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Impact of a Contract Farming Scheme on Income, Food Security, and Nutrition among Maize Farmers in North Western, Nigeria

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ABSTRACT

Background: The study examined the impact of a contract farming scheme on the farmers' income, food security, and nutrition. **Methods:** Simple random sampling was used to select 100 respondents for the study. Data were analyzed using descriptive and inferential statistics as well the Propensity Score Matching technique. **Results:** The major determinants of participation in contract farming included commercialization index, distance from the collection center, and total labor available in the household. The average treatment effect on the treated, the average effect of the treatment, and the average treatment on the untreated shows that contract farming will enhance the income from Maize production by ₦50234.8 ($131.79)/hectare, ₦37170.8 ($97.53)/hectare, and ₦28809.8 ($75.59)/hectare respectively. **Conclusion**: Contract farming participation can affect farming households negatively if food security concerns are not considered into the contract farming agreements.

Keywords: *Food security; Income; Nutrition; Maize; Contract farming*

Introduction

Agriculture contributes about 29.15% of the Gross Domestic Product in 2017 (National Bureau of Statistics, 2017) employing about 75% of the Nigerian labor force (Awotide *et al.*, 2015). Notwithstanding, poverty is very high in Nigeria; the current rate is about 62% (World Bank Group, 2016). The present emphasis on the agricultural sector in Nigeria is geared towards viewing agriculture as a business. One of the significant factors is the development of entrepreneurial farmers, whereby the farmers themselves are involved in proactive, innovative, and dynamic business activities (Fawole and Thomas, 2011). One of the first steps in transition from subsistence to commercial agriculture is the transition from smallholder farmers producing small quantities of several crops for home consumption to larger farms producing large quantities of one or two crops for sale, so that an intermediate sector is emerged between the agricultural and manufacturing sectors. Recently, the concept of contract farming had reached a favorable status among policy makers, development planners, extension agents, and researchers as one of the modern farming methods. In this regard, contract farming can develop agricultural entrepreneurs and overcome the

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difficulties faced by the agriculture sector (Fawole and Thomas, 2011). Smallholder farmers are constrained in terms of access to productive resources such as water for irrigation purposes and land, which often limit their production. In the same vein, smallholder farmers have limited access to production technologies and support services such as credit, extension education, and information on uncertainties regarding risks associated with new technologies (Barrett *et al.*, 2012). However, the participation of smallholders in contract farming can impact their welfare in various ways. Contract farming arrangements provide services such as training, credit, and technical advice including market information that aim at alleviating constraints on smallholder productivity, thereby increasing the marketed surplus. In addition, it helps to increase and stabilize smallholder incomes by setting the prices of outputs in advance and reducing the risks associated with price fluctuations (Baumann, 2000, Bellemare, 2012, Eaton and Shepherd, 2001). On the other hand, little is known about the impact of smallholder farmers' participation in contract farming arrangement on household food security and nutrition in Nigeria. Previous studies in Nigeria on the impact of contract farming did not focused on the food and nutrition security outcomes (Kutawa, 2016). The broad objective of this study was to evaluate the impact of contract farming participation on income, food security, and nutrition among Maize farmers.

It is critical and politically wise to investigate the positive as well as unintended effects of contract farming arrangements in order to put Nigeria on the right tract for the attainment of the Sustainable Development Goals.

Materials and Methods

The study was conducted in Kaduna State north central Nigeria. Kaduna State is located between latitude 90^{o} and 140^{o} north of the equator and between longitude 70^{o} and 100^{o} east of the Greenwich meridian. To conduct the study, five communities were randomly selected from the study area and 20 respondents were selected from each community, resulting in a total of 100 respondents for the study. Only respondents willing to participate in the study were included. Primary data for the study were collected during 2018-2019.

A Logit regression model was used to identify the determinants of participation in contract farming. The Dependent variable (Y) takes the value of "1" for respondents participating in contract faming and 0 if otherwise. The explanatory/independent variables were:

X_1= Years of maize farming experience (years)
X_2= Maize farm size (Ha)
X_3= Extension contact (number of visit)
X_4= Other occupation (number of livelihood activities)
X_5= Distance to collection produce collection center (KM)
X_6= Commercialization index (Quantity sold/ Quantity harvested)
X_7= Ownership of transport asset (1 and 0)
X_8= Total labor used (Naira)
μ = (Error term)

Propensity score matching technique (PSM) was applied to analyze the results. In the case that the survey instrument used for measuring the outcomes is identical for the treatment and control groups, PSM can be used to compare two groups (Diaz and Handa, 2004). The matching method compares the beneficiaries and non-beneficiaries with comparable characteristics that affect project participation and outcomes. The difference of the outcome between the treatment and control group is considered as the impact of the intervention (Dehejia, 2005).

Following Kolawole (Kolawole *et al.*, 2020), the average treatment effects (ATE) on the treated population (ATT) was estimated as follows:

$$ATT = E(\Delta Y \mid D = 1, X)$$
$$= E(Y1 - Y0 \mid D = 1, X)$$
$$= E(Y1 \mid D = 1, X) - E(Y0 \mid D = 1, X)$$

Where, Y0 = outcome when the respondents did not participate in contract farming; Y1 = outcome when the respondents participated in contract farming.

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The outcome variables (Y) include income from maize, nutritional status, and food security. Therefore, E (Y1| d = 1, X) = mean outcome from participating in the program; E (Y1 − Y0|D = 1, X) is the mean of the counterfactual, which gives the outcome for the farmers in the absence of the treatment which is participation in contract farming (Adebayo *et al.*, 2016). The outcome of the matched pairs is estimated through the mean difference as follows:

ATT = E [Y1|D = 1, P(X)] = E [Y0|D = 0, P(X)]

ATE = E [Y1|D = 1, P(X)] – E [Y0|D = 0, P(X)]

The ATE, ATT, and average treatment effect untreated (ATU) were computed to estimate the impact of contract farming. Furthermore, two matching algorithms, the nearest neighbor and the Caliper or Radius matching were used. However, the Caliper or Radius matching with band width of 0.25 gave the best matching and balance of covariate that was used for further analysis.

Measurement of impact indicators gross margin analysis: Income from Maize production was determined using the Gross Margin Analysis, which can be specified as follows: GM = GR - TVC; where GM = Gross Margin/Ha, GR = Gross Revenue/Ha, and TVC = Total Variable Cost/Ha. The Gross revenue is the monetary value of the output obtained using the following expression:

TR = Py.Y; where Py = Price per unit of output and Y = Maize output in bags.

Food security status: The Household Food Insecurity Assessment Scale (HFIAS) was used to determine the household food security status (Coates *et al.*, 2007). The HFIAS score was calculated for each household by summing the scores for each of the nine occurrence and frequency-of-occurrence questions. The maximum score for a household was 27 (If the household's score to all nine frequency-of-occurrence questions was 3). The minimum score is 0 (if the household responded "no" to all occurrence questions). Responses to Frequency-of-occurrence questions could be "often" = 3, sometimes =2, and rarely =1).

Household nutrition status: The nutritional status or nutritional adequacy of the respondents was determined using the Household Dietary Diversity Score (Ali *et al.*, 2014). To obtain the dietary diversity score, scores of all the food types were added for each household.

Results

Participants: The participants' demographic characteristics are represented in **Table 1**. The results show that 87% of the participants were men, while 13% were women. A similar pattern was observed for the non-participants in the contract farming scheme, which indicates that farming activities in the study area is dominated by male farmers. In terms of age, the household head mean age was 43.9 years, while the non-participants had a mean age of 41.4 years. No significant difference was observed between the study groups in terms of mean age (P = 0.10). The participants' average household size was about 8 members, while the non- participants' average household size was 10 members. However, this was difference not significant (P = 0.10).

Determinants of participation in contract farming: The results of determinants of participation in the contract farming are presented in **Table 2**. The estimated Logit model for participation in contract farming was a good predictor of participation according to the goodness of model fit (the Hosmer – Lemeshow H-L statistic and the Chi square test). The H-L goodness of fit test statistic was 4.17 that was not significant (P = 0.84) and indicated a good fitness of the model (Kleinbaum, 2010). Furthermore, the model has a significant Chi-square static of 26.36 (P = 0.05). The major significant determinants of participation in the contract farming were commercialization index, distance from collection point, and total labor available in the household (P = 0.10).

Propensity score and balancing test: The average probability of the households'

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participation in the contract farming was 55%. The high total bias reduction, the insignificant P-values of the likelihood ratio test after matching, low pseudo-R^2, and significant reduction in the mean standardized bias indicate successful balancing of the distribution of covariates between participants and non-participants groups (Wossen *et al*., 2018). The results reveal that the standardized mean difference for all covariates used in the PSM reduced from 22.5% pre-matching to 3.5% post-matching. This shows that matching reduces bias by about 84%. In addition, the joint significance of covariates post-matching was insignificant (P = 0.84).

Impact of contract farming on income from Maize (GM): Contract farming had a positive and significant effect on Gross Margin/ha for Maize farmers considered in the study area. The ATT was ₦50234.8 ($131.79)/hectare of area cropped with maize, while the ATE was ₦37170.8 ($97.53)/hectare. This implies that on the average, the income of a randomly sampled maize farmers will increase by about ₦37170.8 ($97.53)/hectare**.** Regarding the untreated category, the average treatment on the untreated (ATU) value of ₦28809.8 ($75.59) implies that if this category of respondents were treated, their maize income would increase by ₦28809.8 ($75.59). Most importantly, participation in the contract farming would increase income from maize as measured by the Gross Margin/hectare.

Impact of contract farming on household nutrition: The contract farming had a negative, but not significant effect on the household nutrition in the study area. The ATT shows that participation in contract farming reduced the food diversity score by 3.09. Moreover, the ATE indicates the household food diversity will reduce by 3.11. The HHDDS of the non-participants would reduce by 3.12 if they participated in contract framing**.** The results above show that participation in contract farming adversely affected the farming households' nutrition in the study area.

Impact of contract farming on household food security: The ATT was 3.69, indicating that participation in the scheme would reduce the food insecurity score by 3.69. The ATE was 4.23, while the ATU was estimated as 4.58. This implies that the food insecurity assessment score for the non-participants will increase by 4.58 if they these farmers participated in the program. Based on these findings, participation in contract farming negatively affected the household food security status in maize farmers in the study area.

Table 1. Mean (±SD) of the socioeconomic characteristic of respondents

Variables	Participants	Non-participants	P-value[a]
Age (y)	43.86 ± 16.0	41.43 ± 22.0	0.74
Household size	7.93 ± 5.1	10.13 ± 6.40	0.14
Farm experience	22.33 ± 10.2	13.53 ± 11.3	0.98
Maize p lot	1.10 ± 0.04	2.15 ± 1.00	< 0.001
Distance to collection point	14.33 ± 3.50	21.53 ± 7.30	< 0.001
Dependency ratio	0.80 ± 0.12	0.95 ± 0.22	0.12
Commercialization index	0.69 ± 0.025	0.55 ± 0.37	0.99
Total labor	10105.33 ± 3200.00	19076.00 ± 5210.00	0.16
Household food insecurity assessment scale	9.20 ± 3.7	4.93 ± 2.20	0.99
Dietary diversity score	7.6 ± 3.4	10.5 ± 2.6	0.0003
Gross margin	158757.00 ± 34500.24	111822.80 ± 28054.50	0.96

a: student *t-test*

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Table 2. Logistic regression for participation in the contract farming

Variables	Odd ratio	Standard error	P-value[a]
Commercialization index	2.33e+10	3.22e+11	**0.08**
Ownership of transport assets	0.78	1.39	0.89
Experience in maize farming	1.15	0.12	0.19
Distance to collection point	0.73	0.13	**0.07**
Extension contact	0.99	0.00	0.60
Total labor	1.00	0.00	**0.09**
Other occupation	1.93	0.91	0.16
Farm size	0.75	0.32	0.49
CONSTANT	4.79e-07	4.50e-06	0.12

a: Chi-square *test*

Discussion

In terms of the determinants of participation in contract farming, it was reported that short distance to markets was effective on contract farming among Paddy farmers in India (Swain, 2012). However, this finding is different from (Kutawa, 2016) findings, who suggested that the major determinants of contract farming participation among Tomato farmers included the farm size, frequency of extension contact, and farmers' level of education. This difference could be due to the differences in the crop under study as well as the socio economic characteristics of the respondents in the two studies. In this study, a positive impact of contract farming on income was expected, which is supported by the literature (Azumah *et al.*, 2016, Fawole and Thomas, 2011, Igweoscar, 2014). This indicates that contract farming has potentials for poverty alleviation and is critical for the achievement of the Sustainable Development Goals (SDG) number one (no poverty).

Our findings over the impact of contract farming on food security, concurs with a very a recent study by (Olounlade *et al.*, 2020). The authors observed that contract farming significantly and negatively affected food security and pointed out that decreased food consumption was a result of contract farming participation. This finding can be due to the unfavorable contract farming agreements and the fact that food security concerns were not factored in the contract faring agreement. However, this finding was contrary to an earlier finding by Bellemare *et al.* who observed that contract farming had a significant effect on food security and reduced hunger periods among farmers in contract farming compared to non-participants (Bellemare and Novak, 2017). The study used the propensity score matching approach which only controls for selection bias due to observed covariates. However, the study contributed to literature on the impact of contract farming on nutrition in Nigeria. Future studies can use a panel data approach to glean further insight.

Conclusion

Contract farming can enhance the income of small scale maize farmers. However, it can have a negative impact on both the food security and nutrition of small scale maize farmers as measured by the household food insecurity assessment scale and dietary diversity scores respectively if food security and nutrition concerns are not factored or considered in contract farming agreements.

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Authors' contributions

Hussaini Yusuf I and Sakinatu Umar G designed the research. Sakinatu Umar G and Munir Jamiu W collected the data. Hussaini Yusuf I and Sakinatu Umar G conducted statistical analysis. Sakinatu Umar G and Munir Jamiu W wrote the manuscript. Sakinatu Umar G had primary responsibility for final content. All authors read and approved the final manuscript.

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Conflict of interest

The authors hereby wish to declare that there is no conflict of interests with the conduct of the research.

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