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Effect of Contract Farming on Rice Yield in Bontanga Irrigation Scheme

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ABSTRACT

Contract farming, which involves an agreement between a farmer(s) and buyer under specific conditions is supposed to yield mutual benefits. It has gained grounds in Ghana's rice production sector including rice farmers in the Bontanga Irrigation Scheme. Farmers are expected to get higher yields through the provision of necessary improved inputs and management advice by the contractors. Meanwhile, there is no empirical evidence on the effect of contract farming on rice yield in the Bontanga Irrigation Scheme. This study aimed to examine the effect of contract farming on rice yield in the Bontanga Irrigation Scheme. A multi-stage sampling procedure was employed to select a total of 130 respondents. Heckman treatment effect model and Kendall's coefficient (W) of Concordance were employed as analytical methods for achievement of the objectives. The study revealed that household size, farmer-based organization membership, labour, fertilizer, weedicides and pesticides positively affected rice yield. Extension service had no improvement or positive contribution to yield which could be due to poor extension delivery. The seed used also negatively affected rice yield. Small farm size and strict specification of contractors were respectively the most pressing and least pressing constraints associated with farmers` decision to participate in contract farming in the study area. The study recommends that Ghana Irrigation Development Authority (GIDA) should increase the irrigable land in the area so that farmers can access more land for farming. The Ministry of Food and Agriculture (MoFA) should also stimulate farmers to participate contract farming and provide support through intensified input subsidization and collateralization.

INTRODUCTION

Agriculture is a proven path to prosperity (AGRA, 2017), a linchpin and an integral economic activity for scores of people. In Ghana, financing of agricultural activities is often largely carried out by individual small-scale farmers who are poor and do not have adequate requisite resources that can help optimise their outputs. Some of these resources comprise extension services, credit, inputs, guaranteed markets for their produce among others (Chakrabarti, 2015). Several interventions and programmes such as the Rice Sector Support Project, Export Development and Agricultural Investment Fund (EDAIF), contract farming (CF), among others, are currently implemented by both government and non-governmental organisations as vital mechanism to arrest some of the constraints in the agricultural sector.

Rice is an essential food crop and its consumption is increasing largely among urban dwellers. Donkoh *et al.* (2013) showed that rice has the potential to attaining global food security and sustainable gross domestic product (GDP). MoFA (2016) indicated that rice is the fifth largest major crop cultivated in the country with production estimates 688,000 Mt. Northern region is the second largest contributor of the total rice production in the country after Volta region with 177,464.50 Mt and 206,908.45 Mt production estimates respectively. The estimated cropped area for rice in the country according to MoFA (2016) is 236,000 Ha with an average yield of 2.92 Mt/ha. Regardless of the progress attained in rice production over the years, the average yield (2.92 Mt/Ha) still lags behind the potential yield (6 Mt/ha) (SRID-MoFA, 2016) and the supply (milled rice) is still at deficit of 580,300 Mt in the country (SRID, 2017).

The government of Ghana has over the years attempted to advance rice production domestically. The strategic establishment of several irrigation projects including the Bontanga irrigation scheme was one of such approaches. It is the largest irrigation scheme in the Northern Region under the management of GIDA with a potential irrigable area of 800 ha and the developed area of 495 ha (GIDA, 2011).

One of the key tools for agricultural transformation in developing countries is contract farming due to its potential to solve agricultural marketing problems (Kirstenand Sartorius, 2002). According to Eaton and Shepherd (2001), contract farming refers to an agreement between farmers and processing/marketing firms for the production and supply of agricultural products under forward agreements, frequently at predetermined prices Contract farming arrangements provide farmers with access to a wide range of services that otherwise may be unattainable. Access to market, credit, new technologies and risk reduction are some of the benefits farmers gain from participating in contract farming (Chakrabarti, 2015; Eaton and Shepherd; Kumar *et al.*, 2019). The engagement of smallholder farmers in formal marketing can create proper co-ordination and allocation of resources, goods and services thereby alleviating poverty and improving the livelihoods of households.

For optimal allocation of resources in agriculture and for stimulating farmers to increase output, an efficient, cohesive, and responsive market mechanism is vastly relevant. Lack of farmers' link to stable and ready markets, price instability, land, credit and inputs inaccessibility, among others render increase in output, rural incomes and better livelihoods unsustainable. Ideally, farmers should have certain well-structured linkage with dynamic market players. In this way, they can access agricultural inputs easily and sell their produce for a suitable price while the synergy can create benefits for other stakeholders through the service provided. Additionally, this synergy can bridge gaps in domestic agricultural products and industrial products for supplying the world's demand (Berdegué *et al.*, 2008; Haggblade *et al.*, 2007). A multiplicity of drawbacks causes farmers failure in the marketing systems. Inaccessible roads, poor transportation systems, lack of agro-processing centers, no link to market actors, price control and quality control, among others, are found to be core causes leading to failure in agricultural marketing (World Bank, 2007).

The government and other non-governmental organisations have used contract farming as a strategic tool to address market and institutional failures that most likely pose as barriers to agricultural development policy. The study will principally aid to unravel the drivers and effect of contract farming on rice yield and rank identified constraints. This justify as a potential for apprising policy makers on the rational allocation of scarce resources to address the challenges and significantly contribute to the development of contractual arrangement models, useful for decision makers and agricultural development's stakeholders, in designing appropriate related policies on agricultural development, to ensure greater support and thus improve efficiency and boost rice yield. In furtherance, the study will add up to relevant literature on the effect of contract farming on rice yield and the drivers of contract farming participation in the district.

MATERIALS AND METHODS

Study Area

The study was carried out in the Kumbungu district of the Northern region of Ghana. The Kumbungu District was carved out of the then Tolon/Kumbungu District in 2011. It was inaugurated on the 28th June, 2012 with Kumbungu as its capital. The District shares boundaries to the north with Mamprugu/Moagduri district, Tolon and North Gonja districts to the west, Sagnerigu district to the south and Savelugu/Nanton Municipal to the east. The district has a total population of 39,341 and a land mass of 1,599 km^2 being one of the smallest districts in the Northern region (GSS, 2014). About 81.3 percent of the population aged 15 years and older are economically active while 18.7 per cent are economically not active. Majority of the people according to the 2010 population and housing census, are engaged in skilled agriculture, forestry and fishery workers. The district has relatively dry climate, with a unimodal rainy season that starts in May and ends in October. The recorded amount of rainfall annually in the area is 1000 millimeters. The dry season starts in November and ends in March/April with maximum temperatures occurring towards the end of the dry season (March-April) and minimum temperatures in December and January (GSS, 2014). The Bontanga irrigation dam is one of the core economic potentials in the district where people cultivate vegetables and crops such as rice among others.

Bontanga irrigation scheme lies between latitude 90 30” and 90 35” N and longitude 10 20”and 10 04” W (GIDA, 2011). A preponderance of people in the district are engaged in agriculture with a greater percentage of the farming population practicing subsistence or small-scale farming. Maize, millet, yam, guinea corn, rice, groundnuts, beans, soya beans and cowpea include the crops produced. Livestock production is also very common in the district.

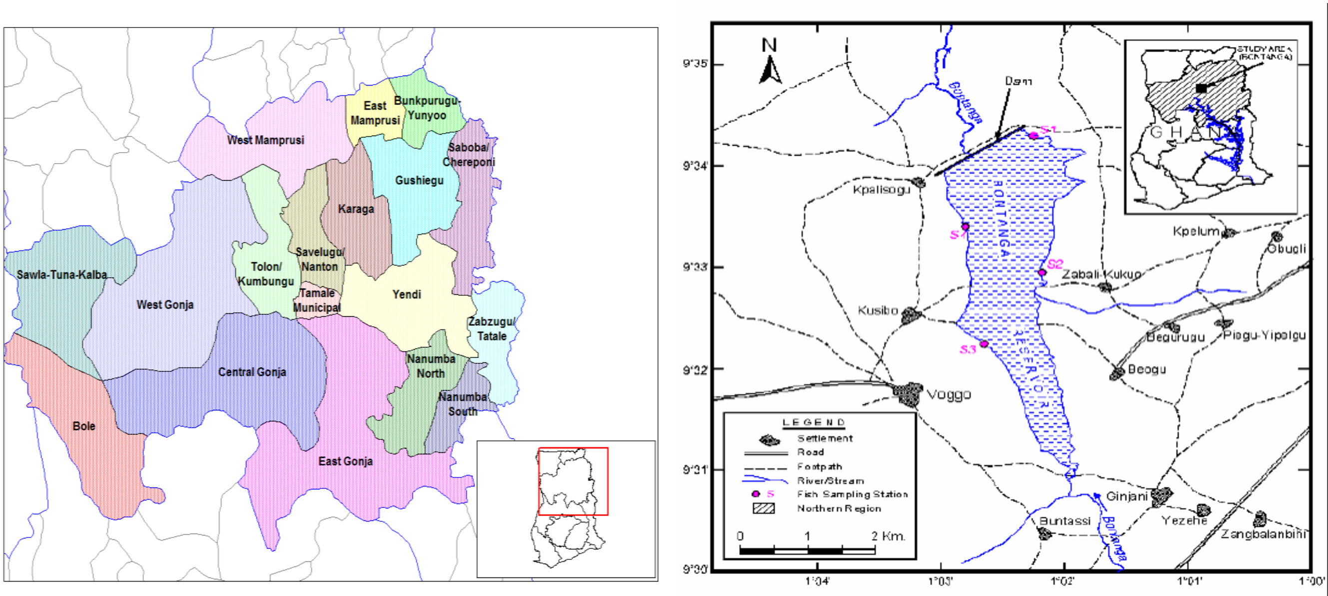

Figure 1. Maps of Northern Region and Bontanga Irrigation Scheme

Sampling Technique and Data Collection

A multi-stage sampling technique was employed. Firstly, the selection of the study area was purposive due to the availability of a large irrigation scheme and contractual arrangements. Secondly, stratified sampling technique was used to select seven (7) communities in the district which cultivate rice in the irrigation scheme. A simple random sampling technique was finally employed to select nineteen (19) respondents from each community making a total of 133 respondents, with 130 questionnaires completed for analysis. Primary data was collected directly from rice farmers who farm at the Bontanga irrigation scheme basically using semi-structured questionnaires which were administered through interview.

Theoretical Specification of the Heckman Treatment Model

According to Maddala (1983), the treatment effect model, is a form of the Heckman two stage procedure for rectifying selectivity bias. This has been employed extensively in programme evaluations as a result of the non-random selection criteria for observations. The principal objective of this study was to determine the effect of contract farming on the yield of rice farmers. Inferentially, we were not only focused in rectifying the selectivity bias but also, measuring the effect of contract farming on the yield of rice. Based on that premise, the treatment effect model is employed. The model estimates the selection equation in the first stage to obtain the predicted values of the selection variable, which is then used to generate an Inverse Mills Ratio (IMR) also known as lambda. The predicted values of the selection variable (contracting) and the Inverse

Mills ratio (IMR) are then incorporated into the outcome equation in the second stage.

First stage: estimation of the selection equation (Probit)

At the first stage, a selection equation of C_i is firstly estimated to determine the factors influencing a farmer`s decision to participate in contract farming. This is empirically specified as:

$$C^*{}_i = Z_i'\gamma +_i u_{1i} \quad (3)$$

Where Z_i' denotes a set of exogenous variables that influence the selection variable C_i. γ represent a parameter to be estimated and the parameter u_i is a two-sided error term with $N(0, \sigma_v{}^2)$.

The decision to participate in contract may be influenced by unobservable or latent variables like ability, innovativeness that may also influence yield. This implies that the two error terms (in the selection and substantive equations) are correlated (autocorrelation), leading to biased estimates.

It is postulated that u_{1i} and u_{2i} have a joint normal distribution with the form:

$$\begin{bmatrix} u_{1i} \\ u_{2i} \end{bmatrix} \approx N\left(\frac{[0]}{[0]}, \frac{[1\rho]}{[\rho\sigma^2]}\right) \quad (4)$$

It implies that the expectation of those who participate in contract farming is specified as:

$$E[X_i/C_1 = 1] = Z_i\beta + \delta\_E[u_{2i}/C_i = 1]$$
$$Z_i\beta + \delta + \rho\sigma\lambda_i \quad (5)$$

Where: $\lambda_i = \varphi \frac{(-Z_i'\gamma)}{1-\varphi(-Z_i'\gamma)}$ denotes the Inverse Mills Ratio (IMR)

This equation implies that the coefficients of β *and* δ will be biased if equation 2 is estimated without the inverse Mills ratio. The inverse mills ratio is to correct selection bias (Mills, 1926).

Stage two: outcome model

At this stage the yield of rice is estimated using Maximum Likelihood estimation.

$$E(x/x \succ \alpha) = \mu + \sigma[\{\phi(\alpha - \mu(/\sigma)\}/\{1 - \varphi((\alpha - \mu)/\sigma)\}] \quad (6)$$

Where: α is a constant, φ represents the standard normal density function and ϕ signifies the standard normal cumulative distribution function.

$$E[(\varepsilon_i/u_i \succ -Z_i\gamma)] = \rho\varepsilon u\sigma\varepsilon\lambda_i(Z_i\gamma) = \beta\lambda_i\lambda_i(-Z_i\gamma) \quad (7)$$

X equates to u; hence μ, the mean of u (previously x) =0. Also σ^2 is the variance of u (previously x). α equates to $-Z_i\gamma$

Hence: $E(u_i/u_i \succ -Z_i\gamma) = [\{\phi(-Z_i\gamma)\}/\{1 - \varphi(-Z_i\gamma)\}$ (8)

Nevertheless, we aim to get $E[(\varepsilon_i/u_i \succ -Z_i\gamma)]$ and not $E(u_i/u_i \succ -Z_i\gamma)$

Therefore, $E[(\varepsilon_i/u_i \succ -Z_i\gamma)] = \rho\varepsilon u\sigma\varepsilon[\{\phi(-Z_i\gamma)\}/\{1 - \varphi(-Z_i\gamma)\}$ (9)

Comparing equation (3) and (5)

$$E[(\varepsilon_i/u_i \succ -Z_i\gamma)] = \rho\varepsilon u\sigma\varepsilon\lambda_i(Z_i\gamma) = \beta\lambda_i\lambda_i(-Z_i\gamma) \quad (10)$$

Both are the same where $\lambda_i(-Z_i\gamma = [\{\phi(-Z_i\gamma)\}/\{1 - \varphi(-Z_i\gamma)\}$ (11)

Empirically,

$$Y = X_i'\beta + \delta C_1 + u_{2i} \quad (12)$$

Where, Y denotes the yield, X_i' denotes a set of exogenous variables that influence the yield. C_i denotes contracting which takes the value of 1 if a farmer is a contract farmer and 0 if otherwise. u_i represent the random or error term with mean zero, constant variance and normally distributed, $N(0, \sigma_v{}^2)$. β *and* δ represent parameters to be estimated. When the yield of both contract farmers and non-contract farmers is taken into consideration according to Maddala (1983), the first equation will take the form:

$$Y_i = \beta'(\varphi_i X_i) + \delta'(\varphi_i C_i) + \sigma\varphi_i + e_{2i} \quad (13)$$

Where $\varphi_i = \varphi(Z'\gamma_i)$

Empirical model specification

Following the above theoretical model, the empirical model to be estimated to determine the factors influencing farmers' decision to enter into contracting and the effect on output are presented in Equation 14:

Contract farming =

$$\delta_o + \delta_1 Age + \delta_2 Education + \delta_3 Experience + \delta_4 sex + \delta_5 Farmsize + \delta_6 Income + \delta_7 Status of\ land + \delta_8 Marital status + u_2$$

In the second stage,

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + u_1 \quad (15)$$

Where: β_0= Vector of unknown parameters to be determine, $x_1 - x_8$ denote a vector of independent variables affecting yield which are shown in Table 1 and u_i denotes the error term.

Kendall's Coefficient of Concordance

The Kendall`s Coefficient of Concordance, which was propounded by Maurice G. Kendall and Bernard Babington Smith, measures the agreement among several parameters or variables (m) both quantitative and semi quantitative variables which evaluates a set of objects (n) of interest. (Kendall, 1962). It is a nonparametric statistical approach employed to estimate the strength as well as direction of relationship that exist between two variables and ranks the variables from the outmost important to the least important using an ordinal scale, and then estimates the level of concordance/agreement between the respondents (Edwards, 1964; Kendall, 1962; Sheskin, 2007).

Empirical specification of the Kendall`s Coefficient of Concordance:

$$W = \frac{n\left[T^2 - {(\sum T)^2}/{n}\right]}{mn^2(n^2-1)} \text{ or } {nT}/{nm^2\left(n^2-1\right)} \quad (16)$$

The parameters are denoted as follows:
T = sum of ranks for the factors being ranked;
m = number of respondents; and
n = number of factors being ranked.
The index W estimates the ratio of the observed variance of the sum of
ranks and the maximum possible variance of the sum of ranks.
The maximum variance (T) is specified as:

$$T = {m^2(n^2-1)}/{12} \quad (17)$$

$$Var\ T = \left[\sum T^2 - \frac{(\sum T)^2}{n}\right] \quad (18)$$

The key rational for employing this approach is to establish the summation of the ranks assigned to each ranked parameter that is the constraints confronted by farmers who constitute the respondents and then evaluate the variability of this sum. The variability among these sums will be a maximum provided the rankings are in perfect agreement. The challenges are ordered from outmost important to the least important using numerals 1,2,3,4,5……. n. The coefficient of concordance (W) which estimates the level of concordance is calculated using the aggregate rank score. The limits of W are specified as $0 \le W \le 1$.
It is 1.00 and 0.00 if there is maximum agreement and maximum disagreement among the respondents respectively.

RESULTS AND DISCUSSION

Inferential Statistics of Socio-economic Variables

The results in table 1 show that the mean ages of contract farmers and non-contract farmers are 34.33 and 34.07 years respectively. This indicates that, there is no significant age differential between contract farmers and non-contract farmers. With respect to household size, it showed that the average number of people constituting a household for contract farmers and non-contract farmers are 6 and 5 respectively. This could serve as a source of family labour since farmers prefer to employ family labour as noted by Ninson (2012). It was also revealed that 77.14 % of the contract farmers were males while 71.67 % of the non-contract farmers were males. While 61.43 % of the contract famers had formal education, 56.67 % of the non-contract farmers had formal education. Education enhances understanding and access to information and hence influences people`s decision to adopt technologies (Afari, 2001).
Essentially, contract framers gained higher yield (3,310 kg/ha) compared to their non-contract counterparts (3,040 kg/ha). This is justified by the fact that contract farmers have access to inputs

such as fertilizer, improved seed, capital, weedicides, among others. Setboonsarng *et al.* (2008) identified that contract farmers in Lao had on average, significantly higher rice yields (3,272 kg/ha) compared with 2,603 kg/ha for non-contract farmers.

The results also revealed that the averagely, contract farmers lived at a closer proximity to their farms from their residence (4.73 km) compared to that of non-contract farmers (5.63 km). Meanwhile, there was no significant disparity in terms of farming experience between both contract farmers and non-contract farmers. The mean experience for both is approximately 16 years.

In terms of labour and capital, while there is no significant variance in terms of the labour employed between contract and non-contract famers, contract framers had higher capital (GH₵134.27) compared to the non-contract framers (GH₵101.43). It was also ascertained that non-contract framers used more seed (50.58 kg) compared to their contract farming counterparts (20.71 kg). With regards to farm size, contract framers had larger farmer size (0.78 Ha) compared to non-contract farmers (0.65 ha) meanwhile the land size for both contract and non-contract famers was less than 2 hectares which is consistent with the finding of SRID (2011). The results also indicate that 74.29 % of the contract farmers had contact with extension officers while only 35% of the non-contract famers had contact with extension officers.

With respect to land ownership, it was established that while only 28.57 % of the contract famers owned land for farming, 43.33 % of the non-contract farmers owned the land. This implies that most of the contract farmers (56.67 %) leased or rented the land for farming. In terms of credit access and FBO membership, the results indicate that 57.14 % of contract farmers had access to credit and were members of FBO while only 33.33 % and 25 % of the non-contract farmers had access to credit and were members of FBOs respectively.

Table 1: Inferential Statistics of Socio-economic Variables

Description (Variable)	Measurement	Mean[a] Contract farmers (70)	Non-contract farmers (60)	t-test
Farmer characteristics				
Age	Years	34.33	34.07	0.14
Sex	1=male, 0=female	77.14%	71.67%	0.71
Household size	Number of people in a household	5.71	5.42	0.65
Education	1=educated, 0=otherwise	61.43%	56.67%	0.55
Distance of farm	Km	4.73	5.63	1.34*
Farming experience	Years	16.14	15.86	0.13
Production variables				
Rice yield	Kg/ha	3,310	3,040	2.74***
Seed	Kg	20.71	50.583	3.12***
Weedicides	Liters	1.93	3.12	5.10***
Pesticides	Liters	0.91	0.75	0.86
Capital	Ghana Cedes	134.27	101.43	1.61*
Labour	Man-days	11.46	11.48	0.02
Fertilizer	Kg	8.99	5.28	5.24***
Farm size	Ha	0.78	0.65	2.40***
Institutional and policy variables				
Contact with agricultural extension officers	1=yes, 0=otherwise	74.29%	35.00%	4.86***
Land ownership	1= own, 0=otherwise	28.57%	43.33%	1.76*
Credit Access	1=access, 0=otherwise	57.14%	33.33%	0.64
FBO membership	1=member, 0=otherwise	57.14%	25.00%	3.88***

For dummy variables, the values under the “mean” column describe the proportion coded 1.
Source: Field survey (2018).

Determinants of Contract Farming Participation

Heckman treatment effect model at Maximum Likelihood estimation was employed. Contract farming engagement was the dependent variable at the first probit equation which is presented in table 2. Age, sex, farm size, credit access, distance and extension services were the significant variables. The Chi-square value indicated a significance level at 1% signifying that the dependent variable was jointly determined by all the variables.

The results empirically revealed that access to credit for farmers (contract and non-contract) was significant at 1% and negative which does not meet apriori expectation. The variable is dummy with one (1) if the farmer accesses credit and zero if otherwise. This implies that farmers who access credit are less likely to participate, ceteris paribus. This could contextually be explained on the basis of high interest rate on contracted credit which was ranked as their second most pressing challenge shown on table 4. According to a study conducted by Boateng and Boateng (2014), MFIs charge between 40% - 100% interest on loans which leaves a lot to be desired.

The age of farmer was determined to be negative and significant at 1%. This means that when the age of the farmer increases by one year, the farmer is less likely to participate or younger farmers are more likely to participate than their older counterparts, ceteris paribus. This was evident as majority of the respondents were younger per the study conducted. It does not meet apriori expectation. Donkoh and Awuni (2011) thoerised that there is high propensity of aged people to be more mature, may have contact with research and extension agents, more probable to be resourceful and hence more likely to participate ceteris paribus.

The results revealed sex of farmer to be negative and with a significance level at 1%. The variable sex was dummy with zero (0) if the farmer is a female and one (1) if the farmer is a male. The negative significance indicates that females are more likely to participate compared to their male counterparts, ceteris paribus. This does not meet apriori expectation because males generally have more control over land and other production resources in the northern Ghana. This may however be a reflection of changing gendered dynamics of contract farming in the area.

The results also indicate that access to extension services was negative and significant at 10%. This implies that ceteris paribus, farmers who have access to extension services are less likely to participate in contract farming compared to those who do not. According to MoFA (2012) the extension officer to farmer ratio is 1:1,500. Given the disproportionate extension officer farmer ratio, farmers do not get adequate and quality extension services and are therefore less influenced.

Distance from the results tabulated was found to be negative and significant at 10%. This indicates that when the distance of the farm from the farmer`s residence increases by one km; the farmer is less likely to participate or farmers at a close proximity to the farm are more likely to participate in contract farming ceteris paribus. This affirms apriori expectation because the high cost of transportation among other costs associated with longer distance could pose as a disincentive for farmers to participate.

From the results, farm size was revealed to be significant at 10% and positive and hence affirms apriori expectation. This means that when farm size increases by one hectare, the farmer is more likely to participate. This is explained on the basis that larger farm owners are commercial oriented. Poku *et al.* (2018), noted that commercialization of cassava through large farm size increases the likelihood of contract farming participation.

Table 2: Maximum Likelihood Estimation of the Determinants of Contract Farming Engagement

Variable	Coefficient	Standard Error	P-Value
Age	-0.1135***	0.0022	0.000
Sex	-0.0674*	0.0346	0.051
Farmer Group Association	-1.6100	0.2131	0.450
Farm Size	0.4036*	0.2304	0.080
Credit Access	-0.1737***	0.0381	0.000
Distance	-0.0432*	0.0240	0.072

Extension Services	-0.5380*	0.2189	0.014
Years in Farming	-0.0039	0.0096	0.685
Years in Education	0.0097	0.0181	0.591
Constant	0.0768	0.2492	0.758

LR test of independent equations (rho=0):
chi2 (1) =130.45
Prob > chi2 0.000
N 130

** and *** indicate statistical significance at 10% and 1% respectively*

Effects of Contract Farming on Rice Yield

This section presents the results of the second stage of the treatment effect model. The maximum likelihood estimation of the outcome equation is presented in Table 3. The likelihood ratio test of independence revealed a chi-square value significant at 1% implying that there was selectivity bias. This explains that the decision to participate and the output were influenced by some unobserved or latent variables.

The table of results indicates that contract farming was positive affirming apriori expectation and significant at 1%. The positive significance justifies the initial hypothesis of the study and indicates that farmers who engaged in contract farming had a higher yield level than their non-contracting counterparts. This is explained on the basis that farmers gain credit which can be in the form of input credit or financial credit to assist in production and the farmers in turn pay back (Eaton and Shepherd, 2001; Kumar *et al.*, 2019; Eaton and Shepherd, 2001). These contractual arrangements allow farmers to access scarce productive resource such as fertilizers, seeds, weedicides, pesticides as well as technical support and seminars which can optimise yield. This result confirms the finding of Wang *et al.* (2014). Setboonsarng *et al.* (2008) investigated rice contract farming in Lao, and found that farmers under contract also had significantly higher yields than non-contract farmers.

The results also indicated that household size was positive and significant at 1% which means that when the household size increases by one person, the yield level of rice is more likely to increase ceteris paribus. According to Ninson (2012), larger households serve as potential source of labour for farm activities which can lead to increment in the yield level.

The results revealed that extension service was negative and significant at 1%. The variable was dummy with 1 if a farmer receives extension services and 0 if otherwise. This implies that farmers who have no access to extension services are more likely to get higher yields compare to those who have access. This finding contradicts our apriori expectation since farmers gain knowledge and training regarding good agricultural practices from extension agents which could crucially improve yield. This could however be ascribed to the low and poor extension services received due to limited extension agents that is 1: 1,500 in the area.

From the results, labour was revealed to be positive and significant at 1% which indicates that when labour increase by one man-day, the of rice yield level is more likely to increase ceteris paribus. This finding is in line with the finding of Tanko *et al.* (2016), who conducted a study on the determinants of rice yield in Northern region of Ghana and concluded that rice yield increased with increase in labour availability. Ayedun and Adeniyi (2019), also noted that quantity of hired labour correlated positively with high rice output.

Farmer-based organization (FBO) was revealed as positive and significant at 10 %. The variable was dummy with 1 if a farmer belongs to FBO and 0 if otherwise. The positive significance means that farmers who belong to FBOs are more likely to get higher yields than non-participants, all other things held constant. Farmers who belong to FBOs could be privileged to access credit and extension services since they are in groups which can influence their yield levels.

The quantity of fertilizer weedicides and pesticides applied were identified to be positive and significant at 10 %, 1 % and 10 % respectively. Their positive significance means that when their quantities applied increases by one unit the yield level is more likely to increase ceteris paribus. This result is consistent with the findings of Abdulai *et al.* (2013). Ayedun and

Adeniyi (2019), also identified a positive and significant correlation between quantity of fertilizer applied and rice output. Seed was however negative and significant at 1 % which implies that when the quantity of seed increases by one unit, the level of yield is less likely to increase ceteris paribus. This could be due to over use of the seeds resulting to sub optimal yield.

Table 3: Effect of Contract Farming on the Yield of Rice (Outcome Model)

Variable	Coefficient	Standard Error	P-Value
Household size	0.7271***	0.2323	0.002
Years in Education	-0.4743	0.6540	0.468
Years in Farming	0.3152	0.3490	0.366
Farmer Group Association	13.361*	7.6484	0.081
Extension Service	-20.3254**	7.6702	0.008
Labour	0.5184***	0.1085	0.000
Capital	0.0084	0.0077	0.271
Fertilizer	1.9571*	0.8694	0.024
Weedicides	2.3022***	0.1543	0.000
Seed	-1.8837*	1.0381	0.070
Pesticides	1.0467*	0.4768	0.028
Distance	1.1098	0.8675	0.201
CF Engagement	18.3858***	1.2701	0.000
Constant	-13.6775	9.4009	0.146

P>chi2=0.000, N=130

** and *** indicate statistical significance at 10% and 1% respectively.*

Constraints Affecting Farmers' Participation in Contract Farming

The decision of a farmer to participate in contract farming is confronted by a multiplicity of constraints. In order to appropriately rank these constraints in order of importance and to also assess the level of agreement among the respondents, the Kendall`s Coefficient of concordance was employed.

The most pressing constraint ranked was small farm size which recorded the smallest mean rank of 2.47. Output optimising farmers aim at increasing the parcel of land in order to increase their output and earn maximum profit. Available labour and for that matter family labour as well as productive resources are sub-optimally utilized given only a small size of farm.

The second ranked constraint was high interest on contracted credit which also recorded a mean rank of 2.63. The profitability of contract farming engagement is correlated with the disposable income. The high interest on contracted credit both input and financial credit imply that a substantial amount of their income is paid to the contractors and are left with meager profit and hence constitute a major constraint.

Lack of education was recorded as the third significant challenge with mean rank of 3.01 which is evident due to the fact that majority of the respondents were illiterates. The ability to read and write facilitates the communication, bargaining/negotiation, information dissemination and adoption of technology. Literate farmers explicitly have more access to crucial information compared to their illiterate counterparts.

The fourth ranked constraint was low price of farm produce. This constraint recorded a mean rank of 3.80. The plausibility of this lies on the fact that the producers are price takers and do not have control over the price of the produce. Farmers selling at low prices are unable to make sufficient profits to cover their expenses and are therefore constrained.

Hidden information in terms of contracting was recorded as the fifth constraint with a mean rank of 5.48. This condition is tantamount to information asymmetry or imperfect information. Certain information which farmers need in their decision-making process are denied which adversely affect their participation.

The sixth ranked constraint was inadequate extension services. This recorded a mean rank of

5.58. Extension services form a crucial requirement for the advancement of farmers' productivity. According to MoFA (2012), the extension officer to farmer ratio is 1:1,500. However, given only few extension officers compared with the numerous farmers, farmers do not get the adequate level of services to help in their agricultural production processes.

The seventh ranked constraint was contractors deciding for farmers which recorded a mean rank of 6.15. This constitute a challenge because most often than not, farmers are compelled to side with contractors so that they can access inputs for farming. The terms of agreement are usually determined by the contractors. Strict specification was ranked the eight constraints with a recorded mean rank of 6.87.

From the table above, the results indicate that the level of concordance or agreement among the ranking is high, since the Kendall's coefficient (W) is 0.496 or approximately 50%. It implies that there is about 50% agreement among the respondents on the constraints ranked.

There is also asymptotic significance at 1% and recorded a Chi-Square value of 451.569. The null hypothesis, which postulates that there is no agreement amongst the rankings is therefore rejected since there is no statistically significant proof to substantiate the claim.

Table 4: Constraints in Contract Farming Participation

Constraint	Mean Rank	Rank
Small farm size	2.47	1
High interest on contracted credit	2.63	2
Lack of education	3.01	3
Low price for the farm produce	3.80	4
Hidden information in terms of contracting	5.48	5
Inadequate access to extension services	5.58	6
Contractors deciding for farmers	6.15	7
Strict specification of contractors	6.87	8

N =130

Kendall's W^a = 0.496

Chi2 =451.569

df =7

Asymp. Sig =0.000

Source: Field survey, 2018.

CONCLUSION

The study examined the determinants of contract farming participation as well as the effect of contract farming on the yield levels of rice farmers in the Bontanga irrigation scheme. The propensity of farmers going into contract farming was greater for farmers with large farm size. However, extension services, credit, FBO, distance and sex had negative effect on contract farming participation and yield level. Small farm size was recorded as the most pressing constraint followed by high interest on contracted credit with strict specification on contracted credit as the least constraint. Participation in contract farming led to higher yield than non-participation. This means that notwithstanding the subjective evidences that contracting farmers are often cheated; contract farming is still relevant as it has the potential of making farmers better off. It is recommended that Ghana Irrigation Development Authority (GIDA), should increase the irrigable land in the area so that farmers can access more land for farming. The Ministry of Food and Agriculture (MoFA) should also stimulate farmers to participate contract farming and provide support through intensified input subsidization and collateralization.

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