A Two-stage Empirical Analysis of Market Participation in Yam-growing Areas of West Africa

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Summary

The transition from semi-subsistence to commercialized agriculture has been subject of global debates in Africa for more than a half century. This is the reminiscence of the necessity to formulate policies and programs to increase the yields and stimulate the investments in agriculture. Participation in agricultural markets could be a viable channel to transform subsistence agriculture thereby lifting millions of poor farmers out of hunger and poverty traps. Unfortunately, most of the potential beneficiaries are hindered by several factors in their quest to participate in yam market. This study investigated the underpinning drivers of market participation among small-scale farmers in the yam belt of West Africa. Using a multistage random sample of 1,400 households form Nigeria and Ghana, the study tested the hypothesis that factors affecting the farmers' decision to participate are not necessarily the same as those affecting the level of participation. Non-price constraints played a significant role in decision-making concerning market participation. Creation of an enabling environment and strengthening the social institutions should be considered in order to generate adequate marketable surplus to make market participation possible and valuable. Policies that reduce transaction costs and encourage farmers to commercialise their production could be alternatives to price-based policies. Moreover, improving the productivity of farmers will not only increase the likelihood of market participation but also the volumes offered for sale.

Résumé

Une analyse empirique à deux niveaux de participation au marché dans les zones de production d'igname de l'Afrique de l'Ouest

Depuis plus d'un demi-siècle, passer de l'agriculture de semi-subsistance à une agriculture commerciale fait objet de nombreux débats en Afrique. Ceci est une réminiscence de la nécessité d'élaborer des politiques et des programmes adéquats pour augmenter les rendements et stimuler les investissements dans ce secteur. La participation aux marchés agricoles pourrait être un catalyseur de la transformation de l'agriculture de subsistance capable de faire sortir des millions d'agriculteurs se trouvant dans des conditions de famine et de pauvreté chroniques. Malheureusement, plusieurs facteurs entravent la participation de la plupart des agriculteurs au marché de l'igname. Cette étude avait pour but de déterminer les facteurs qui sous-tendent la participation des petits agriculteurs au marché dans la ceinture de la culture de l'igname en Afrique de l'Ouest. Un échantillon aléatoire à plusieurs degrés de 1400 fermiers a été utilisé dans cette étude réalisée au Nigeria et au Ghana. L'objectif de l'étude était de tester l'hypothèse selon laquelle les facteurs affectant les décisions des agriculteurs à participer au marché ne sont pas nécessairement les mêmes que celles qui affectent le degré de participation. Les facteurs non liés au prix ont joué un rôle significatif dans la détermination des décisions concernant la participation au marché. La création d'un environnement favorable et le renforcement des institutions sociales devraient être considérés afin de générer des excédents commercialisables suffisants pour rendre possible et intéressante la participation au marché. Les politiques réduisant les coûts de transaction et incitant les agriculteurs à commercialiser leur production pourraient constituer des alternatives par rapport aux politiques fondées sur le prix. De plus, améliorer la productivité des fermiers ne va pas seulement augmenter la probabilité de participation au marché mais également les volumes offerts à la vente.

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Introduction

Background information

A high percentage of the population of most African countries is dependent on arable crop agriculture (14). Although the African contribution to the supplies of some of these arable crops has been phenomenal in the region, the contributions to worldwide supplies of grains are modest: maize, about five percent; rice, three percent; wheat, three percent in the late 2000s (15). Africa has been a lead player in the supplies of cassava with 50 percent of world production and of yam with 95 percent of world production. Research efforts have been directed to cereals but cassava is now enjoying some level of support (33). However, yam has received lowered attention in national food policy programs in West Africa which remains one of the main areas challenged by hunger and poverty.

Yam can be a great defense against the menace of hunger and poverty, if investments in food crop Research and Development, specifically directed on yam by national governments, regional and non-governmental organizations, and donors, are used to bring the crop into a central focus in national food policies. An approach in this regard is the encouragement of yam-growing rural farming households and other stakeholders in the yam sector to participate in the market. Agricultural growth depends on agricultural/food commercialization contributing largely to economic development. According to Mathenge *et al*. (31), market-oriented production could be highly instrumental in realizing welfare gains by exploiting the opportunities and benefits provided via specialization and comparative advantage, economies of scale, and the regular interaction and exchange of ideas. Moreover, increasing agricultural output will amount only to an exercise in futility if it is devoid of markets that effectively bind the increasingly specialized activities of widely dispersed producers into an integrated national economy. Therefore, participation in agricultural markets could be one of the key schemes in lifting millions of poor farmers out of the hunger and poverty traps. Market participation appears as an effect as much as a cause of development and getting good prices does not induce broad-based, welfare-enhancing market participation (4). Farmers must have access to productivity-increasing technology, inputs, and capital in order to produce a marketable surplus; and market structures to realize the value of increased production. Moreover, the institutional and physical infrastructure necessary to ensure low- cost access to markets structures.

So what does it take to unlock most of the farmers from subsistence farming trap through their participation in yam market? And what are the drivers of effective market participation in Nigeria and Ghana? Stimulating small scale farmers' participation in agricultural markets will help them to enjoy the benefits necessary to boost food security in the region. Enhancing returns from yam production through improved access to market can be a way-in for welfare gain and a way-out of poverty. Farmers in the study area have been locked into the traditional marketing system and thus confronted with problems indicated by low farm-gate prices in spite of the high yam market value, leaving households with low income. Empirical evidence in this domain especially with respect to yam crop has been very thin. Literature on market participation in rural areas continues to be relatively scarce (5).

This case study, thus, intends to fill those knowledge gaps by clarifying the drivers of market participation among small-scale farmers in the yam area and looks beyond the decision to participate. In the first stage, households that produce yam decide whether or not to sell the commodity in the market. In the second stage, the households that decide to sell determine the extent of their participation. The study will help therefore inform decision-makers at the national and project levels, and other researchers about factors hindering smallholder yam producers' decision-making that could have impacts on the transition towards a commercially-oriented yam market. The remainder of this article is organized as follows. In the next section, we discuss the overview of yam marketing in West Africa, followed by some previous empirical work on agricultural market participation and provide some background from a theoretical model. Then we describe the farm survey data and the methodologies used, before presenting and discussing regression results. The concluding section discusses policy implications.

The state of Agricultural Market Participation and yam marketing in West Africa

Participation in the agricultural market has been conceived as the integration of subsistence farmers into the input and output markets of agricultural products with a view to increasing their income level and hence to reducing poverty (21). In the study carried out on agricultural supply response and poverty in Mozambique participation in agricultural markets by rural households has been conceived as a fundamental approach to alleviating poverty and enhancing food security in developing countries (21). Inopportunely, many challenges constrain reaching these goals:

(i) Farmers in a whole do lack a coordinated decision-making with production and marketing not well-linked;
(ii) Lack of trust in markets from the supply side; few farmers believe that there will be enough yam to purchase on the market, and more of them prefer to grow and consume their own yam;
(iii) Farmers fail in planning. Although most farmers plan how much of their yam production to market, production decisions are driven more by the (known) prices of inputs than the (supposed) market prices of output;
(iv) Lack of proper storage facilities, with detrimental effects on the yam quality;
(v) Farmers are not selling to preferred buyers; and if they do, this is mainly because the need to receive a quick cash from a local trader or middleman overriding the desire to sell for a higher price to a more convenient buyer.

Omiti *et al.* (36) while working on factors influencing the intensity of market participation by smallholders in Kenya observed that most farmers in rural areas produce lower volumes of relatively low-value and less perishable marketed surpluses than their peri-urban counterparts. They also sell mainly at the farm gate and in rural markets. Only a small proportion of the total output is taken to the more lucrative (but distant) urban markets. The study showed that distance indeed confines rural farmers to the perpetual production of low-value and less perishable commodities and suggested that farm-to-market roads should be upgraded with equipped retail market centers. However, agricultural marketing may be productivity-enhancing over time. In fact, firms or farms with high productivity have tended to become highly commercialized and export-inclined (6). In their work on farm productivity and household market participation in Tanzania, Vietnam, and Guatemala, Rios *et al.* (40) asserted that enhancing market access through the construction of roads may not consistently lead to improvements in agricultural productivity. In contrast, increasing output directly through investments in irrigation equipment and improved seeds is likely to have a more consistent impact on participation.

On market infrastructure and institutional factors, Tung and Costales (49), in the study of market participation of smallholder poultry producers in northern Viet Nam, found that market infrastructure and the institutional aspects of market access are crucial for improving the opportunities of smallholders to increase market participation. However, general or local market instability, manifested in unpredictable price fluctuations, has a far larger negative impact on the livelihoods of smallholder producers than the dominance of traders. Fischer and Qaim (16) while investigating the determinants of intensity of participation in marketing asserted that participation could be expected to be driven by a clear personal benefit in terms of higher sale prices. Farmers with lower transaction costs participated in markets and sold more because they were likely to recover their production and marketing costs (22). Distance to roads, markets, or towns, was important and farmers with the means of transportation or more labor were found to participate and sell more products. Population density positively affected market participation and sales as farmers in more densely populated areas faced greater demand for their farm produce (3). Poor infrastructure often increases the transaction costs of smallholders' market participation (5). The ease of flow of market information to the farmers in a way that enhances their information base would improve market access (46).

In developing countries, agrarian rural areas are among the poorest and the largest, so strategies and policies that stimulate their participation in the market will enhance economic growth. However, agricultural households often face imperfect or incomplete markets for some goods and factors, which are then non-tradable (42) and decisions on production and consumption are no longer separable. Sadoulet and de Janvry (42) summarize the sources of such incomplete or imperfect markets including costs resulting from distance to markets, poor infrastructure, high marketing margins, imperfect information and supervision, and incentive costs. These are the reasons for the literature's interest in the effects of transaction costs on market participation (18, 23, 23, 37, 44). As a result, the reduction of transactions costs as a means of increasing market participation has been identified as a goal of development policy (13).

Significant barriers exist to entry into commercial yam markets that discourage significant sales by smallholder producers. In fact, Renkow *et al.* (39) observed that the food crop marketing system, including that for yam, has been inefficient in most African countries. As a result, farmers find it difficult to dispose of their produce at attractive prices and in places of their choice due to such perceived weaknesses. This development reduces any enthusiasm about raising production and improving supply; this often steps up food prices to consumers and restricts any increase in farm income (41). In the case of yam markets, the bulkiness of the raw materials increases the likelihood of spoilage and losses during processing or transport. The associated costs reduce the profitability of marketing yam.

Material and Method

Underlying theoretical background

Any decision-making process entails defining the objective, identifying possible choices, collection relevant information and drawing appropriate inferences (12).

This paper considers farmers' participation in the market and recognizes that this decision may be

made in a single or a sequential two-step process. In the sequential process, the farmers decide whether or not to participate in the market and, if they choose market participation, the next step in the decision is about the quantity to sell (5, 24, 50). Making a simultaneous decision-making means that the farmers make choices about market participation and quantity at the same time (1, 9). For more details on how farmers make sequential or simultaneous decisions to participate in the market, based on a utility model used prescriptively in decision analysis and predictively in economics, an interested reader is referred to Mignouna *et al.* (33).

In modeling the utility or satisfaction resulting from the farmers' participation in yam markets as integrated into the smallholder farming scheme, the benefits or economic values associated need to be considered. A typical smallholder-farming household seeks to participate in the commercial market to maximize a multi-dimensional objective function, including increasing incomes and food security and reducing risks (47). In the local market economy, the basic decisions are taken by individual farmers for market that lacks regulatory and advisory actions.

Model specification

On a general note, not all households participated in yam market. This could be explained in two ways. First the farming households that did not have yam to take to market or the households that have yam but did not take it to market, for some reason like believing there are too many yam sellers in the market. The zero values in the former case are behavioral zeros related to the respondents' yam ownership decisions, while the random zeros in the latter case result from random events[1]. Second the generation of zero values could be related to the design of the time use survey due to the fact that the same time use questionnaire are posed to the households without initially asking whether they have yam or not.

According to Tobin (48) allowing incorporation of all observations including those censored at zero without taking into account the sources of the zeros is appropriate in handling data that have such many zeros. The Tobit model enforces assumptions that the zeros values result from other factors than non-participation decisions. The model estimator fits conceptually when we think of decisions on market participation and yam supply as being made simultaneously. Using a Tobit indicates that fixed costs associated with market participation do not significantly affect a farmer's decision to participate in commercial markets. It also means that factors affecting market participation and quantity decisions are one and the same, affecting the dependent variable in the same direction.

As opposed to the Tobit model, Heckman (19) in his model considers the zero values generated by non-participation decisions to arise mainly from respondents' self-selection.

Heckman (19) asserts that an estimation on a selected subsample results in sample selection bias. The model established a two-step estimation procedure known as heckit to solve the problem. The selection or participation equation is estimated with a Probit followed by a censored estimation carried out on the selected subsample to depict the level of participation conditional on observing positive values. The model assumes that different sets of variables could be used in the two-step estimations. The heckit model differs from the Tobit model but could be viewed as a generalized version of the Tobit approach.

Cragg (10) proposed an alternative to the Tobit model to overcome its restrictive assumption allowing a first set of parameters to control the likelihood of a limit observation, and a second to determine the density of the non-limit observations. He thus suggested the Double Hurdle (DH) approach to tackle the issue of many zeros in the data by providing distinct treatment to the participation decision. In this model, two hurdles must be crossed in order to report participation and level of participation decisions. When thinking of decisions on market participation and yam supply as a sequential process, the DH model is appropriate for analyzing the possibility that the factors influencing a farmer's decision to participate in the yam market may not affect the quantity sold. The DH model also allows us to consider that the same factor can potentially affect participation and the amount sold in different ways. We relied on this approach and estimated a DH model which combines a Probit estimation with a truncated normal regression in the second step (7). The heckit and the DH models are comparable in recognizing that the discrete (zero or positive) outcomes are governed by the selection and level decisions to participate. However, in contrast the heckit assumes that there will be no zero observations in the second stage once the first-stage selection is passed while the DH considers the possibility of zero realizations in the second-hurdle arising from the households' deliberate choices or random circumstances. In this regard, the DH model can be considered as an improvement both on the standard Tobit and generalized Tobit (heckit) models. In terms of policy relevance, our analysis clearly shows that participation and the level of participation may be different decisions and that an estimation of participation intensity on the basis of factors affecting the participation decision, as implied by other approaches, may be liable to error.

[1]Carlin and Flood (9) refer the presence of many zeros in the data either to censoring or to incorrect reporting, or other random effects.

The DH model has been extensively applied in several studies (27, 30 34). However, it has not been much used in the area of market participation. The DH approach implies that farmers make two decisions with regard to their decision to participate in the commercial market. The first decision is whether they will participate. The second decision is about the amount of yam that they will convey into the market, conditional on the first decision.

The two decisions are, therefore, whether to participate and how much to participate. The importance of treating the two decisions independently lies in the fact that the factors that affect a decision to participate may be different from those that affect the decision on how much to participate. The DH model allows for the possibility that these two decisions are affected by a different set of variables. The advantage with this approach is that it allows us to understand the characteristics of a class of households that would never participate. Thus, the probability of a household belonging to a particular class depends on a set of household characteristics. The DH model is a parametric generalization of the Tobit model, in which two separate stochastic processes determine the decision to participate and the level of participation. As defined from Mignouna *et al.* (33), the first equation in the DH model relates to the decision to participate and can be expressed in equation I.

$y_i = 1$ *if* $y_i^* > 0$ *and* 0 *if* $y_i^* \leq 0$
$y^* = x_1^* = x'\alpha + \varepsilon_i$ (I)

Where:
y_i^* is latent participation variable that takes the value of 1 if a household participates and 0 otherwise, x is a vector of household characteristics and α is a vector of parameters;

The second hurdle, which closely resembles the Tobit model, is expressed from Mignouna *et al.* (33) in the equation II:

$t_i = t_i^* > 0$ *and* $y_i^* > 0$
$t_i = 0$ *otherwise* (II)
$t^* = z_i'\beta + u_i$

Where:
t_i is the observed response on how much yam should be conveyed to market,
z is a vector of the household characteristics and β is a vector of parameters.

The decisions whether or not to participate in market and about how much yam to convey to market can be jointly modelled, if they are made simultaneously by the household; and independently, if they are made separately; or sequentially, if one is made first and affects the other as in the dominance model (30). If the independence model applies, the error terms are distributed in equation III.

$\varepsilon_i \sim N(0,1)$ and
$u_i \sim N(0, \delta^2)$ (III)

If both decisions are made jointly (the Dependent DH) the error term can be defined in equation IV.

$(\varepsilon i, u_i) \sim BVN\ (0, Y)$ (IV)

$$Y = \begin{bmatrix} 1 & p\delta \\ p & \delta^2 \end{bmatrix}$$

Where:

The model is said to be a dependent model if there is a relationship between the decision to participate and the level of participation. This relationship can be expressed in equation V.

$$p = \frac{cov\left(\varepsilon_i u_i\right)}{\sqrt{var\ \varepsilon_i\ var\ u_i}} \quad \text{V}$$

If p=0 and there is dominance (the zeros are associated only with non-participation, not standard corner solutions) then the model decomposes into a Probit for participation and a standard OLS for *Y*. Following Smith (52) we assume that the error terms and ε_i and u_i are independently and normally distributed and thus we have the expression in equation VI.

$$\begin{pmatrix} \varepsilon_i \\ u_i \end{pmatrix} N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & 0 \\ 0 & \delta^2 \end{pmatrix}\right] \quad \text{VI}$$

And finally, the observed variable in a DH model is $t_i = y_i$ and the log-likelihood function for the DH model is expressed in equation VII.

$$LogL = \sum_0 \ln\left[1 - \phi\left(x_i'\alpha\right)\phi\left(\frac{z_i'\beta}{\delta}\right)\right] + \sum \ln\left[\phi\left(x_i'\alpha\right)\frac{1}{\delta}\left(\frac{t_i - z_i'\beta}{\delta}\right)\right] \quad \text{VII}$$

Thus in this study we estimate the decision to participate and the level of participation using a DH model.

In order to check for multicollinearity in the model, variance inflation factor (VIF) for categorical variables was estimated (17). According to Maddala (28), *VIF* can be defined in equation VIII.

$VIF(X_i) = 1/(1-R_i^2)$ *With* $(1-R_{i2}) = TOL(X_i)$ (VIII)

Where:
R_i^2 is the squared multiple correlation coefficient between Xi and the other explanatory variables; TOL is Tolerance. The larger the value of VIF, the more troublesome it is.

To avoid the problem of multicollinearity, it was essential to exclude the variables with the *TOL* of less than 0.20 or a *VIF* of 5 and above (35).

Similarly, there might also be an association between dummy variables. In order to test multicollinearity problem between discrete variables, contingency coefficient (*CC*) which is, chi-square based measure of the relation between two categorical variables (proposed by Pearson, the originator of the Chi-square test) was computed. The values of contingency coefficient range between 0 and 1, with zero indicating no association between the variables and values close to 1 indicating a high degree of association. If the value of contingency coefficient is greater than 0.75, the variable is said to be collinear. The contingency coefficient can be defined in equation IX.

$$CC = [\chi^2/(n+\chi^2)]^{1/2} \quad \text{(IX)}$$

Where:
CC= Contingency coefficient, *n*= sample size, X^2= Chi-square value.

Empirical specification

We use a DH model. These decisions are made in a sequential manner and can be subject to two very different decision-making processes. Therefore, we use a set of explanatory variables. The choice of the variables used in this study is largely based on work by Bellemare and Barrett (5), Alene *et al.* (2), and Xu *et al.* (50), who extensively reviewed factors that influence farmers to participate in marketing. The set of independent variables potentially expected to influence market participation are grouped into the following classes: household characteristics, physical assets, social capital, transaction costs, livelihood development services, and regional variables. Households' background characteristics are captured by age, education, household size, and number of female in the household. The relationship with age is expected to be negative depending on the levels of development. Younger farmers are expected to be progressive, more open to new ideas, to join forces in setting up strong cooperatives and understand better the benefits of agricultural commercialization. In most cases, older farmers view farming as a way of life rather than as a business and have a strong emotional or almost biological connection with farming and the land. Intellectual capital as captured by education is expected to play a positive role in influencing market participation. The level of education gives an indication of the household's ability to process information and causes some farmers to have better access than others to understanding and interpreting information. However, the expectation may be reversed when there are competing and more remunerative employment opportunities available in the area requiring skills that are enhanced by more education (1).

Household size is included as a proxy for the availability of family labor. Household size may be relevant for attending group meetings while number of female in the household for attending market days and transporting yam, emphasizing higher probability of market participation. Therefore, a household with a large number of members is expected to produce a larger marketable output (22) hypothesized that the propensity to participate in the market economy declines with lower numbers of household members.

Physical assets are captured through the storage facilities farmers own that could preserve the quality of harvested yam. Owning a storage facility is expected to exert a positive impact on both the likelihood that participation will occur and the proportion of sales that will be undertaken once the decision to participate has been made. This hypothesis is supported by Heierli and Gass (20) who argue that the acquisition and ownership of productive assets can catalyze a family to participate in economic activities.

Again, households using motorized equipment to market are likely to convey their agricultural product easily and on time to the market before it loses value. It is therefore hypothesized that such households are more likely to participate in commercialization and will have a larger quantity of yam to transport to market. Sufficient farm land is required for raising overall output with surplus for trade. This variable is measured by the size of the farm land that the household operates and is likely to be important. The larger the size of land a household uses, the higher the production levels are likely to be, and the higher the probability of market participation. However, large farms may face high transaction costs and a lack of economies of scale, leading to a lowering of the additional benefits of participation.

Non-farm activities mostly consist of non-farm employment usually available in nearby towns. Off-farm income may lead to risk-reduction in a household's decision-making and, with it, an increased propensity to undertake activities with a higher level of risk, notably selling crops or producing for the market.

Membership in yam producer and marketing groups/cooperatives is another construct of transaction costs as applied in the study. Membership has been linked to a variety of outcomes which can improve smallholders' market power and ensure a more equitable distribution of benefits (25) and it is through networks that information and other resources can be transmitted (43).

Membership strengthens farmers' bargaining and lobbying power and facilitates coordination and the obtaining of institutional solutions to some problems (32). This variable is expected to have a positive impact on market participation.

However, membership could be a limiting factor as an indication of other preoccupations that are taking members away from commercialization. This could generate unsuccessful group action (29, 38).

Transaction costs are hypothesized to impede market participation because they impose added cost burdens on the efficient conduct of market entry activities. The following factors were used to capture the transaction costs variable: distance from residence to farm, access to market information, and price factor.

Distance from residence to farm is a proxy for the time and cost of transportation. The proximity reflects how far farmers have to travel to reach the farm. Thus, the further away a household is from the farm, the higher the transaction costs of obtaining a farm outlet (26, 24, 5). A long distance from residence to farm is expected to influence market participation negatively. Another variable used as a proxy for transaction costs is access to information on output markets and prices. Marketing efficiency is hindered by delay and difficulty in obtaining information which increases transaction costs by raising search and bargaining costs. Therefore, access to market information becomes crucial in capturing the information relevant to predict market participation. Small-scale farmers are often not aware of prices and market opportunities for their yam and find it difficult to participate in alternative markets. Access to such information is hypothesized to influence market participation positively.

The price factor influences market participation positively as pointed out by (2) and 11). The output price is an incentive to sellers to supply more in the market. The final construct of transaction costs applied in the study is the country dummy that is included in the analyses to capture differences that might arise due to diversity in human, economic, and ecological conditions among households located in both countries.

Sampling and data collection

This study was conducted in Nigeria and Ghana. In both countries, yam is a food and cash crop; it plays an important role in food security and in the livelihoods of close to 60 million people. The crop is cultivated mostly in the Derived, Humid and Southern Guinea Savannah agro-ecologies. About 48 million tons of yams (95 percent of global supply) are produced on 4 million hectares annually in West Africa with Nigeria and Ghana constituting major share. This study employed primary data collected from farming households in Nigeria and Ghana. The household survey was carried out between May and September 2012.

Using a carefully designed and tested questionnaire, we conducted structured, household-level interviews with yam growers in communities classified as yam-growing areas. A multistage, random sampling procedure was adopted to get the total sample size of 1400 households from both Nigeria and Ghana which were selected with equal probability from each community. The first stage involved a purposive selection of eight states in Nigeria and five districts in Ghana based on high yam production potential in the two countries. Afterwards, based on probability proportional to the level of yam production and number of communities in each state/district, 200 and 100 communities were selected in Nigeria and Ghana, respectively. Finally, a total selection of 800 households in Nigeria and of 600 households in Ghana was made from all communities with an equal probability of selection (33). In selecting the households, a sampling frame consisting of all households in the surveyed communities was developed by extension agents in collaboration with community heads. Then a random selection of farm households was achieved through a random number generator using Microsoft Excel. Under simple random sampling, at the 95% confident level desired, the sample size *n* must satisfy the equation X.

$$n \geq \frac{Z^2_{0.95} NP(1-P)}{(N-1)e^2 + Z^1_{0.95P}(1-P)} \Rightarrow n \geq \frac{Z^2_{0.95} P(1-P)}{e^2} \quad (X)$$

if *N > 10,000*

Where:

Z = value of the standard variate at a given confidence level and to be worked out from the table showing the area under normal curve, at 1.96 corresponding to 95% confidence level;

N= Total population

$$n \geq \frac{(1.96)^2 x\, 0.45\, x\, 0.45\, x\, 0.55}{0.05^2}$$

n≥ 380 Provided that response rate is 100%

n_{srs}=380/r = 380/0.95 = 400 given 95% response rate.

Under cluster sampling, for the results to be useably reliable, we apply a default value of design effect[2] of 2.0 in Nigeria and 1.5 in Ghana is expressed in equation XI.

$$ncls = x\ nsrs \quad (XI)$$

Where:

n_{cls}= Sample size under cluster sampling; δ= Design effect, given the default effect δ=2.0 for Nigeria and 1.5 for Ghana (United Nations 2005);

n_{cls} (Nigeria)=2.0x400=800

n_{cls} (Ghana)=1,5x400=600

The extent of market participation was captured by the proportion of quantity of yam produced that ended up being sold for each household. For all the households across Nigeria and Ghana, about 55% of the yam production was marketed, with zero as the lowest registered and almost the total production (99.92%) as the highest percentage marketed (Table 1). This is reflective of the importance of yam as a main source of income in the region. The average age of the farmers was 50 years, an indication that most of them are still economically active with strength and ability to carry out agricultural activities. Availability of labor for farming (especially family labor) was indicated by the large size of households (10). Illiteracy was frequent in both countries, as most farmers did not complete six years of primary education. The farmers cultivate small plots of land with an average size of about 2.5 ha. Access to non-farm credit was extremely low as a sizeable proportion of the respondents claimed that they had never had access to loan facilities from any formal or informal institutions. The yields obtained from the farms vary from farmer to farmer but are low on average (about 9 t/ha).

The econometric estimation results of output market participation among households using the DH of (10) are discussed in this section. Correlates are hypothesized of yam market participation (whether a household sold yam) and extent of participation (the proportion of yam sold) are hypothesized variables focused on existent literature of interest which will inform conclusions for this. The estimation was done separately for each of Nigeria and Ghana before being pooled together. Based on relevant statistical tests as evidenced by the values of Wald chi[2] and Log Likelihood as well as signs and magnitude of the estimates, the pooled regression made better statistical sense and was therefore used in explaining market participation decisions.

The Probit results on the decision to participate in markets and truncated regression analysis results on the extent of market participation for the three regressions are presented (Table 2).

Results

Age was negative and insignificant in influencing market participation but significant in affecting the extent of participation, meaning that more of the younger people participated in yam marketing. Similarly, number of females was negative but insignificant in influencing decision and extent of market participation. Education was negative and significantly related to decision to participate in yam market.

Farm size was positively and significantly associated with a higher probability of participating in the yam market. In addition, farm size positively and significantly influenced marketed volumes for yam. This is in agreement with the a priori expectation. The result also showed that the yield of yam was positively and significantly related to the probability of participating in marketing activities. The higher the yam yields the greater the tendency for the farmers to sell yam. After the decision to participate in the market has been made, yield has a significant influence on the proportion of yam sold. Membership of a yam producer and marketing group/cooperative society was positively associated with the extent of participation in the yam market. After the decision to participate has been made, membership has a significant influence on the share allocated for sale. Contrary to expectations, the price for yam was negatively, albeit insignificantly, associated with the decision to sell. This is in agreement with the findings of Mathenge *et al.* (31).

The country variable is significantly and positively associated with both market participation and the extent of participation. This underscores the associated socioeconomic and population-related factors that are more available and evident in Nigeria and cumulate in higher demand for the yam crop there.

[2]A design effect represents the combined effect of a number of components such as stratification, clustering, unequal selection probabilities, and weighting adjustments for non-response and non-coverage. Specific design effect has been applied for Nigeria and Ghana due to the different form of complex sample design employed.

Table 1
Descriptive statistics

Variables	Symbol	Obs.	Mean	Std. Dev.
Dependents				
Yam market participation (=1 if the household sold yam; 0 otherw ise)		1400	0.97	0.17
Proportion of yam sold		1400	55.32	25.76
Independents				
Age of the household head (years)	AGE	1400	50.09	14.29
Education status (=1 if the head has 6 years of schooling or more; 0 otherw ise)	EDUCS	1400	0.46	0.50
Number of female in the household	NFEM	1400	4.51	2.62
Household size (number)	HSIZE	1400	10.02	5.61
Total farm size (ha)	TFSIZE	1400	2.51	1.16
Yam yield (kg/ha)	YYIELD	1379	8932	12203
Average price at w hich each unit of yam is sold ($/kg)	PRICE	1400	0.49	0.44
Off-farm income (in $US)	OFF-INC	1400	413.88	1358.33
Access to output markets and prices (=1 if household has access; 0 otherw ise)	AOMP	1400	0.11	0.32
Membership of yam producer and marketing group/cooperative (=1 if a member; 0 otherw ise)	MBER	1400	0.03	0.17
Yam storage facility ow nership (=1 if household has a storage room, yam barn, or raised huts; 0 otherw ise)	YSFO	1400	0.54	0.50
Means of transport used from residence to market (=1 if use motorized equipment; 0 otherw ise)	MTUM	1400	0.57	0.50
Distance from residence to farm (in minutes of w alking time)	DISTF	1391	43.53	44.42
Country (=1 for Nigeria and 0 for Ghana)	CTRY	1400	0.57	0.50

Table 2
Estimates of Double-Hurdle Model of Determinants of yam market participation decision and degree of participation

	NIGERIA		GHANA		POOL	
Variable	Coefficient	Z- value	Coefficient	Z- value	Coefficient	Z- value
			First Hurdle			
AGE	-0.00034	-0.04	-0.01205	-1.59	-0.00711	-1.38
NFEM	-0.09968	-1.57	-0.02261	-0.29	-0.06819	-1.38
EDUCS	-0.24161	-0.96	-0.32342	-1.33	-0.29410**	-1.72
HSIZE	0.02231	0.61	0.03174	0.68	0.03487	1.17
TFSIZE	0.08444	0.84	0.26693***	2.67	0.17629***	2.54
PRICE	-0.16912	-0.69	-0.37952	-1.45	-0.24941	-1.42
MBER	3.32360	0.02	-0.31452	-0.55	0.13125	0.28
DISTF	0.00026	0.09	0.00083	0.33	0.00110	0.58
MTUM	0.01745	0.07	-0.36826**	-1.73	-0.19923	-1.28
YYIELD	0.00003**	1.76	0.00004**	1.67	0.00003***	2.36
OFF-INC	3.77e-07	0.07	0.00022	0.89	6.59e-06	0.17
AOMP	0.05079	0.12	0.00882	0.03	0.00447	0.02
CTRY	-	-	-	-	0.40899***	2.30
CONSTANT	2.14636***	3.57	1.77728***	3.19	1.79255***	4.65
			Second Hurdle			
AGE	-0.17008***	-2.67	-0.11565	-1.49	-0.13937***	-2.81
NFEM	-0.03096	-0.07	-0.76202	-1.21	-0.32086	-0.89
EDUCS	-0.86820	-0.47	2.02278	0.77	0.26102	0.17
HSIZE	0.05943	0.29	0.34455	1.17	0.16943	0.99
TFSIZE	0.87674	1.14	0.90772	0.89	0.76689	1.24
MBER	7.39265**	1.73	6.80771	0.85	8.15127***	2.11
DISTF	0.03053	1.46	-0.06612***	-2.87	-0.01889	-1.23
MTUM	-1.27318	-0.69	-4.18795**	-1.90	-2.43567**	-1.71
YYIELD	0.00068***	9.04	0.00031***	3.94	0.00049***	8.93
OFF-INC	9.94e-06	0.82	-0.00025	-1.52	7.12e-06	0.57
AOMP	-2.94375	-0.94	0.70747	0.23	-0.37325	-0.17
YSFO	-4.97950***	-2.47	2.26733	0.87	-2.51182	-1.55
CTRY	-	-	-	-	6.37639***	3.52
CONSTANT	62.0677***	12.83	57.97048***	10.65	56.33972***	16.15
Sigma	22.97337***	35.90	24.27748***	28.56	23.84733***	45.73
Number of obs	790	582	1372			
Wald chi2 (12)	8.49	18.15	23.68			
Prob>chi2	0.7461	0.1113	0.0342			
Log likelihood	-3572.89	-2626.7816	-6224.6287			

* P <0.01, **P< 0.05, ***P<0.10

Discussions

The rationale behind greater participation of younger farmers than older ones was that younger people tend to be energetic and risk takers. Results implies that more the education, the less the willingness to sell yam by farming households. The tendency could be attributed to improved understanding of storage and possession of better storage facilities by seemingly educated yam farmers. Moreover, the findings show that farmers with large farms produce beyond what they use for home consumption. An increase in farm size naturally implies an increase in output. This underscores the constraints that farmers who happen to have farms of smaller sizes face in getting access to markets due perhaps to their inability to produce a marketable surplus. Also, increased productivity which correlates with positively with market participation could be due to a larger marketed surplus of yam which could drive the commercialization of other crops. Consequently, engendering the potential to release some forest and other resources tied up in subsistence farming. Importance of social capital in the volume of yam sold by the poor smallholder farmers indicates that facilitating and strengthening social institutions such as farmers' cooperative society is a potent factor that could drive increased market participation of the yam farming households. A possible explanation for this unexpected behavior in the sign of price could be connected with the status of the households as net buyers of food crops. A high price could stimulate farmers to keep as much yam as possible on the farm to prevent significant spending on the food crop. Moreover, resource-poor households do participate in the market immediately after harvest when the prices are low and purchase at other times when prices are high. Another reason is the fluctuation in prices occasioned by a lack of storage facilities and high perishability of yam crop. Large population and state of yam market in Nigeria underscore increased tendency of market participation in Nigeria than Ghana.

Conclusion

Yam was the main source of income for most smallholder farmers in the region and stimulating increased participation by small scale yam farmers is becoming crucial to reach considerable gains. Evidently there exists significant obstacles that impede number of potential beneficiaries in their quest to participate in the yam market. This study, thus, examined the underpinning drivers of market participation among small-scale yam farmers in the yam sector. The DH estimation reveals that market participation is governed by two independent decisions: the decision to participate in the market and the decision on the extent of participation. The estimation results show that these two separate decisions are determined by different sets of factors. Non-price constraints played a significant role in determining decisions on market participation. Education of household head, farm size, yam yield, and country-specific variable were found to influence the decision to participate. Age of the household head, membership of a yam producer and market group/cooperative, yam yield, distance from farm to residence, means of transport used from residence to market and country variable influenced the extent of participation. Therefore, the study suggests policy thrust aimed at large scale yam production to increasing market participation of farming households. Consideration should be given to creation of enabling environment to generate adequate marketable surplus to make market participation possible and valuable. Moreover, improving productivity of farmers will not only increase the probability of market participation but also the volumes of produce offered for sale in the market. The productivity gains could be addressed through development and deployment of improved seed yam varieties and associated crop management practices to farming households. Better disease and pest management approaches could also ameliorate shortages that hamper productivity. Concerted efforts should also be made to encourage farmers to form farming organization that would afford them synergy of activities to pull resources and produce together for active participation in commercialization of yam. Drawing from above, policies that reduce transactions costs and induce farmers to commercialize could be critical alternatives to policies based on price to promote a marketed surplus and the commercialization of agriculture as a way-in for welfare gain and a way-out of poverty.

Literature

1. Abdoulaye T. & Sanders J.H., 2005, Stages and Determinants of Fertilizer Use in Semiarid African Agriculture: The Niger Experience, *Agric. Econ*., **32**,167-179.
2. Alene A.D., Manyong V.M., Omanya G., Mignouna H.D., Bokanga M. & Odhiambo G. 2008, Smallholder market participation under transactions costs: Maize supply and fertilizer demand in Kenya, *Food Pol*., **33**, 4, 318-328.
3. Balint B. & Wobst P., 2005, Institutional factors and market participations: The case of Romania, *Int. Food Pol. Res. Inst.*, **48**, 223-224.
4. Barrett C.B., 2007, *Displaced Distortions: Financial Markets Failures and Seemingly Inefficient Resource Allocations in Low-Income Rural Communities*. Paper presented in Seminar on Resource Allocation among Low-Income Farmers, Cornel University, 12-15 December 2007.
5. Bellemare M. & Barrett C., 2006, An Ordered Tobit Model of Market Participation: Evidence from Kenya and Ethiopia, *Am. J. Agric. Econ*., **88**, 2, 324-337.
6. Bernard A.B. & Jensen J.B., 1999, Exceptional Exporter Performance: Cause, Pathway, or Both?, *J.Int. Econ*., **47**, 1, 1-25.
7. Burke W.J., 2009, Fitting and Interpreting Cragg's Tobit Alternative Using Stata, *Stata J*., **9**, 4, 584-592.
8. Carlin P. & Flood L., 1997, Do Children Affect the Labor Supply of Swedish Men? Time Diary vs. Survey Data, *Labour Econ*., **4**, 167-183.
9. Chirwa E.W., 2005, Adoption of Fertilizer and Hybrid Seeds by Smallholder Maize Farmers in Southern Malawi, *Dev. South Afr.*, **22**, 1-12.
10. Cragg J.G., 1971, Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods. *Econometrica*, **39**, 5, 829-844.
11. Cunningham L.T., Brown B.W., Anderson K.B. & Tostao E., 2008, Gender differences in marketing styles. *Agric. Econ*., **38**, 1, 1-7.
12. Dams T., Kenneth E. & Hunt E.K., 1978, *Decision Making and Agriculture*, University of Nebraska Press Publication, 603pp.
13. Delgado C., 1995, *Africa's Changing Agricultural Development Strategies: Past and Present Paradigms as a Guide to the Future,* IFPRI, Washington D.C., USA.
14. FAO, 2009, *Food and Agriculture Organization of the United Nations*. On-line and Multilingual Database http://faostat.fao.org/
15. FAO, 2013, *Food and Agriculture Organization of the United Nations*. On-line and Multilingual Database http://faostat.fao.org/
16. Fischer E. & Qaim M., 2011, *Smallholder Farmers and Collective Action: What Determines the Intensity of Participation?* Proceedings of the German Development Economics Conference, Berlin 2011, No. 28. Available at: http://hdl.handle.net/10419/48336
17. Fox J. & Monette G., 1992, Generalized Collinearity Diagnostics. *J. Am. Stat. Assoc*., **417**, 178–183.
18. Goetz S.J., 1992, A Selectivity Model of Household Food Marketing behavior in sub-Saharan Africa, *Am. J. Agric. Econ*., **74**, 2, 444-452.
19. Heckman J., 1979, Sample selection bias as a specification error, *Econometrica*, **47**, 1, 153-161.
20. Heierli U. & Gass T., 2001, *Enhancing employment and income generation in rural areas.* Paper submitted to the Operations Committee of the Swiss Agency for Development and Cooperation (DEZA) 11 October 2001 [online]. www.deza.admin/themen (Accessed 02/06/2014).
21. Heltberg R. & Tarp F., 2001, Agricultural Supply Response and Poverty in Mozambique. Presented Paper at the Conference on Growth and Poverty at WIDER. 25-26 May 2001, Institute of Economics, University of Copenhagen.
22. Holloway G.J., Nicholson C., Delgado C., Ehui S. & Staal S., 2000, Agroindustrialization through Institutional Innovation: Transaction Costs, Cooperatives and Milk Market Development in the East African Highlands, *Agric. Econ.*, **23**, 279-288.
23. Holloway G.J., Nicholson C., Delgado C., Staal S. & Ehui S., 2004, A revised Tobit Procedure for Mitigating Bias in the Presence of Non-Zero Censoring with an Application to Milk Market Participation in the Ethiopian Highlands, *Agric. Econ.*, **3**, 97-106.
24. Holloway G.J., Barrett C.B. & Ehui S., 2005, The Double-Hurdle Model in the Presence of Fixed Costs, *J. Int. Agric. Trade & Dev.*, **1**, 17-28.
25. Key N. & Runsten D., 1999, Contract farming, smallholders and rural development in Latin America: the organization of agroprocessing firms and the scale of outgrower production, *World Dev.*, **27**, 2, 381-401.
26. Key N., Sadoulet E. & de Janvry A., 2000, Transaction costs and agricultural household supply response, *Am. J. Agric. Econ*., **82**, 1, 245-259.
27. Langyintuo A.S. & Mungoma C., 2008, The effect of household wealth on the adoption of improved maize varieties in Zambia, *Food Pol*., **33**, 6, 550-559.
28. Maddala G.S., 1992, *Introduction to Econometrics*. Second Edition. New York: Macmillan Publishing Company. 631pp.
29. Markelova H., Meinzen-Dick R. Hellin, J. & Dohrn S., 2009, Collective action for smallholder market access, *Food Pol*., **34**, 1, 1-7.
30. Martínez Espiñeira R., 2006, A Box-Cox double-hurdle model of wildlife valuation: the citizen's perspective, *Ecol. Econ.*, **58**, 1, 192-208.
31. Mathenge M., Place F., Olwande J. & Mithoefer D., 2010, *Participation in Agricultural Markets among the Poor and Marginalized: Analysis of Factors Influencing Participation and Impacts on Income and Poverty in Kenya, a study report.* Tegemeo Institute of Agricultural Policy and Development, Nairobi, Kenya.
32. Matungul P.M., Lyne M.C. & Ortmann G.F., 2001, Transaction costs and crop marketing in the communal areas of Impendle and Swayimana, KwaZulu Natal, *Dev. Southern Afr.*, **18**, 3, 347-363.
33. Mignouna D.B., Abdoulaye T., Akinola A., Kamara A.Y., & Oluoch M., 2016, Understanding market participation choices and decisions of maize and cowpea farmers in Northern Nigeria, *Tropicultura*, **34**, 1, 26-39.
34. Moffatt P.G., 2003, *Hurdle models of loan default. School of Economic and Social Studies University of East Anglia.* Available on-line at http://www.crc.ems.ed.ac.uk/conference/presentations/moffat.pdf

35. O'Brien R.M., 2007, A Caution Regarding Rules of Thumb for Variance Inflation Factors, *Qual. Quant.*, **41**, 5, 673- 690.
36. Omiti J.M., Otieno D.J., Nyanamba T.O. & Mccullough E., 2009, Factors Influencing the Intensity of Market Participation by Smallholder Farmers: A Case Study of Rural and Peri-urban areas of Kenya, *Afjare*, **3**, 1, 57-82.
37. Poulton C., Kydd J. & Dorward A., 2006, Overcoming market constraints on pro-poor agricultural growth in sub-Saharan Africa, *Dev. Pol. Rev.*, **24**, 3, 243-277.
38. Poulton C., Dorward A. & Kydd J., 2010, The future of small farms: New directions for Services, institutions, and intermediation, *World Dev.*, **38**, 10, 1413-1428.
39. Renkow M., Hallstrom D.G. & Karanja D.D., 2004, Rural Infrastructure, Transactions Costs and Market Participation in Kenya, *J. Dev. Econ.*, **73**, 1, 349-367.
40. Rios A.R., Masters W.A. & Shively G.E., 2009, F*arm Productivity and Household Market Participation: Evidence from LSMS Data*. http://www.agecon.purdue.edu/staff/shively/RMS_ IAAE.pdf (Accessed May 2010).
41. Rosegrant M.W., Cline S.A., Li W., Sulser T.B. & Velmonte-Santos R.A., 2005, *Looking Ahead. Long-term Prospects for Africa's Agric*. Paper presented in a Seminar on 2020 Development and Food Security in Washington, D.C., 12-15 2005.
42. Sadoulet E. & de Janvry A., 1995, *Quantitative Development Policy Analysis.* Baltimore and London: The Johns Hopkins University Press.
43. Sharp J.S. & Smith M.B., 2003, Social capital and farming at the rural-urban interface: the importance of non-farmer and farmer relations, *Agric. Syst.*, **76**, 913-927.
44. Shilpi F. & Umali-Deininger D., 2008, Market facilities and agricultural marketing: Evidence from Tamil Nadu, India, *Agric. Econ.*, **39**, 281-294.
45. Smith M.D., 2003, On dependency in Double-Hurdle models. *Stat. Pap.*, **44**, 4, 581-595.
46. Stifel D. & Sahn D. E., 2003, Employing alternative measures of welfare in the absence of expenditure data. Review of income and wealth, *Int. Food Pol. Res. Ins*t., **49**, 463-489.
47. Strauss D., Bednar L. & Mees R., 1989, Does one percent of forest fires cause ninety-nine percent of the damage? *For. Sci.*, **35**, 319-328.
48. Tobin J., 1958, Estimation of Relationships for Limited Dependent Variables. Econometrica, 26, 24-36.
49. Tung D.X. & Costales A., 2007, M*arket Participation of mallholder Poultry Producers in Northern Viet Nam.* Pro-Poor Livestock Policy Initiative (PPLPI) Research Report, March 2007, 14 pp.
50. Xu Z., Burke W.J., Jayne T.S. & Govereh J., 2009, Do Input Subsidy Programs Crowd In or Crowd Out Commercial Market Development? Modeling Fertilizer Use Decisions in a Two-Channel Marketing System, *Agric. Econ.*, **40**, 1, 79-94.

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