct relationship between increased levels of commercialization and increased land size. It's also similar to the finding of Iro (2016) that used Double Hurdle model to explain determinant of tomato contract farming extent of participation among smallholder farmers in northern Nigeria and that of Khoza *et al.* (2019) in South Africa.

Moreover, farmer's access to Agricultural credit was found to be positive and significant ( $P < 0.05$ ) on influencing level of participation in contract farming; This implies that farmers that access to agricultural credit services have high level of participation in contract farming, as credit is one of the key aspect of contract farming was providing input credits to participating farmers.

Furthermore, distance to firm collection center was also identified to be negative and significant ( $P < 0.1$ ) on influencing level of contract farming participation at 10% probability level. This connotes that farmers that are located far away from contracting firm collection center have low level of participation in contract farming. Therefore, establishment of additional collection centers at various farming communities will increases level of participation.

The farming experiences was found to be positive and significant ( $P < 0.1$ ) on influencing farmer's extent of participation in maize contract farming at 10% level of probability. This implies that farmers with more experience in maize production have high level of participation in maize contract farming. These findings concur with that of Okoye *et al.* (2009), Tarawali *et al.* (2012) and Bidzakin *et al.* (2019) who found that farming experience has significant influences on participation in contract farming.

In addition to that, duration of contract agreement was found to be positive and significant ( $P < 0.05$ ) influencing extent of contract farming participation at 5% level of probability. The result implies that longer period of contract agreement attributes high level of

farmers participation; in other word the longer the period of contract maturity the more will be the land size to be devoted by the farmer for the contract.

Contract farming experience was also identified to be positive and significant ( $P < 0.01$ ) on influencing extent of participation in maize contract farming. This implies that farmers with more years of contract farming experience allocate more land for contract farming. This may be because as farmers spent more years in the contract farming they developed more interest by allocating an additional land for contract production.

Finally, engagement in side-selling was found to be positive and significant ( $P < 0.01$ ) on influencing extent of contract farming participation. The result implies that farmers with side-selling tendencies have high level of participation in contract farming. Therefore contracting firm should provide adequate monitoring of farmers in order to avoid side-selling action of farmers.

### **Constraints Preventing Smallholder Farmer's Participation in Maize Contract Farming**

The constraints preventing farmers' participation in maize contract farming are presented in Table 5. The most important constrain identified was inadequate requisite land size to allocate in the contract; this is due to the fact that the farmers are smallholder farmers and they produced multiple crops which limit the land size they can allocate for contract farming, secondly ranked constrain was lower pricing of maize by contracting firms; this is because of the perception of the farmer that it's the firm that decide on the price and on the other hand farmers preferred to sell their harvested maize during the off-peak periods when the price is usually high. Untimely distribution of inputs and disease and drought shocks associated with maize production was ranked as 3<sup>rd</sup> and 4<sup>th</sup> constrains respectively. The 5<sup>th</sup> and 6<sup>th</sup> constrains were inadequate knowledge of contract terms and conditions of agreement and high transaction charges in the contract respectively. Other constrains identified by the farmers are inadequate provision of insurance, inputs quantity (fertilizer and herbicide) and lower crop income obtained by participating farmers.

**Table 5.** Constraints Preventing Farmer’s Participation in Contract Farming

Constraints	Frequency	Percentage	Rank
Inadequate requisite land size to allocate in the contract	89	81.12	1 <sup>st</sup>
Lower pricing of maize by contracting firm	159	68.24	2 <sup>nd</sup>
Untimely distribution of inputs	155	66.52	3 <sup>rd</sup>
Diseases and drought	154	66.09	4 <sup>th</sup>
Inadequate knowledge of contract terms and conditions of Agreement	137	58.8	5 <sup>th</sup>
High transaction charges	134	57.51	6 <sup>th</sup>
Inadequate provision of insurance	120	51.5	7 <sup>th</sup>
Inadequate inputs quantity distributed to farmers	81	34.76	8 <sup>th</sup>
Lower crop income by participating farmers	81	34.76	8 <sup>th</sup>

Source: Field Survey, 2019

## CONCLUSIONS

Factors that significantly influenced farmers decision to participate in CF were level of education, main occupation, access to credit, access to extension services, access to agricultural training and period of contract farming awareness. Meanwhile, age of the farmer, farm size, farming experience, access to credit, duration of contract agreement, access to agricultural training, contract farming experience, distance to firm collection center and side-selling by farmer were the significant factors influencing extent of farmers participation in maize contract farming. In addition to that, inadequate requisite land, lower prices offered by firms and untimely distribution of inputs were identified as major constraints affecting smallholder maize farmer’s participation in CF Hence, Participation in contract farming will therefore be enhanced if access to extension services, credit, and trainings are improved. On the other hand extent at which farmers participate in the scheme will also increase with farm size increase, nearness to CF firm

collection center, and longer period of contract agreement. Therefore taking proactive measures regarding these factors such as creating more CF awareness through extension workers by relevant investors and agencies will promote contract farming participation among smallholder farmers.

## REFERENCES

- Adetola, I., Isaac B., Raheem, O.S. (2014). Determinants of market participation among maize producers in Oyo State, Nigeria. *British Journal of Economics Management and Trade*, 4(7), 1115–1127.
- Akanbi S.O., Alarape, W.I., Olatunji, S.O. (2019). Economic implication of contract farming on small-scale rice farmers in Kwara State, Nigeria. *Agrosearch*, 19(2), 26–40.
- Anim, F.D. (2011). Small-scale maize farmers’ decision to participate in contract farming: Implications for integration into the marketing chain. *African Journal of Business Management*, 5(1), 5065–5069.
- Armah, J., Schneider, K., Gugerty, M.K. (2010). Smallholder contract farming in sub-Saharan Africa and south Asia. *Evans School Policy Analysis and Research*,

- Prepared for the farmer productivity team of the Bill and Melinda Gates Foundation.
- Asfaw, S., Shiferaw, B., Simtowe, F., Haile, M.G. (2011). Agricultural technology adoption, seed access constraints and commercialization in Ethiopia. *J. Dev. Agric. Econ.*, 3(1), 436–447.
- Bellemare, M.F., Novak, L. (2017). Contract farming and food security. *American Journal of Agricultural Economics*, 99(2), 357–378.
- Bidzakin J.K., Fialor S.C., Vitor D.A., Yahaya, I. (2019). Impact of contract farming on rice farm performance: Endogenous switching regression. *Cogent Economics & Finance*, 7(1). DOI: [10.1080/23322039.2019.1618229](https://doi.org/10.1080/23322039.2019.1618229).
- Burke, W.J. (2009). Fitting and interpreting Cragg's Tobit alternative using Stata. *Stata Journal*, 9(4), 584–592.
- Fawole, P., Thomas K.A. (2014). Effect of contract farming scheme on cassava production in Oyo State. *Journal of Rural Economics and Development*, 20(1), 1–7.
- Gabriel, A., Orifah, M., Yusuf, M., Apeverga, P. (2017). Contract Farming: A Panacea for the Attainment of Food Self-Sufficiency in Nigeria. *Journal of Agricultural Economics, Environment and Social Sciences*, 3(1), 133–141.
- Greene, W.H. (2007). *Econometric analysis*. 6th Edition. New York: Macmillan, USA.
- Heckman, J. (1997). Instrumental variables: A study of implicit behavioral assumptions used in making program evaluations. *Journal of Human Resources*, 32(4), 441–462.
- Iro, K.I. (2016). Empirical evidence on contract farming in northern Nigeria: case study of tomato production. *Asian Journal of Agriculture and Rural Development*, 6(12), 240–253.
- Issa, N., Chrysostome, N.J. (2015). Determinants of farmer participation in the vertical integration of the Rwandan coffee value chain: Results from Huye District. *J. Agric. Sci.*, 7, 197–211. DOI: [10.5539/jas.v7n9p197](https://doi.org/10.5539/jas.v7n9p197).
- Khoza, T.H., Senyolo, G.M., Mmbengwa, V.M., Soundy, P. (2019). Socioeconomic factors influencing smallholder farmers' decision to participate in agro-processing industry in Gauteng province, South Africa. *Cogent Social Sciences*, 5(1). DOI: [10.1080/23311886.2019.1664193](https://doi.org/10.1080/23311886.2019.1664193).
- Komárek, A., Hansen, B.E., Kuiper, E.M.M., Buuren, H.R., Van, B., Lesaffre, E. (2010). Discriminant analysis using a multivariate linear mixed model with a normal mixture in the random effects distribution. *Stat. Med.*, 29(30), 3267–3283. DOI: [10.1002/sim.3849](https://doi.org/10.1002/sim.3849).
- Makhura, M.T. (2001). Overcoming transaction costs barriers to market participation of smallholder farmers in the northern province of South Africa. A PhD Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of in the Department of Agricultural Economics, Extension and Rural Development Faculty of Natural and Agricultural Sciences University of Pretoria, Pretoria.
- Miet, M., Vande, V.K. (2017). Contract farming in staple food chains. *World Development Journal*, 95(1), 73–87.
- Mgbenka, R.N., Mbah, E.N. (2016). A review of smallholder farming in Nigeria; need for transformation, *International Journal of Agriculture and Rural Development Studies*, 3(2), 43–54.
- NiMet, Nigerian Meteorological Agency. (2012). *Nigeria Climate Review*. 59 pp.
- NPC, National Population Commission. (2006). *Nigerian population census report 2006*.
- Ntaganira, E., Shukla, J., Mbeche, R., Mbabzize, M. (2017). Determinants of participation in contract farming among small holder diary farmers in Rwanda. *Int. J. Thesis Proj. Diss.*, 5, 11–19.
- Olusegun, O. (2016). Production efficiency and profitability of certified rice seed production among outgrowers in Katsina State Nigeria. Masters dissertation submitted to the school of postgraduate studies. Zaria: Ahmadu Bello University.
- Ofuoku, U.A., Agbamu, U.J. (2016). Maize contract farming experience in Delta state, Nigeria. *Journal of Northeast Agricultural University*, 23(1), 65–73.
- Ogungbile, O.A., Tabo R., Duirenbooden N.V. (1999). Multi-scale Characterization of Production System of Prioritize Research and Development in the Sudan Savanna Zone of Nigeria. *International Crop Research Institute for the Semi-Arid Tropics in Collaboration with Institute for Agricultural Research Information Bulletin*, 55, 25–32.
- Okoye, B.C., Okoye, A.C., Dimelu, M.U., Agbaeze, C.C., Okoroafor, O.N., Amaefula, A.B. (2009). Adoption scale analysis of improved cocoyam production, proprocessing and storage technologies across gender in Enugu North Agricultural Zone of Enugu State, Nigeria. St Louis, MI: IDEAS.
- Olofin, E.A. (2008). *The physical setting within Kano Region: a Geographical Synthesis* (pp. 5–34). Kano City: Adamu Joji Publishers.
- Olomola, A.S. (2010). *Enhancing Productivity, Income and Market Access of Rural Producers in Africa: the Case of Contract Farming in Nigeria*. Paper Presented at the Inaugural National Science Foundation (NSF) Joint Workshop of the African Economic Research Consortium (AERC) and the International Growth Centre (IGC) held in Mombassa, Kenya.
- Pandey, A.P. (2016). Socio economic factors of contract farming: a logistic analysis. *IRA-International J. Manag. Soc. Sci.*, 3, 749–762. DOI: [10.21013/jmss.v3.n3.p31](https://doi.org/10.21013/jmss.v3.n3.p31).
- Rondhi, M., Aji, J.M.M., Hasan, A.F., Yanuarti, R. (2020). Factors Affecting Farmers' Participation in Contract Farming: The Case of Broiler Sector in Indonesia.

- Tropical Animal Science Journal, 43(2), 183–190. DOI: [10.5398/tasj.2020.43.2.183](https://doi.org/10.5398/tasj.2020.43.2.183).
- Swain, B.B. (2012). Determinants of farmers' participation in contract farming: The cases of gherkin and paddy seed in Andhra Pradesh, India. *Millenn. Asia*, 3, 169–185. DOI: [10.1177/097639961200300203](https://doi.org/10.1177/097639961200300203).
- Tarawali, G., Iyangbe, C., Udensi, U.E., Ilona, P., Osun, T., Okater, C., Asumugha, G.N. (2012). Commercial scale adoption of improved cassava varieties: A baseline study to highlight constraints of large-scale cassava-based agro-processing industries in Southern Nigeria. *Journal of Food, Agriculture & Environment*, 10(4), 689–694.
- Yakubu, A., Oladimeji, Y.U., Hassan, A.A. (2019). Technical efficiency of maize farmers in Kano State of Nigeria using Data envelopment analysis approach. *Ethopian Journal of Environmental Studies & Management*, 12(2), 136–147.

## WARUNKI UCZESTNICTWA W ROLNICTWIE KONTRAKTOWYM WŚRÓD MNIJSZYCH PRODUCENTÓW KUKURYDZY W PÓŁNOCNO-ZACHODNIEJ NIGERII

### Streszczenie

Udział drobnych rolników w rynku poprzez kontraktowe umowy rolne cieszy się dużym zainteresowaniem w Afryce Subsaharyjskiej. Prowadzi to do zwiększenia komercjalizacji i specjalizacji podstawowych mechanizmów upraw. W badaniu wykorzystano próby 361 losowo wybranych hodowców kukurydzy. Zidentyfikowano czynniki wpływające na decyzję mniejszych rolników uprawiających kukurydzę i zakres ich udziału w uprawach kontraktowych w północno-zachodniej Nigerii. Do analizy danych wykorzystano statystyki opisowe i model podwójnej przeszkody Craggsa. Stwierdzono, że w rolnictwie kontraktowym (CF) uczestniczy 51,8% hodowców kukurydzy. Przeciętny wiek rolników uprawiających kukurydzę w systemie kontraktowym wynosi 39 lat. Są to producenci z ponad 20-letnim doświadczeniem w rolnictwie, a średnia wielkość gospodarstwa wynosi 2,46 ha. Z drugiej strony osoby nie zajmujące się rolnictwem kontraktowym mają średni wiek 37 lat, ponadto 18-letnie doświadczenie w rolnictwie i gospodarstwie o przeciętnej wielkości 2,16 ha. Jednak upowszechnianie informacji i wzrost świadomości w zakresie upraw kontraktowych, dostępu do kredytów, usług doradczych i szkoleń rolniczych miały istotny pozytywny ( $p < 0,05$ ) wpływ na decyzje rolników o ich udziale w uprawach kontraktowych kukurydzy. Istotnymi czynnikami ( $p < 0,01$ ) wpływającymi na zakres udziału w rolnictwie kontraktowym są: wielkość gospodarstwa, doświadczenie rolnicze, dostęp do kredytu, czas trwania umowy, doświadczenie w rolnictwie kontraktowym i sprzedaż uboczna. Za główne ograniczenia wpływające na udział drobnych rolników uprawiających kukurydzę w CF uznano niewystarczającą powierzchnię gospodarstwa, niższe ceny oferowane przez firmy i nieterminową dystrybucję nakładów. Dlatego istotne jest podejmowanie inicjatyw proaktywnych dotyczących zwiększania świadomości na temat CF przez doradców czy odpowiednich inwestorów i agencje, dotyczących korzyści wynikających z umów kontraktowych dla drobnych rolników.

**Słowa kluczowe:** kukurydza, Nigeria, podwójna przeszkoda, rolnictwo kontraktowe