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# Making Contract Farming Arrangements Work in Africa's Bioeconomy: Evidence from Cassava Outgrower Schemes in Ghana

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**Abstract:** This paper uniquely focuses on rapidly-developing domestic value chains in Africa's emerging bioeconomy. It uses a comparative case study approach of a public and private cassava outgrower scheme in Ghana to investigate which contract farming arrangements are sustainable for both farmers and agribusiness firms. A complementary combination of qualitative and quantitative methods is employed to assess the sustainability of these institutional arrangements. The results indicate that ad hoc or opportunistic investments that only address smallholders' marketing challenges are not sufficient to ensure mutually beneficial and sustainable schemes. The results suggest that firms' capacity and commitment to design contracts with embedded support services for outgrowers is essential to smallholder participation and the long-term viability of these arrangements. Public-private partnerships in outgrower schemes can present a viable option that harnesses the strengths of both sectors and overcomes their institutional weaknesses.

**Keywords:** contract farming; contract design; cassava; bioeconomy; Ghana

## 1. Introduction

Rapid agro-industrialisation in sub-Saharan Africa is leading to the development of high-value supply chains for agro-food systems [1]. Additionally, there is increasing demand for feed and other biomass-based raw materials, such as fuel and fibre crops, in Africa's emerging bioeconomy [2]. This has meant a transition towards modernised procurement systems even for agricultural commodities that have traditionally been dominated by spot market exchanges between small scale farmers and traders [3]. Consequently, contract farming (CF)—the institutional arrangement wherein processors enter into formal or informal contractual agreements with farmers to produce and supply them with agricultural commodities—has increasingly been embraced by agribusiness firms in developing countries as an efficient approach for coordinating supply chain activities [4–7].

CF, however, remains a highly-contested institutional arrangement in terms of poverty alleviation and rural development. Empirical evidence from developing countries on smallholder participation in CF and its impact presents mixed results. Some studies have found that smallholders actively participate in CF schemes and earn higher income as a result. These farmers were found to have benefitted from better access to inputs and new technology leading to improved farm productivity [5,6,8–10]. Conversely, other studies have reported evidence of smallholder exclusion, high default rates, and various forms of opportunistic behaviour by firms, such as delayed payments and a lack of compensation for crop losses in CF schemes [11–13]. These divergent findings shed light on how essential contract design is to

the performance and impacts of CF schemes. However, there is a paucity of studies, particularly in the African context, examining which institutional arrangements and contract conditions are sustainable for both farmers and agribusiness firms in these schemes. Addressing this knowledge gap is even more pertinent considering the increased competition for the procurement of multi-purpose crop biomass in rapidly developing domestic agricultural value chains. Such domestic value chains have previously been considered as less than suitable for CF arrangements [14]. Therefore, in the wake of numerous failed contract farming arrangements in Africa [15], this paper empirically investigates the role of contract design in facilitating sustainable contract farming arrangements between farmers and agribusinesses, particularly for a staple crop. The study does not directly address the impacts of CF, but rather focuses on investigating which CF arrangements are sustainable for both farmers and agribusiness firms. Sustainability in this context refers to the long-term viability of CF arrangements for all the actors involved. The paper uses the empirical example of two cassava outgrower schemes (state-operated and privately-operated) in Ghana.

Cassava is a major staple crop in Ghana which has the advantage of being able to produce economic yields even under marginal production conditions. Cassava accounts for approximately 50% of all root and tuber production in the country and is second only to maize in terms of area planted [16]. It is, therefore, considered as a primary food security crop. This has made it a preferred crop among small-scale, resource-poor farmers [17]. Cassava is an annual crop that is mainly consumed in the form of cooked fresh roots and domestically processed products traded on the open market. However, it is slowly shedding its image as a “poor man’s crop” and overcoming its seasonal marketing challenges due to the economic potential and increasing industrial applications of cassava biomass for food, feed, and energy [18]. Therefore, there has been increasing commercial use of the crop due to rising urban demand for processed cassava products and increased recognition of its industrial potential in the emerging bioeconomy [19]. This has led to the emergence of medium and large scale processors using various contractual arrangements to source cassava from farmers. Cassava roots are not as perishable as fruits and vegetables, which need to be harvested at a specific time to avoid losses. The roots can remain unharvested for some time after maturity. However, unlike grains that can be stored after harvest, cassava roots must be processed or consumed shortly after harvesting. Cassava roots begin to deteriorate within 24 to 36 hours after harvest [20]. This necessitates efficient procurement systems.

CF in Ghana thus far has been dominated by a range of public and private large-scale production arrangements of horticultural and tree crops mainly for export [21,22]. Many of these arrangements have been characterised by contract conditions that allow agribusiness firms to maximise their short-term returns at the cost of the long-term sustainability of the schemes. They, therefore, only operate for a few years before collapsing [23]. This study uniquely highlights the role CF is playing in strengthening the link between biomass production and utilisation as the agricultural sector in sub-Saharan Africa gradually transitions from a food-supplying to a biomass-supplying sector. Therefore, smallholders growing traditional staple crops are increasingly presented with the opportunity of participating in CF schemes for the first time. Poorly designed contracts may, however, expose farmers to additional risks and exploitation by larger agricultural actors. These contractual arrangements have hardly been analysed in the literature.

A complementary combination of qualitative and quantitative methods is employed to assess the suitability and sustainability of these institutional arrangements. First, in-depth interviews and focus group discussions are used to elucidate the contract design features of the schemes, as well as both the firms’ objectives and constraints, and farmers’ perceptions of these features. Second, probit analysis based on primary survey data is used to determine the contract design features that influence farmers’ decisions to participate in each scheme. The paper draws on this comparative case study analysis to examine forms of CF that will promote the long-term sustainability of viable firm-farmer contract arrangements. The study demonstrates that ad hoc or opportunistic investments that only address smallholders’ marketing challenges are not sufficient to ensure mutually beneficial and sustainable CF schemes in fast developing domestic value chains. There is the need for direct

firm investment in supporting outgrower operations. Therefore, even for a staple crop like cassava, that does not traditionally have an intense cultivation pattern, embedded support services such as input supply and technical assistance are critical to smallholder participation and the long-term success of outgrower schemes. Public-private partnerships may be the best avenue to sustainably providing these conditions.

The rest of the paper is organised into four sections: Section 2 briefly highlights prevalent contract design features of CF in developing countries. The data collection and analytical approach used in the study are described in Section 3. In Section 4, the empirical results are presented. Section 5 discusses the empirical findings, and Section 6 provides the conclusion.

## 2. Firm-Farmer Contract Relations

The relationship between the agribusiness firm and the farmer in contract production can be conceptualised as a four stage process [5]. A firm first chooses a procurement location; offers farmers a contract; farmers decide whether or not to accept the offered contract; finally, both the firm and farmers choose whether or not to honour the terms of the contract based on how equitable and sustainable the established relationship is for both parties. Agricultural contracts essentially differ based on their intent to transfer decision-rights and risks between the farmer and the contractor. A distinction can be made between three types of such contracts [24]: Market specification contracts where there is a pre-production agreement by both parties on the conditions governing future sale of the produce; resource providing contracts where in conjunction with marketing arrangements the buyer supplies the farmer with key inputs; production management contracts where the farmer additionally agrees to adhere to precise production methods and input regimes. Most contemporary agricultural contracts incorporate various elements of these contract typologies [25]. This invariably implies trade-offs in terms of coordination, motivation and the transaction costs associated with the design of contractual arrangements [26]. The following sections abstract prevalent contract design features that govern crop production in developing countries.

### 2.1. Output Arrangement

The nature of a CF arrangement is central in assuring farmers of a marketing outlet and firms of the supply of essential raw materials. Contracts can either take the form of an informal oral agreement or a formal written agreement. Written contracts provide superior enforcement possibilities and typically specify pricing, roles and responsibilities, quality and quantity requirements, and conflict resolution mechanisms [5]. However, most CF arrangements in developing countries remain as simple verbal agreements predicated on social capital such as reputation and relationship-specific incentives [27]. Such informal arrangements are less costly for agribusiness firms and provide both parties with the option to opt-out of the arrangement. Some case studies have found that such self-enforcing agreements can work effectively [11,28,29]. However, there remains insufficient evidence on smallholders' preference for either oral or written agreements.

Another key aspect of CF arrangements is the pricing mechanism which is meant to insure farmers against the uncertainty of spot market price volatility. The pricing alternatives used in CF range from fixed pricing, variable or incentive based pricing to formula pricing [30,31]. Empirical evidence from several studies reveals the common use of fixed contract prices in developing countries [8,9]. Therefore, firms tend to bear the marketing risk while smallholders bear the production risk. Farmers effectively accept to pay a risk premium in the event that spot market prices rise above the contract price. Nonetheless, this pricing option generally increases the firm's risk exposure. Agribusiness firms can, however, employ risk management strategies that are not available to smallholders. This gives them a higher risk tolerance to market price fluctuations [32]. An important, and yet often overlooked, aspect of pricing arrangements is the extent to which farmers find the actual price determination mechanism equitable.

## 2.2. Quality Standards

Agribusiness firms' quality requirements are a major motivating factor for CF [33]. Contractual arrangements typically include either pre-specified minimum quality standards [34,35] or variable quality standards for farmers' produce [31]. Minimum quality standards may be suited to firms targeting single-supply channels while variable quality levels may be appropriate for firms with different marketing outlets. From the farmers' perspective, minimum quality standards offer little incentive for improving quality, although there is a higher risk of complete rejection of produce. Variable quality standards on the other hand expose farmers to potential quality measurement error or bias [36]. Indeed, contractors may be tempted to falsify quality testing in order to reduce the price paid to farmers [37]. Beyond price differentiation based on quality, current case study evidence on contract farming does not provide much insight into the influence the credibility of quality verification procedures has on farmer participation, particularly for crop production.

## 2.3. Input Arrangement

The interlinkage of input and output markets is a fundamental element of CF in developing countries [38]. Smallholders often have limited access to inputs and technical assistance as input markets are not well developed and the state tends to lack the capacity to adequately provide these services [27,39]. Contracts regularly include seasonal inputs provided on credit, technical assistance, as well as crop delivery arrangements for smallholders [5,11,40]. Such interlocking contracts confer lending advantages on agribusiness firms through monitoring of input use and control over crop management decisions that might jeopardise farmers' output quality or input repayment [13]. As a staple crop widely grown with low input use in sub-Saharan Africa, it is unclear whether input provision will effectively incentivise contract production of cassava among smallholders.

## 2.4. Contract Enforcement

Conflicts between agribusiness firms and farmers in CF arrangements often arise due to misunderstandings related to the operational aspects of agreements and contract non-compliance [41,42]. Beyond firm-farmer dialogue or third party mediation of disputes, the main contract enforcement mechanism at the disposal of agribusiness firms in the case of oral arrangements is the termination or non-renewal of the contract with non-compliant farmers [8]. Written contracts present both parties with the additional option of sanctions such as legal redress for contract breach. However, in developing countries legal institutions are often absent or ineffective in ensuring contract enforcement [43,44]. In any case, smallholders typically lack the capacity to pursue legal action against firms. Even so, there is deficient empirical evidence on the extent to which farmers consider the means of contract enforcement in deciding whether to participate in CF.

The study aims to contribute to the CF literature by investigating which combination of output and input arrangements, quality standards and contract enforcement mechanisms are sustainable for both farmers and agribusiness firms. Farmers' evaluation of the contract design features that govern CF arrangements as revealed by their participation decision is an integral aspect of this empirical analysis.

## 3. Data and Methods

This section presents a description of the data collection methods, followed by the method of analysis and profile of the outgrower schemes.

### 3.1. Data Collection

At the time of data collection for this paper, five cassava outgrower schemes were identified throughout Ghana. The schemes ranged from informal oral arrangements to different forms of written agreements. The schemes studied in this paper are the two largest cassava outgrower schemes in Ghana. The first scheme is operated by a state owned agro-processing firm located in the Awutu Senya

district of the Central region while the second scheme is run by a private agribusiness firm located in the Ho Municipal district of the Volta region (see Figure 1). Data collection was done in three stages for each scheme from July 2015 to December 2015, starting with the state-run scheme and subsequently with the privately operated scheme. First, in-depth interviews were conducted with government officials, management personnel and staff of the two selected processing companies, some of their off-takers, as well as with ten purposively-sampled outgrowers in each scheme who have supplied the companies from the inception of the schemes. This was to fully understand how the schemes operate and how they may have evolved over time.

Secondly, two focus group discussions were carried out for each scheme. The first set was done with ten purposively-selected outgrowers (five males and five females) of each scheme identified from the companies' supply ledgers for 2015. This refers to the period from January 2015 to September 2015 when the focus group discussions were conducted. In both cases this was followed by focus group discussions with ten non-participating smallholder farmers from the same communities as the outgrowers. These focus groups also had the same gender profile of five males and five females each. Some of these farmers had previously taken part in the schemes and opted out. This was to gain contextual insight into farmers' understanding and experiences in the schemes. Specifically, the groups were asked to elaborate on their evaluation of the output and input arrangements, quality standards and contract enforcement mechanisms of the schemes. All the interviews and focus group discussions were audio recorded with the expressed permission of the respondents. The qualitative data collection methods of the study are summarised in Table 1.

In the final stage, a pre-tested questionnaire designed on the basis of the first two stages of data collection was administered to a total of 315 farmers using a multistage sampling process. For the state-led outgrower scheme, the supply ledger for 2015 was used to identify the four highest supplying communities. Proportional random sampling based on supply was used to select 100 outgrowers from these communities to participate in the survey. Fifty (50) non-participating cassava growing farmers were similarly sampled from these communities from lists provided by community leaders. Subsequently, for the privately-run outgrower scheme, the supply ledger for 2015 revealed 65 active outgrowers all of whom were selected for the survey. These outgrowers were distributed across five communities. Twenty (20) non-participating farmers growing cassava were randomly sampled from each of these communities from lists provided by community heads. All sampled farmers also met the firm's criteria of having a minimum of two acres of farmland.

Non-participant farmers had a high level of awareness and understanding of the contract terms and conditions of both schemes. This was due to extensive community outreach by the firms and farmers' interaction with outgrowers. Furthermore, some of the sampled non-participant farmers had previously been outgrowers of the schemes. Overall, 70% of the farmers who participated in the survey had landholdings of five acres or less. The questionnaire collected a wide range of information on respondents' socio-economic characteristics as well as their experiences and perceptions of the contractual details of the schemes. The interviewers overtly presented themselves as researchers with no affiliation to either agribusiness firm. Neither firm was involved in the selection process of the respondents. All responses were kept confidential.

### 3.2. Method of Analysis

The study employs the probit model to analyse the survey data. The model is used to estimate the factors that influence a given farmer's decision to participate in the outgrower scheme in each case. Considering the discrete nature of a farmer's decision of whether or not to participate in CF arrangements, binary choice models such as the probit and logit models are most suitable [45]. In most applications, the choice between the probit and logit models does not make much difference. However, the probit model was selected for this study because it can account for non-constant error variances in more advanced econometric settings [46].

Consistent with the objectives of the study, a separate probit model was estimated for each outgrower scheme to account for the different production and marketing arrangements in the respective study areas. The regressors include socio-economic characteristics such as gender, education, farming experience, farm size and off-farm employment, having tested for the possibility of other socio-economic explanatory factors. Additionally, the importance of the contract design features to farmers' participation decision is included in the models as dummy variables. Specifically, farmers were asked whether particular contract design features were important in their participation decision (dummy takes a value of 1) or not (dummy takes a value of 0). This approach was used to validate the qualitative information collected on farmer perceptions.

The probit model is expressed as:

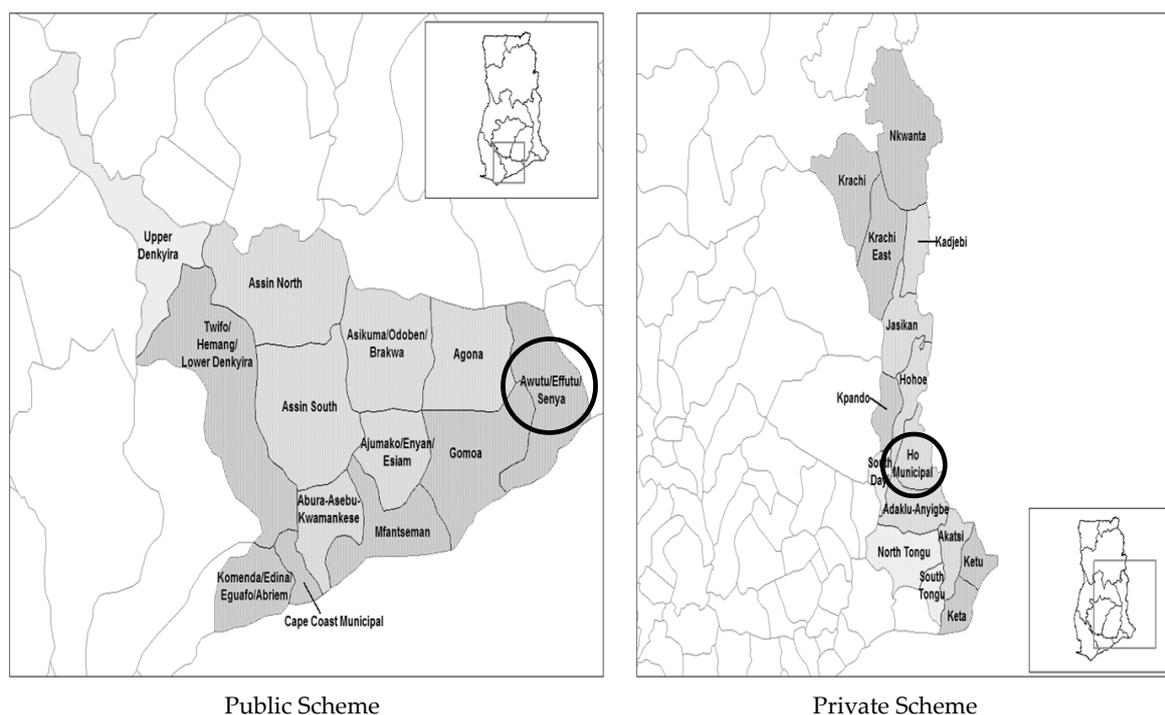
$$Y_i = X_i\beta_i + \mu_i \quad (1)$$

where  $Y_i$  is the dependent variable (a farmer's decision of whether or not to participate),  $X_i$  is the vector of explanatory variables that influence a farmer's decision of whether or not to participate in the outgrower scheme,  $\beta_i$  is the coefficients of the explanatory variables, and  $\mu_i$  is the error term capturing all unmeasurable effects that influence a farmer's participation decision. Specifically, the empirical probit model is specified as follows:

$$Y_i = \beta_0 + \beta_1\text{NoC} + \beta_2\text{PA} + \beta_3\text{PS} + \beta_4\text{PQ} + \beta_5\text{Inputs} + \beta_6\text{Assist} + \beta_7\text{Delivery} + \beta_8\text{Conflict} \\ + \beta_9\text{Sanct} + \beta_{10}\text{Edu} + \beta_{11}\text{Gend} + \beta_{12}\text{FarmExp} + \beta_{13}\text{FarmSize} + \beta_{14}\text{OffFarm} + \mu_i \quad (2)$$

where NoC denotes the nature of the contract for outgrowers, PA signifies the pricing arrangement, PS represents the payment system, PQ denotes the product quality specification, Inputs represents the input supply arrangement, Assist denotes the technical assistance arrangement, Delivery represents the crop delivery arrangement, Conflict denotes the conflict resolution procedure of the arrangement and Sanct signifies the sanctions to be meted out breach of contract. The a priori assumptions of these variables in the context of smallholder farming, such as cassava production in Ghana, have been addressed in Section 2.

In terms of the socioeconomic variables in the empirical model, Edu denotes the number of years of education of the farmer. It is expected that the likelihood of participation in contract farming increases with more years of education due to a better understanding of the contract terms, as well as the benefits of contract farming. Gend represents the gender of the farmer. Cassava production in Ghana is a male-dominated activity [18]. A major contributing factor to this social dynamic is the fact that women are disadvantaged in terms of access to productive resources, such as farmland. Therefore, it is expected that male farmers are more likely to participate in cassava contract farming. FarmExp denotes farming experience. A farmer may become more or less averse to the risks of contract farming based on the amount of farming experience. Thus, this variable can either have a positive or negative effect on a farmer's participation decision. FarmSize represents the total farm size of a farmer. As larger farm sizes are an indicator of wealth and influence, it is expected that farmers with larger farm sizes will be more likely to participate in contract farming. OffFarm denotes off-farm employment. A farmer with off-farm employment has a diversified risk portfolio with multiple income streams. Therefore, the expectation is that a farmer with off-farm employment will be more likely to participate in contract farming.



**Figure 1.** Locations of case study outgrower schemes in Ghana; Source: Ghana Districts Repository.

**Table 1.** Summary of qualitative data collection.

Method	Public Scheme	Private Scheme
<b>In-depth interviews (with stakeholders)</b>		
<i>Company management &amp; staff</i>	7	8
<i>Government officials</i>	5	2
<i>Breweries</i>	1	1
<i>Food processing companies</i>	-	2
<i>Bakeries</i>	-	1
<i>Paperboard manufacturing companies</i>	-	2
<i>Plywood manufacturing companies</i>	-	3
<i>Outgrowers</i>	10	10
<b>Focus Group Discussions (with farmers)</b>	2	2

### 3.3. Profile of the Schemes

The state-owned agro-processing firm being studied was commissioned in 2003 as part of a Presidential Special Initiative (PSI) aimed at developing industrial cassava starch production for both the domestic and international market and, by so doing, also better the socioeconomic conditions of smallholders in the area. However, the firm was plagued with high operational costs and technological challenges which culminated in it temporarily shutting down on two occasions. This necessitated a more focused and sustainable operational strategy. In 2012, the firm signed an exclusive supply agreement with Guinness Ghana Breweries Limited (GGBL) to supply food-grade starch from cassava. The brewery uses the starch to produce one of its brands of beer for the domestic market. This is in line with an excise tax break announced by the government in 2012 for local content beers (the Customs and Excise Act 855 is an excise duty concession on a sliding scale for breweries using greater than 30% local raw materials for the manufacture of excisable goods). The state firm sources half of its feedstock from its firm-managed farm and the other half from about 400 outgrowers. These outgrowers are all members of a farmers' association that represents their interests when dealing with the firm. There is

a verbal agreement in place between the firm and its outgrowers based on trust and understanding. The outgrowers do not receive support from the firm in the form of technical assistance, credit, or inputs. Supplied cassava roots must meet the firm's set quality standards to be accepted. The firm generates additional revenue from selling the by-products (the cassava peels and pulp) from the starch production process to local piggeries as feed.

The privately-owned agribusiness firm was established in 2006. The firm produces high-quality cassava flour (HQCF) and industrial grade flour which is sold to Accra Breweries Limited (a local subsidiary of SABMiller Plc), food processing companies, bakeries, paperboard manufacturing companies, and domestic plywood manufacturing companies. There were also advanced plans for the firm to commence bio-ethanol and biogas production from cassava biomass at the time of data collection for the study. The firm sources approximately 70% of its feedstock from its firm-managed farm and 30% from outgrowers. At the time of the survey there were 65 outgrowers. The outgrowers are all members of a representative farmers' association. There is a standard seasonal written contract between the firm and each of its outgrowers. The firm provides technical assistance and optional inputs in measured quantities to the outgrowers. The cost of inputs provided is deducted from the value of the delivered cassava roots with no interest. The cassava roots must be a healthy approved variety to be accepted. The firm also sells the cassava peels and pulp from its production process as animal feed. The main design features of both outgrower schemes are summarised in Table 2. Both agro-processing firms are located in areas where cassava is the predominant crop grown and the spot market is the only other marketing channel for farmers' produce.

**Table 2.** Salient outgrower scheme design features for case study firms.

Scheme Design Features	Public Firm *	Private Firm **
<b>Output Arrangement</b>		
Nature of the contract	Oral contract communicated through the outgrower farmers' association	Written contract with individual outgrowers
Farmer selection criteria	No selection criteria	A minimum of two acres of farmland contingent on farm inspection by the firm
Contract duration	Optional seasonal arrangement	Binding seasonal arrangement
Supply quota	No specified quantity of produce to be supplied	No specified quantity of produce to be supplied
Outgrower quota	Unrestricted number of outgrowers	Maximum of 100 outgrowers
Pricing arrangement	Fixed seasonal price per ton whereby the amount paid is determined by a weighing bridge	Fixed seasonal price per ton whereby the amount paid is determined by the number of delivered tractor trailer loads
Payment procedure	Weekly invoice payment system for delivered produce	Cash payments upon delivery of produce
<b>Quality Standards</b>		
Product quality specification and verification	A minimum of 15% starch content of a recommended variety verified through laboratory testing of samples prior to delivery	Healthy appearance of an approved variety verified by physical inspection of produce upon delivery
<b>Input Arrangement</b>		
Input supply arrangement	No input supply arrangement	Supply of free planting material and agro-chemicals in measured quantities, the cost of which is deducted from final payment
Technical assistance	No technical assistance	Technical assistance is provided
Crop delivery arrangement	Specified delivery date without firm-provided transportation services	Transportation of the produce from farm to factory by the firm
<b>Contract Enforcement</b>		
Conflict resolution procedure	No established conflict resolution procedure	Mediation between farmer association executives and the firm
Sanctions	No sanctions	Fines and Legal action

\* Based on firm and outgrower interviews, and direct observation; \*\* Based on written contract agreements, firm and outgrower interviews, and direct observation.

## 4. Results

This section begins with a descriptive analysis of the socio-economic characteristics of the sampled farmers, as well as an account of the contract design features in both schemes from the survey carried out. This is followed by an analysis of the firms' motivations for scheme design features based on the in-depth interviews with staff of the firms. Finally, the results of the probit analysis of the determinants of participation in the schemes are presented.

### 4.1. Descriptive Analysis

#### 4.1.1. Socio-Economic Characteristics

A comparison of the sampled groups of participating and non-participating farmers in both outgrower schemes is presented in Table 3. In the state-run outgrower scheme, both groups exhibited similar individual and household level characteristics in terms of age, household size, farming experience, land ownership, and off-farm employment. However, outgrowers were found to have significantly higher levels of education on average. Although both groups were male dominated which reflected the gender profile of the scheme and cassava production in the area, there was a significantly larger number of males among the sampled outgrowers. With regards to income, there was not a significant statistical difference between the two groups. Outgrowers reportedly earned 18% higher total farm income compared to non-participating farmers for the year under consideration. Similarly, outgrowers earned 37% more non-farm income than non-participating farmers. With regard to the production characteristics, farmland showed the only significant difference between the two groups. Outgrowers had an average farmland size of almost six acres which was double that of non-participating farmers. Furthermore, as can be seen in Table 3, non-participating farmers had a higher average gross margin per acre for cassava production than outgrowers in the state-run scheme. However, there was not a significant statistical difference between the two groups' gross margins. The gross margin per acre for cassava production is calculated by subtracting total variable costs per acre (wage labour and agro-chemical costs) from the revenue per acre obtained for cassava production.

In the privately operated scheme, there was not a significant difference between the two groups in terms of average age, household size, farming experience, land ownership and off-farm employment. Outgrowers were, however, significantly more educated than the non-participating farmers. There were also significantly more males participating in the scheme than among non-participating farmers. Outgrowers notably earned 50% higher total annual farm income than non-participating farmers. Non-participating farmers on the other hand earned marginally higher non-farm income, but the difference was not statistically significant. In terms of the production characteristics, outgrowers had an average of six acres of farmland, while non-participating farmers had an average of four acres of farmland. Outgrowers were also found to have significantly higher yield for cassava production. As shown in Table 3, outgrowers in the private scheme had a higher gross margin per acre for cassava production than non-participating farmers. The difference was statistically significant.

It must be noted that the difference in the average set of prices between the two case study areas, as shown in Table 3, reflects the fact that the state scheme is located in a peri-urban area with a relatively higher cost of living. The private scheme on the other hand is located in a rural area with a lower cost of living (the Ghana Statistical Service [47] provides a source of reference for the cost of living across Ghana).

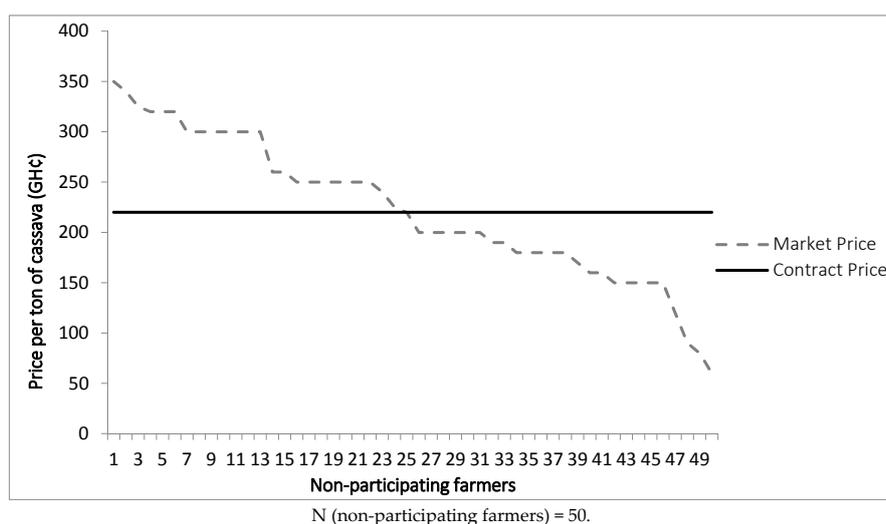
**Table 3.** Socio-economic characteristics of sample farmers.

Variables	Public Firm			Private Firm		
	Participant Farmers (n = 100)	Non-Participant Farmers (n = 50)	Equality Test	Participant Farmers (n = 65)	Non-Participant Farmers (n = 100)	Equality Test
<i>Individual Characteristics</i>						
Age (years)	44.05 (11.52)	43.94 (10.29)	0.06	49.85 (11.78)	47.47 (12.05)	1.25
Household size (persons)	5.58 (2.39)	5.52 (2.18)	0.15	5.65 (1.80)	5.12 (2.50)	1.47
Educational level (years)	8.4 (3.30)	6.56 (4.27)	2.91 ***	9.14 (2.94)	7.45 (3.73)	3.08 ***
Gender (% of males)	78	60	2.31 **	78	62	2.22 **
Farming experience (years)	18.71 (11.92)	19.03 (11.18)	0.16	21.26 (13.02)	20.99 (11.43)	0.14
Land ownership (% of owners)	21	32	1.47	71	78	1.05
Off-farm employment (% yes)	53	50	0.35	62	52	1.21
Farm income (GH¢ '000)	7.22 <sup>a</sup> (13.40)	5.92 <sup>a</sup> (13.64)	0.55	8.22 <sup>a</sup> (17.51)	4.15 <sup>a</sup> (4.65)	2.21 **
Non-farm income (GH¢ '000)	2.30 <sup>a</sup> (4.55)	1.46 <sup>a</sup> (2.39)	1.22	2.05 <sup>a</sup> (2.41)	2.40 <sup>a</sup> (5.77)	0.46
<i>Production Characteristics</i>						
Farm size (ac)	5.67 <sup>b</sup> (6.23)	3.05 <sup>b</sup> (2.92)	2.83 ***	6.18 <sup>b</sup> (3.20)	4.28 <sup>b</sup> (3.22)	3.70 ***
Distance to market (km)	1.89 (1.87)	2.46 (2.35)	1.62	2.91 (1.75)	2.86 (1.89)	0.19
Family Labour (mandays/ac)	3.37 (7.86)	4.14 (9.86)	0.52	0.75 (3.35)	0.98 (4.11)	0.38
Wage Labour (mandays/ac)	26.46 (27.76)	25.47 (32.38)	0.19	33.25 (35.98)	26.69 (28.53)	1.30
Cassava yield (ton/ac)	5.20 (3.11)	5.72 (2.11)	1.05	8.40 (1.53)	5.62 (1.97)	9.63 ***
<i>Gross Margins for cassava</i>						
Price (GH¢/ton)	220	222		120	150	
Revenue (GH¢/ac)	1144	1269.84		1008	843	
Wage Labour (GH¢/ac)	470.95	496.02		335.66	300.42	
Fertiliser (GH¢/ac)	14.60	10.27		9.61	10.25	
Herbicides (GH¢/ac)	20.23	18.58		48.93	8	
GROSS MARGINS (GH¢/ac)	638.22	744.97	1.26	613.80	524.33	1.91 **

Standard deviations are presented in parentheses; \* Significant at the 10% level; \*\* Significant at the 5% level; \*\*\* Significant at the 1% level; <sup>a</sup> Exchange rate October 2015: 4 GH¢/\$. <sup>b</sup> Farm size is calculated as the sum of a farmer's respective acreages in the event that he/she cultivates more than one plot.

#### 4.1.2. Contract Design Features

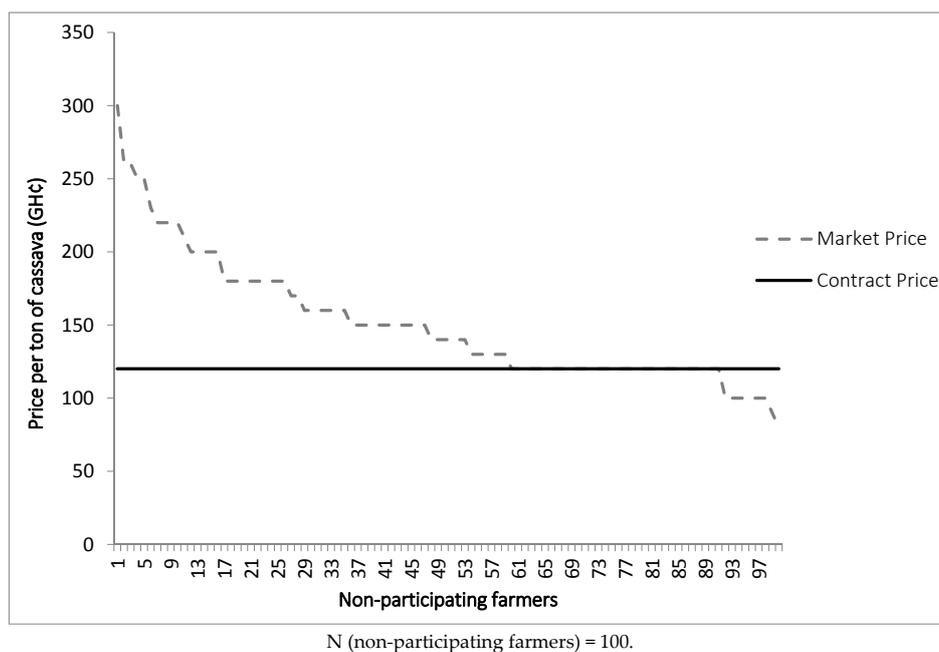
In the state outgrower scheme, the average number of years of participation was four years among sampled outgrowers (Table 4). Outgrowers confirmed that their arrangement with the state firm was based on verbal commitments with no written proof. More than half (56%) of the outgrowers of the public firm reported receiving their invoices to be cashed at the rural bank within two weeks after delivering their produce, while 21% complained of delayed payments within a month of produce delivery. The firm has mainly attributed this problem to intermittent financial challenges caused by delays in purchases from their sole off-takers. A small number (6%), however, reported receiving their invoices at the time of sale as delivery coincided with weekly disbursements during periods when the firm had sufficient cash flow. Figure 2 shows the contract price offered by the public firm as compared to the variable spot market prices non-participating farmers in the survey received for their cassava roots. In terms of quality standards, 19% of the sampled outgrowers reported some of their produce (from at least one of their farmlands) being rejected for not meeting the product quality specification. Seven percent of the outgrowers reported having conflicts with the firm about opportunistic behaviour stemming from delayed payments and a lack of trust in the quality verification system following rejection of some of their produce. One outgrower reported a violation of contract terms after the firm approved delivery of the produce, but later reneged on the purchase, citing technical challenges and the unreliability of the farmer's contact information to be accordingly notified.



**Figure 2.** Contract price for state scheme and open market prices for cassava roots.

In the private outgrower scheme, the average number of years of farmer participation was three years (Table 4). All the outgrowers confirmed that they each had a generic signed written contract with the firm which outlined the terms and conditions of the arrangement. Almost all the farmers (90%) confirmed cash payment at the time of produce delivery. The rest received their money within a week of delivering their produce. This was mainly due to a large number of coinciding deliveries whereby the firm ran out of available cash for immediate payments. Most farmers received their payments in the days that followed. Figure 3 shows that the contract price offered by the private firm was low as compared to the variable prices non-participating farmers in the survey received for their cassava roots on the open market. Only two outgrowers reported some of their produce being rejected mainly for being physically damaged. With regards to the input supply arrangement, majority of the outgrowers (94%) reported the use of firm-provided inputs. The standard supply of inputs includes 20 bundles of stem cuttings per acre (for free) and 0.75 pounds of acid equivalent of glyphosate per acre. Outgrowers also had the opportunity to access funds for farming activities as part of this arrangement. However, all outgrowers received technical assistance from the firm. This mostly entailed monthly

visits from technical staff of the firm. Technical assistance included guidance on better agronomic practices such as planting in rows. The valuation of farmers produce was a source of conflict for some of the outgrowers (9%). The outgrowers complained that the firm would deliberately overload tractor trailers with cassava roots when transporting their produce, knowing that the amount paid to farmers is contingent on the number of trailers rather than the weight of the produce. Three of the outgrowers also complained of the firm violating the terms of the contract by deducting amounts higher than the cost of firm-provided inputs from their final payments. The firm in these instances insisted the farmers had miscalculated the cost of the inputs they had been advanced.



**Figure 3.** Contract price for private scheme and open market prices for cassava roots.

**Table 4.** Contract characteristics.

Outgrower Scheme Features	Public Firm Outgrowers	Private Firm Outgrowers
Participation (mean years)	3.83	2.63
<b>Output Arrangement</b>		
Nature of the contract		
<i>Oral/informal</i>	100%	-
<i>Written/formal</i>	-	100%
Time of Payment		
<i>At the time of delivery</i>	6%	90%
<i>Within 1 week of sale</i>	17%	10%
<i>Within 2 weeks of sale</i>	56%	-
<i>Within one month of sale</i>	21%	-
<b>Quality Standards</b>		
Rejection of any produce	19%	3%
<b>Outgrower Scheme Features</b>		
<b>Input Arrangement</b>		
Use of firm inputs	-	94%
Technical assistance from firm	-	100%
Number of visits		
<i>Once per month</i>	-	94%
<i>Several times per month</i>	-	6%
<i>Once per season</i>	-	-
<i>Other</i>	-	-

Table 4. Cont.

Contract Enforcement		
Conflict with the firm		
<i>Opportunistic behaviour</i>	7%	9%
<i>Violating contract terms</i>	1%	5%
Number of Observations	100	65

#### 4.2. Firm Motivations for Scheme Design Features

In-depth interviews with the management personnel of both firms revealed that while the private firm made a profit in the year under consideration, the public firm registered losses in its operations. Insufficient supply of cassava roots from outgrowers to supplement the firm's own cassava production was a major contributing factor to this underperformance. In this regard, analysis of the interviews with the firms also revealed their motivations for the various design features of the schemes. This captured some of the key differences between the schemes as shown below.

First, the fixed pricing arrangement of the public firm is set based on firm negotiations with the executives of the outgrower association and representatives of GGBL. The firm takes into account farmers' cost of production, transportation cost and market price trends in the catchment area as well as the price for starch offered by GGBL. The fixed price increases the firm's exposure to price risk but also allows for planned budgeting. The private agribusiness firm also uses a fixed pricing arrangement. However, because costs such as crop delivery and technical assistance are paid for by the firm, the seasonal price mainly reflects the market value of the firm's main product. These motivations are reflected in the following quotations from the in-depth interviews:

*"We set the price with their [outgrowers] executives and Guinness, so they know what goes into it. Unlike the unstable price on the open market, this gives the farmers a sense of financial certainty and allows both of us to plan well. [ . . . ]. We use a weighing bridge to determine the tonnage supplied by the outgrowers so there is no error or misunderstanding."* (Production Manager, public firm)

*"We give the farmers a lot of support so the price we pay is mainly based on the going rate for the flour we sell, the HQCF. We look at our selling price and try to be reasonable with the farmers in the price we offer. [ . . . ]. Each tractor trailer we use in transporting the roots weighs 2.5 tonnes with a full load. That is how we know the quantity they [outgrowers] supply."* (Production Manager, private firm)

In terms of quality standards, the public firm's minimum starch requirement of 15% has been set in line with the firm's exclusive supply arrangement with GGBL. Accordingly, farmers who approach the firm with the intention of supplying cassava are given a list of recommended varieties to grow. These improved varieties are intended to give farmers the highest probability of meeting the quality specification. The private firm on the other hand sells to different markets with different quality requirements. As such, the firm accepts cassava roots of variable quality, provided outgrowers supply healthy roots of an improved variety. These reasons are expressed in the following statements:

*"Previously we didn't demand any specific variety. But Guinness demands a high level of quality. That is why we now have specific varieties we recommend. In fact, 15% is still on the low side for us. At least 20% would have been ideal but we also accept that that would be difficult for a lot of the farmers to meet."* (General Manager, public firm)

*"Because we have different uses for the cassava, once they [outgrowers] grow an improved variety we have supplied them with we accept it. The only thing we look out for is that the roots are healthy and not damaged."* (Production Manager, private firm)

In reference to inputs, the public firm does not have a supply arrangement with outgrowers. This is mainly due to the resource constraints of the firm and the size of the outgrower scheme. The private firm on the other hand provides outgrowers with stem cuttings and herbicides to ensure high output of the raw material supply. These motivations are reflected in the following interview excerpts:

*“We can’t afford to supply inputs. They [outgrowers] are too many. And supplying them with fertiliser or herbicides also comes with responsibility of monitoring how they use them to make sure they don’t divert them, and we don’t have the manpower to do that.”* (General Manager, public firm)

*“We want the outgrowers to treat cassava as a cash crop. So we supply them with planting material and chemicals. This way, they can get more money and we can get more roots from them. [ . . . ]. We go round and make sure every farmer uses the chemicals correctly because it is an investment we are making.”* (Outgrower Coordinator, private firm)

Concerning contract enforcement, the public firm has not seen the need to establish a conflict resolution procedure or sanctions given the informal nature of the arrangement. Conversely, the private firm resorts to fines for input diversion and legal action against outgrowers for contract violations, such as side-selling. The firm views this as the most effective means of discouraging contract breaches by farmers. These reasons are supported by the following statements:

*“Our arrangement is simple and straightforward so there are no sanctions. There is also no conflict resolution process in place per se. [ . . . ]. Well, sometimes farmers complain about delays in payment because they always want instant cash but they are aware that that is how our system works. And they always get their money.”* (Production Manager, Public firm)

*“If we catch them [outgrowers] diverting inputs they pay for it with interest which we [the firm] decide on. [ . . . ]. We have caught some of them side-selling and we have terminated their contracts and taken them to court to pay us back. Since we started doing that side-selling has gone down.”* (Outgrower Coordinator, Private firm)

Information on the evolution of the schemes provided by the firms was consistent with that of the outgrowers who were interviewed. The public company initially provided outgrowers with inputs, technical assistance, and instant cash payments until it run into financial and technical difficulties. The public scheme has been running in its current form since the company’s supply agreement with GGBL in 2012. The contract arrangements under the private outgrower scheme on the other hand have not changed since its inception in 2006. These interviews provide insight into the significance of the probit model results for both schemes.

Two separate models were estimated for the state and private outgrower schemes due to the difference in their marketing arrangements and management structures, as revealed by their contract designs. Thus, merging them in a pooled dataset would fail to provide robust findings of how independent variables affect the participation decision of farmers in the schemes.

#### 4.3. Empirical Probit Model Estimates for the State Outgrower Scheme

The estimates derived from the probit model for the state outgrower scheme are presented in Table 5. The results indicate the factors that either positively or negatively affected smallholder participation in the scheme. The oral contract with the firm increased the likelihood of farmer participation in the outgrower scheme. The state firm has been operating in the study area for an extended period of time and has had an outgrower scheme from its inception. According to information from the focus group discussion with outgrowers, farmers have a high level of trust in the relationship based on the firm’s reputation and recurrent transactions.

The pricing arrangement also increased the likelihood of participation. This arrangement insures risk-averse farmers against volatile spot market prices for cassava. The outgrowers’ farmer association enjoys significant bargaining power in negotiations to set the seasonal price as a satisfactory price is the firm’s only guarantee of outgrower participation. Beyond that, the firm provides an objective and acceptable means of valuing farmers’ produce through the use of a weighing bridge, leaving little margin for error.

Conversely, the payment procedure decreased the likelihood of participation. The weekly invoice payment system often led to delays in payment. While there does not appear to be any risk of

non-payment by the firm, inefficiency in the payment system has been a major source of dissatisfaction for outgrowers and a deterrent to smallholder participation. Additionally, the payment system which required farmers to receive their money through a bank increased their transaction cost.

The fixed product quality specification of the state firm also decreased the likelihood of participation. The minimum starch requirement increased the risk of complete rejection of farmers' produce due to information asymmetry as farmers have no means of knowing or verifying the starch content of their produce.

The lack of an input supply arrangement and a transportation arrangement similarly decreased the likelihood of participation in the outgrower scheme. As a traditional staple crop, cassava is generally viewed by most farmers as a crop that does not require a lot of inputs. However, the firm provides farmers with a more reliable marketing outlet for large quantities of cassava than spot markets. This has provided an incentive for farmers to improve their productivity through the use of improved planting material and agro-chemicals. Furthermore, although transportation is factored into the seasonal price, farmers complained that access to reliable transport services for bulk delivery was hard to come by at affordable prices.

Interestingly, the individual characteristics of farmers did not significantly influence the decision to participate in the scheme. This highlighted the fact that the various contract conditions of the outgrower scheme were the main determining factors in farmers' participation decision. The age variable was found to be highly correlated to the farming experience variable and was, therefore, omitted from the model estimation. The reliability of the model estimation was confirmed using the uncentred variance inflation factor (VIF) test. The result showed a mean of 2.34 which indicated that there was not a problem of multicollinearity.

**Table 5.** Factors influencing participation in the state outgrower scheme.

Variable	Coefficient	Robust Std. Err.	Marginal Effect
Oral contract	1.394 ***	0.316	0.203
Fixed pricing arrangement	0.969 ***	0.359	0.136
Weekly payment system	−1.128 ***	0.367	−0.171
Fixed product quality specification	−1.103 ***	0.418	−0.164
Lack of input supply	−0.926 ***	0.330	−0.139
Lack of technical assistance	−0.167	0.451	−0.039
Lack of crop delivery arrangement	−1.048 ***	0.342	−0.143
Lack of conflict resolution procedure	−0.485	0.439	−0.062
Education	0.040	0.039	0.012
Gender	0.352	0.313	0.033
Farming experience	−0.010	0.015	−0.001
Farm size	0.036	0.040	0.005
Off-farm employment	−0.392	0.348	−0.048
Constant	0.398	0.572	
Observations	150		
Wald chi2	52.82 ***		
Log pseudolikelihood	−40.93		
Pseudo R <sup>2</sup>	57.13%		

\* Significant at the 10% level; \*\* Significant at the 5% level; \*\*\* Significant at the 1% level State scheme; VIF, uncentred, 2.34.

#### 4.4. Empirical Probit Model Estimates for the Private Outgrower Scheme

Table 6 reports the probit model estimates for the private outgrower scheme. The results show that the written contract with the firm increased the likelihood of farmer participation in the outgrower scheme. Indeed, as contractual arrangements become more complex particularly with input supply and specialised production practices, written contracts become more beneficial to both firms and farmers. Conversely, the pricing arrangement decreased the likelihood of farmer participation. Price negotiations between the firm and outgrower association appear to be a formality rather than a collaborative process as the firm seems to focus solely on its profit margin. Furthermore, the biased

valuation of farmers' produce using the number of trailers delivered, rather than a weighing system, has been a source of contention between outgrowers and the firm.

The system of on-the-spot cash payments used by the private firm increased the likelihood of farmer participation. Smallholders tend to prefer immediate cash payments following delivery of their produce to satisfy their current household consumption requirements. Similarly, firm-provided inputs and technical assistance at the various stages of production also increased the likelihood of farmer participation. Smallholders believed such support would help improve their productivity significantly.

The private firm's provision of crop delivery services gave outgrowers access to dependable transport services that is well-synchronised with the firm's demand for their produce. This increased the likelihood of smallholder participation as an important post-production feature of the scheme, especially given the highly perishable nature of cassava. Conversely, sanctions meted out for contract violations in the form of fines and legal redress in the private outgrower scheme decreased the likelihood of farmer participation as farmers found these sanctions to be excessively harsh.

Similar to the state outgrower scheme, it was found that individual farmer characteristics did not significantly influence the decision to participate in the outgrower scheme. Again, the age variable was also found to be highly correlated to the farming experience variable and was omitted from the estimation. There was no concern of multicollinearity in the model as implied by the mean uncentred VIF test result of 2.62.

**Table 6.** Factors influencing participation in the private outgrower scheme.

Variable	Coefficient	Robust Std. Err.	Marginal Effect
Written contract	0.597 **	0.268	0.095
Fixed pricing arrangement	−0.940 ***	0.296	−0.144
Instant cash payments	0.699 ***	0.279	0.109
Variable product quality specification	0.308	0.297	0.054
Input supply arrangement	0.996 ***	0.261	0.152
Technical assistance	0.909 ***	0.273	0.152
Crop delivery arrangement	0.836 ***	0.322	0.147
Conflict resolution procedure	0.659	0.390	0.101
Sanctions	−0.871 **	0.284	−0.134
Education	0.052	0.045	0.013
Gender	0.526	0.345	0.079
Farming experience	0.017	0.014	0.003
Farm size	0.082	0.055	0.011
Off-farm employment	0.260	0.268	0.044
Constant	−3.041	0.585	
Observations	165		
Wald chi2	90.70 ***		
Log pseudolikelihood	−49.74		
Pseudo R <sup>2</sup>	55.04%		

\* Significant at the 10% level; \*\* Significant at the 5% level; \*\*\* Significant at the 1% level Private scheme; VIF, uncentred, 2.62.

## 5. Discussion

CF arrangements have great potential to simultaneously increase smallholders' productivity and overcome marketing challenges. In this regard, smallholder participation in CF arrangements is widely viewed by policymakers as important for poverty reduction and rural development. However, the growing case study evidence on the impacts of CF in Africa pays little attention to the critical role contract design plays in the sustainability of these arrangements between agribusiness firms and farmers. The current analysis used a comparative case study approach to highlight contract conditions that will promote the sustainability and viability of outgrower schemes in the burgeoning cassava sub-sector in Ghana. The study uniquely focused on rapidly developing domestic value chains in the emerging bioeconomy. The findings add empirical weight to the argument that state-led contract

farming schemes are generally not an effective government mechanism for overcoming market failures that inhibit the commercialisation of agricultural production by smallholders. Indeed, the continued existence of inefficient state-led schemes often signals the lack of an enabling environment for the private sector to effectively take over these functions.

The interviews conducted for the study reveal that the public firm's outgrower scheme constitutes a low investment informal CF model. The firm does not invest resources in outgrowers' cassava production and as such does not incur monitoring costs. Correspondingly, the quantitative results show that farmer participation is positively influenced by the oral and informal nature of the agreement. Farmers have the option to opt-out of the arrangement at any point in time. This eliminates the issue of side-selling and allows farmers to take advantage of periods of high local spot market prices. The consequence, however, is limited control over the quantity and quality of produce supplied which increases the risk of the firm not meeting the specific needs of its off-taker. The firm must compete with other buyers who may offer higher prices. This is reflected in a pricing arrangement that farmers find favourable in terms of their collective bargaining power and the valuation of their produce. However, the empirical evidence suggests that the scheme, which initially aimed to improve the socioeconomic conditions of smallholders in the area, is ultimately not beneficial to either the firm or outgrowers. The firm receives an insufficient supply of cassava roots from outgrowers. Outgrowers' productivity and revenue from cassava production also do not appear to have increased through the arrangement.

The private firm's outgrower scheme represents a relatively more capital intensive and formalized CF arrangement as revealed by the interviews conducted with company staff. Due to the provision of inputs, technical assistance, and crop transportation, the firm retains more control over the quality and volumes of outgrowers' output. This makes for more efficient sourcing of cassava roots. Consistently, the quantitative results show that these contract features along with instant cash payments positively influenced smallholder participation in the scheme. Interestingly, even though the firm offers a low contract price with a contestable price determination mechanism, they appear to be able to effectively enforce the contract and control side-selling. This goes contrary to the argument that agricultural commodities with well-developed local markets are not suitable for contract farming because they are associated with a high risk of pervasive side-selling [48,49]. The firm is able to earn a profit using the CF arrangement. Outgrowers also have high farm productivity and earn comparatively higher returns from cassava production.

Contrary to the results past studies [9,31,50], individual characteristics such as education, farming experience and farm size which are considered critical to farming efficiency did not significantly influence the decision to participate in the schemes. This emphasized the importance of contract design to farmers' participation decision as revealed by the study's results. It must, however, also be noted that the use of different statistical models and data collection techniques may present a nuanced picture. Future studies may benefit from the collection of longitudinal data for richer analysis of farmers' participation decision.

The findings of the study further demonstrate that firm investment in supporting farm production is critical to the success of outgrower schemes. Cassava may not be an input-intensive crop. Nonetheless, there is still the need for embedded support services in outgrower schemes. Farmers desire arrangements that address both production and marketing challenges. Abebe et al. [36] found that smallholders' decision to participate in CF is even more dependent on input market uncertainty than on output market uncertainty. In order for the public firm to improve the economic viability of its model, the scheme must facilitate the adoption of improved technologies to stimulate increased farm productivity among outgrowers through an input supply arrangement. The seed market for cassava in Ghana is missing. Public sector extension agents are the primary source of supply for vegetative propagules (stem cuttings) of improved varieties that have been developed by the research system. These stem cuttings are often distributed to influential farmers with the expectation that they will, in turn, be disseminated to smallholders. This is often not the case as most smallholders do not get access to improved cultivars. Alene et al. [51] reported that the area planted to

improved cassava varieties in Ghana only increased from 25% to 36% between 1998 and 2009. It is, therefore, a challenge for many smallholders to grow varieties recommended by the firm. As Wiggins and Sharada [52] observed, smallholders are also susceptible to purchasing adulterated agro-chemicals because they are often more affordable. Likewise, access to reliable transport services for bulk delivery of produce is often inaccessible at affordable prices. The lack of suitable access routes to farms often means that drivers charge higher prices or refuse to transport produce. Firm involvement in providing such post-harvest logistical support is critical given the perishability of the crop, quality requirements and the poor state of the existing road infrastructure in rural areas. An alternative to the firm providing such services directly could be arrangements with intermediaries such as aggregators or lead farmers who have closer proximity to smallholders and could facilitate bulking and crop delivery.

Notably, the bargaining position of the firms in their respective value chains is also a determining factor of the contract features of the outgrower schemes. This is particularly important for quality standards, which can often be one of the most contentious issues in contract arrangements, as reported by Henson et al. [53]. The differentiated marketing strategy of the private firm enabled a system of variable quality standards which reduced the risk of complete rejection of farmers' produce. Comparatively, the fixed product quality specification of the public firm is a direct consequence of its exclusive supply agreement with GGBL. This uncertainty over complete rejection discouraged participation in the public scheme as it largely eliminated the incentive of a guaranteed market. Transparency in quality assurance systems is, therefore, imperative to maintaining smallholders' trust in CF arrangements, especially as they adjust to stricter quality requirements in increasingly competitive value chains for high-value products. Barrett et al. [5] found that firms appear more likely to fabricate quality testing or speciously reject perishable commodities on the grounds of quality when supply is guaranteed from a large pool of smallholders. Indeed, a study by Torero and Viceisza [54] showed that third party quality testing improved farmers' trust in the validity of results as this was perceived to be a more objective system.

Overall, the increased use of cassava biomass associated with commercialisation of the sub-sector in Ghana's emerging bioeconomy has necessitated more organised sourcing arrangements. Government policies like the PSI on cassava starch and the tax incentive policy for local content beers have also served as catalysts to these institutional arrangements. Results from the public scheme reveal that although cassava is a staple crop that has traditionally been cultivated with minimal inputs, ad hoc or opportunistic investments that merely provide a marketing outlet for smallholders are not sufficient to ensure the success of outgrower schemes. The evidence highlights the tendency of public sector schemes to be bureaucratic and lack financial autonomy. Private sector ventures, on the other hand, tend to adopt authoritarian management styles and can also be prone to opportunistic behaviour in contract arrangements with smallholders. Therefore, public-private partnerships in cassava outgrower schemes present a viable and sustainable remedy that harnesses the strengths of both sectors and overcomes their institutional weaknesses. These arrangements would allow schemes to take advantage of government support such as grants and input subsidy programs while also benefitting from the private sector's financial autonomy, systems of accountability and highly-trained and specialised staff. It is the recommendation of this paper that this approach should be pursued by policymakers. Ultimately, smallholder participation and the sustainability of cassava outgrower schemes in Ghana's emerging bioeconomy are contingent on a fully-integrated and comprehensive farm-to-market approach within a conducive enabling environment for agricultural contracting.

## 6. Conclusions

The study's findings highlight the point of divergence between the low investment model of the state outgrower scheme which has led to insufficient supply from outgrowers and the more capital-intensive arrangement of the private firm that benefits from the productive capacity of smallholders. The state outgrower scheme, initially established to improve smallholders' socioeconomic conditions, offers farmers some favourable contract conditions. However, a lack

of embedded support services has not enabled outgrowers to increase their productivity and revenue from cassava production in the scheme. CF arrangements must, therefore, address both production and marketing challenges to be sustainable and mutually beneficial to farmers and firms.

As competitive value chains continue to develop in Africa's evolving agricultural sector, there is the need for equitable and transparent contract design features, as well as direct firm investment in supporting farm production activities within an enabling environment. Public-private partnerships can provide these necessary conditions for ultimately unlocking the potential of CF in Africa's bioeconomy.

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