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Factors influencing the use of selected inputs in yam production in Nigeria and Ghana

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Abstract

In West Africa, yam can be an important crop to reduce poverty and hunger if Research and Development measures identify and properly engage its key production factors for enhanced outputs and better income. Data from 1400 households in Ghana and Nigeria were collected in a multistage random sampling survey (and complementary data from 76 farm family fields) with a structured questionnaire and qualitative interview questions. The results showed that yam is produced mainly with crude inputs/technologies to reduce high dependence on labour, seed production and control of pests and diseases. Yam is produced widely with purchased inputs including seed yam and hired labour; chemical fertiliser, herbicide and pesticides are less often used. Analyses of determinants of use of purchased inputs reveal three serious impediments to expansion in yam production: the increasing scarcity and high cost of hired labour, shortage of suitable land and poor farm roads. As employment opportunities for unskilled labour in urban centres are presently expanding, increased yam production will be hard to achieve without labour-saving inputs for at least some of the production tasks, especially seedbed preparation and weeding, and without improvement in infrastructure.

Keywords: yam, production factors, Nigeria, Ghana

1 Introduction

In West Africa, the importance of yam cannot be over-emphasized. Yam (*Dioscorea* spp.) is important for the food security and livelihoods of 60 million people in the region and is cultivated mostly in the derived, humid and southern Guinea savanna agro-ecologies. About 48 million tons (95 % of the global supply) are produced annually on 4 million hectares mainly in five countries, Bénin, Côte d'Ivoire, Ghana, Nigeria and Togo. Nigeria alone accounts for 70 % of this supply. Yam is rich in carbohydrates, available all year round as tubers can be stored without high potential losses compared with roots such as cassava (FAO, 1987). In Nigeria, it is the third most important source of protein in the diet after maize and rice and has higher protein contents than any other common tuber crop with a substantial amount of vitamins and minerals (Oyenuga, 1968). It could also be a source of industrial starch (Osisiogu & Uzo, 1973). Yam's significant contribution to the food security in the sub-region has been well documented (Maroya *et al.*, 2014). It serves as vital sources of calories especially in Bénin, Côte d'Ivoire, and Ghana. Similarly, the crop substantially provides protein to the diet following after maize and rice. Moreover, yam features prominently in social rites of passage, thanksgiving, etc. in the region.

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High percentages of the population of most developing countries depend on arable crop production to ensure their food security. Africa contributes only small amounts to the worldwide supply of grains: maize, about 5 %; rice, 3 %; and wheat 3 % in the late 2000s (FAO, 2013) but on this continent grows most of the worldwide produced cassava (50 %) and yam (95 %). However, both crops are produced at high costs because of heavy dependence on labour and other relatively scarce inputs (Nweke *et al.*, 2002, 2011).

Investments in Research and Development (R&D) on food crops by national governments, regional organisations, donors and NGOs are mainly focused on cereals and some root and tuber crops. Yam is sidelined in many national food policy programs and ignored by most regional development agencies although yam merits to be brought into focus. Costs of producing yam relative to cereals and other roots and tubers such as cassava constitute major challenge to its production (Ogbonna *et al.*, 2011). Therefore, developing technologies that result in agricultural inputs which reduce the cost of production of each kilogram of yam would greatly ameliorate problems faced by yam producing households. This is the thrust of a new project – *Yam Improvement for Income and Food Security in West Africa* (YIIFSWA) – sponsored by the Bill and Melinda Gates Foundation and executed by the International Institute of Tropical Agriculture, Nigeria. This project is expected to develop technologies based on key yam production inputs including seed yam, hired labour and farmland for enhanced yam output.

This paper is developed based on a previous working paper published informally by the same authors to disseminate intermediate output (see Mignouna *et al.*, 2014) which attempts to assess the contribution of key production factors especially seed yam, hired labour and farmland for enhanced yam outputs. This study is premised on the assertion that yam is more of a cash crop than a food crop. It is believed that the conception of a staple as a food or cash crop has a direct bearing on the level of investment in terms of inputs to produce the crop (Poulton *et al.*, 2001; Timmer, 1988, 1997). Perception of yam as only a food crop could contribute to persistent neglect in R&D efforts based on established linkage between cash crop, welfare gains and livelihood improvement. Cash cropping allows farm families to boost their income by producing what gives the highest returns to their productive resources and to use the cash to buy consumer goods (Timmer, 1988) or to invest it in improved crop technologies (Dorward *et al.*, 1998; Langat *et al.*, 2010). Goertz (1993) opined that it relaxes cash constraints at planting through the delivery of crop inputs on credit. Benefits from such cropping also extend to other households by ways of obtaining employment on the (yam) fields (Poulton *et al.*, 2001).

Based on the importance of yam as a cash crop with great potential to improve rural economy and farm household's living conditions, it is important to understand factors limiting the potential of yam. This paper contributes by investigating those factors in Ghana and Nigeria.

2 Materials and methods

2.1 Sampling procedure

The need for quantitative and qualitative information about households required a statistically plausible sample of the target population. A multistage random sampling survey using a structured questionnaire and a set of qualitative interview questions for focus group discussions was conducted between June–September 2012 (Fig 1). 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 (Mignouna *et al.*, 2014). 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.

To complement the initial data, another field survey was conducted from November to December 2013 within the same yam belt which covered three yam growing agro-ecologies in Nigeria and two in Ghana. A random selection of 15 communities was taken in Nigeria and 10 in Ghana, making a total of 25 communities in the yam ecozones.

In each community members were assembled and requested to group themselves by size of their production operations, large, medium and small; in each group one farm household was randomly selected. The farm size categories were unique to each community and may vary elsewhere. In each selected household, all yam fields planted during the 2013 season were surveyed.

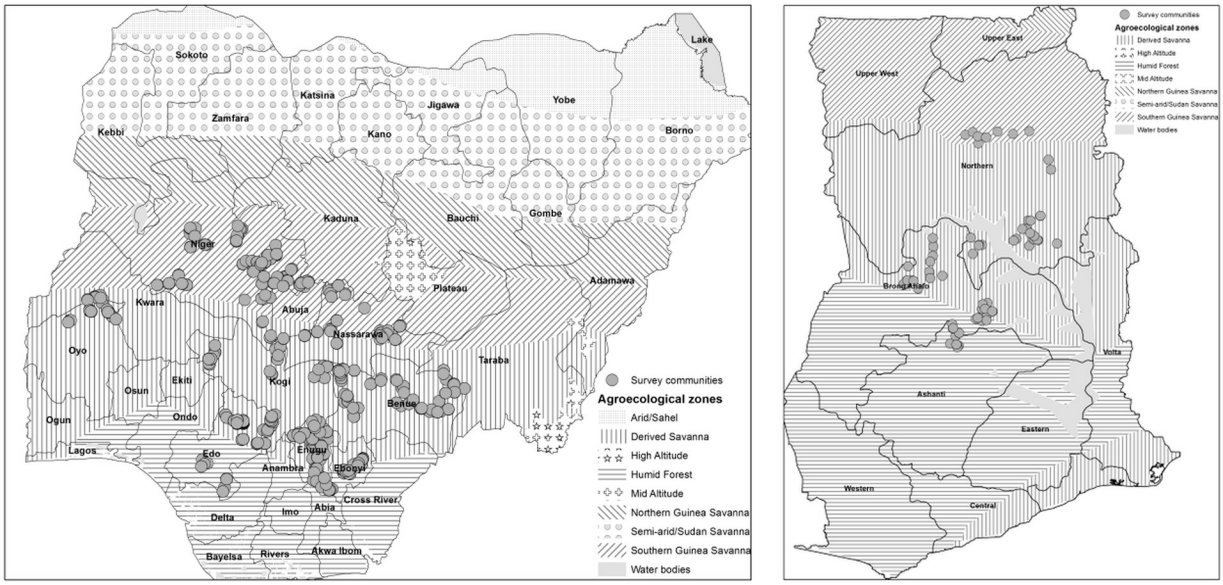

Fig. 1: *Surveyed areas in Nigeria and Ghana.*

The timing of the survey was set to November and December when most mature yam was still in the field and thus could be sampled. Only some early maturing varieties had already been harvested and could not be considered in the yield samples taken.

2.2 Data collection

Data were collected through interviews and direct measurements in the fields. Interviews were conducted using three different structured questionnaires which were designed and pretested at the community, household and field levels. Respondents at the community level were all yam producers, men and women, who were interviewed as a group. Information collected at this level, such as availability of markets and other forms of rural infrastructure would not vary between households. The complementary interviews consisted of 15 community level interviews in Nigeria and 10 in Ghana. All community level interviews were conducted in the village square or the community hall as the community leaders wished.

The head of the household and spouse, where applicable, were interviewed at the household level in their home for information that would vary across households, such as characteristics of the household, available resources and production objectives. At the field level, the owner responded in the farm to the oral interview for information such as production methods, varieties grown and plans for sale and home consumption of yam to be harvested.

Further, a total of 75 yam fields (45 in Nigeria and 30 in Ghana) were surveyed. Yam yield and field area were measured with the guidance of the owner of the field. Field area measurement was done using a global positioning system receiver. Yield measurement, regardless of variety, was based on a sample plot of $50\,m^2$ harvested close to the centre of the field: numbers of stands and mass of tubers were determined. The yam was purchased from the farmer at the market rate. Fields that had been used to remove small tubers for future use as seed yam ('milked') were omitted in yield measurements.

2.3 Analytical techniques

Descriptive statistics, such as mean, standard deviation and frequency distributions, were computed and used for household, community and field description. Factors which motivate a smallholder to invest cash in the purchase of farmland, seed yam, hired labour, chemical inputs and mechanical or mechanised field-to-home transportation, i.e., to adopt these purchased inputs in yam production were investigated using a Probit model.

2.4 Theoretical model

The Probit (the standard cumulative distribution function) and the Logit (the logistic distribution) models (Polson & Spencer, 1991) were used for this study. Following Polson & Spencer (1991) and Adesina & Zinnah (1993) the Probit model is:

$$T_i = F(W_i) = \int_{-\infty}^{W_i} \frac{1}{\sqrt{2\pi}} \exp(-S^2/2)\,\mathrm{d}s \qquad (1)$$

$$\text{For } -\infty < w_i < \infty;\ w_i = X_i'\beta$$

Where:

T_i is the probability that the i^{th} farmer chooses to use purchased input, zero otherwise. X is the n by k matrix of the explanatory variables and β is a k by 1 vector of parameters to be estimated.

The logistic distribution function is closely associated with the standard normal cumulative function of the Probit model. For equation 1, the change in the probability that the farmer uses a purchased input given change in any one of the explanatory variables can be computed as:

$$\frac{\partial T_i}{\partial x_i} = \left(\frac{\partial_F}{\partial w_i}\right)\left(\frac{\partial w_i}{\partial x_i}\right) = F(w_i)\beta \qquad (2)$$

Where:

$F(w_i)$ is the standard normal density (logistic density) function for the Probit (Logit) model.

In this study, three independent probit models were run. This might portend a potential for some of the adoption decisions modeled differently to be correlated. By way of ascertaining likely presence of and to account for the potential contemporaneous errors in these decisions, the models were tried with a multivariate probit model (MVP). The MVP assumes that the different decisions of using different inputs in yam production were made jointly or simultaneously and is estimated by maximum likelihood estimation method.

2.5 Empirical model

The analysis is based on information at the three research levels. The unit of analysis is the individual field. In yam production, seedbed preparation (mounding) and weeding are the two most labour-intensive farm operations (Tshiunza, 1998). Use of hired labour in seedbed preparation is defined as a binary variable, one if the farm operation is performed mostly (≥60 %) or fully (100 %) with hired workers and zero otherwise.

Field size and production objective (for sale and/or home consumption) are possible field-level determinants of the probabilities of the use of hired labour for seedbed preparation or for weeding. The percentage of yam produced and designated for sale by the owner is specified as proxy for production objective. In practice, the decision to sell before planting could be a better determinant of adoption of purchased inputs than the percentage ultimately sold because once farmers decide to plant for sale they invest in purchased inputs, irrespective of how much they ultimately sell. After harvest, the amount sold could be determined by crop performance, home consumption needs and current market conditions.

Seed yam as a purchased input is a continuous variable which varied from zero to 100 and was defined as the purchased percentage of the seed yam planted in the field. Field size and the percentage of the harvest designated for sale are possible field-level determinants of the probabilities of use of purchased seed yam.

Field-to-home transportation as a purchased input is a binary variable defined as one if the yam is transported using mechanical or mechanised means or zero if by head load. Location of the field in the residential area or at a distance could be a likely determinant of the probability that field-to-home transportation is mechanised. In this study, regression analyses of the use of chemical fertiliser, herbicide and mechanisation of farm land clearing were not done as they were not common in both countries.

Household size and the age of the household head were the household variables specified as determinants of the probability that any of the purchased inputs were used. Formal education of the head of the household is a possible determinant but it could have low variability as the farmers usually did not have more than a few years of primary education. The few who are better educated soon agree with the majority with whom they interact daily or else their better ideas are quickly copied by others. As a result, level of formal education was expected not to make much difference in the adoption of farm technologies and practices in a village setting (Nweke, 1996).

Population density and level of commercialisation are among village-level factors which can influence the probability that purchased inputs would be used in yam production. Frequency of periodic village market meetings, per week or per month, and distance to the nearest urban centers are used as proxies for population density and level of commercialisation of the village community specified as discrete variables.

Country dummy is specified as a binary variable. Similarly, the agro-ecologies are also specified as binary variables and specified to remove their effects. The variables are defined in Table 1.

Table 1: *Variables specified in the regression functions of use of purchased inputs in yam production.*

Variable	*Unit or Type*	*Explanation*
Dependent variables		
PLABOUR (Probability of use of hired labour for seedbed preparation)	Binary	1 if hired labour used for seedbed preparation, otherwise 0
PSEED (Probability of use of seed yam purchased)	Binary	1 if purchased, otherwise 0
PLAND (Probability of renting or purchasing farm land for planting)	Binary	1 if rented or purchased, otherwise 0
Field variables		
FSIZE (Field size)	ha	Field size in hectares
PSALE (Percentage of yam for sale)	Percentage	Percentage of yam harvest designated for sale
Household variables		
HHSIZE (Household size)	Discrete	Household size in number
AGEHH (Age of household head)	Years	Age in years
Village variables		
VILMKT (Village market)	Binary	1 if periodic market is in village, otherwise 0
DISTURB (Distance to urban centre)	Kilometer	Distance to centre
Country dummy		
NIGERIA/GHANA	Binary	1 if Nigeria, Ghana 0
Agro-ecological dummies		
HFREST (Humid forest)	Binary	1 if humid forest, otherwise 0
DSAVA (Derived savanna)	Binary	1 if derived savanna, otherwise 0
SGSAVA (Southern Guinea savanna)	Binary	1 if southern Guinea savanna, otherwise 0

Four variations of the Probit model were estimated for each of the four purchased inputs: (1) field variables, (2) household variables, (3) village variables, and (4) a combination of all variables.

3 Results

3.1 Data description and yam production contexts

The survey found that 70 % of the yam producing villages in Nigeria and Ghana are in the derived savanna, 20 % in the humid forest zone and 10 % in the southern Guinea savanna. Village- level information showed periodic markets in 20 % of the villages in Nigeria and in 10 % in Ghana. Only 3 % of surveyed households in Nigeria and 10 % in Ghana are female-headed (Table 2). The level of formal education of the heads of the yam farming households is low as the majority in Nigeria completed only 6 years of primary education. In Ghana they barely completed half that time (Table 2). The findings indicate a large number of household members (11 in Nigeria and 9 in Ghana) for both study areas. Most farm households had one yam field and the average farm size was larger in Nigeria than in Ghana (Table 2). In Ghana, most yam fields surveyed were situated up to 15 km from the village centres. In addition to yam which constitute about 62 % of total land area in both countries, other cultivated crops in the surveyed areas included cassava taro, cocoyam, banana/plantain, maize, sorghum, rice, cowpea. With regards to yield measurement, average yields are as shown in Table 2.

3.2 Yam production with purchased inputs

Common inputs used in yam production by the household are farmland, seed yam, labour, chemical fertiliser and herbicides as well as mechanical and mechanised vehicles used for field-to-home transportation. In both countries, only one or two yam fields in the survey were cleared mechanically, and about 1 % of the fields was mechanically ploughed before mounds were made.

Farmland: In Nigeria, 14 % of the fields surveyed were acquired by purchase, 14 % by renting, 70 % by inheritance and 2 % by allocation from community leaders. In Ghana, 3 % of the fields surveyed were acquired by purchase, 41 % by renting, 34 % by inheritance and 22 % by allocation from community leaders.

Table 2: *Characteristics of sampled households.*

Characteristics	*Nigeria*	*Ghana*
N	800	600
Male (%)	97.0	89.8
Age of household head (years)	50.8	48.7
Household head attended school (%)	67.9	30.0
Average years of schooling of household head	6.2	2.7
Household head with little/no experience in yam growing (%)	26.7	23.4
Number of household members	10.6	9.3
Share of land allocated to yam (%)	63.9 (0.2)	59.0 (0.2)
Average household farm size (ha)*	1.8 (2.3)	1.6 (1.7)
Average measured yam yield (t/ha)*	19.5 (11.0)	18.2 (8.7)

* n = 45 for Nigeria and 30 for Ghana; Figures in parenthesis are standard deviations
Source: YIIFSWA Baseline Survey (2013).

Seed yam: A field is often planted partly with purchased seed yam and partly with farmer's own- production. Fifty one percent of the farming households purchased seed yam. About 37 % of the seed yam used was purchased and 63 % were own-produced by surveyed farmers.

Hired labour: Use of hired labour in yam production is widespread, especially in Nigeria. It was used for at least one of the five farm operations, land clearing, seedbed preparation (mounding), planting, weeding or harvesting, in about 95 % of the fields in Nigeria and in about 80 % in Ghana (Table 3).

Table 3: *Percentage of the yam fields on which hired labour was used for cultivation operations for Nigeria and Ghana.*

Characteristics	*Nigeria*	*Ghana*	*Pooled*
Land clearing	90 (30.4)	81 (40.2)	87 (34.0)
Seedbed preparation	80 (40.5)	81 (40.2)	80 (40.1)
Sowing	68 (47.4)	48 (51.2)	61 (49.3)
Weeding	88 (33.5)	67 (48.3)	80 (40.1)
Harvesting	70 (46.4)	33 (48.3)	57 (49.9)

Notes: Figures in parentheses are standard deviations
Source: YIIFSWA Baseline Survey (2013).

Chemical fertilisers: Chemical fertilisers were applied on 25 % of the surveyed fields in Nigeria but in none in Ghana. However, no farmer claimed to have used organic fertiliser for yam production in both countries. In Ghana, yam is planted mostly in newly cleared forest land; in Nigeria, yam is planted in fields after short fallow of 2 to 3 years.

Herbicide: Herbicide was used for land clearing, weeding or for both. For land clearing, herbicide was more widely used in Ghana, on 46 % of the surveyed fields, than in Nigeria, 17 %. Herbicide was more widely used for weeding in Nigeria with 52 % of the surveyed fields and 38 % in Ghana.

Mechanised field-to-home transportation: Field-to-home transportation was widely mechanised, especially in Nigeria where yam was transported by head load from only 5 % of the surveyed fields, from 20 % by using non-motorized vehicles and from 75 % by motorized vehicles. In Ghana, the crop was transported from 17 % of the fields by head load, from 20 % by use of non-motorized vehicles and from 63 % by motorized vehicles. Since in Ghana yam cultivation is predominantly on newly cleared forest lands, inadequate farm roads make the use of certain motorized vehicles for field-to-home transportation difficult as most fields were situated some distances away from the village centres.

3.3 Determinants of use of key purchased inputs in yam production

As a way of addressing potential contemporaneous errors, MPV was fitted. However, the MPV did not fit the data reasonably well – the Wald test of the hypothesis that all regression coefficients in each equation were jointly equal to zero was accepted for the household level data. As expected, the likelihood ratio test [$\chi^2(10) = 0.001, p = 0.176$] that the covariance of the error terms across equations were not correlated was also accepted. The estimated correlation coefficients were not statistically significant in all the pair cases. The results of the MPV showed that decision to use any of the inputs – hired labour, farmland, and purchased

seed – were not complementary or interdependent. Similar results were obtained for plot- and community-level data. Therefore, individual probit models were adopted for explaining drivers of key inputs in yam production.

Use of hired labour in seedbed preparation: Along with country and agro-ecological dummies, specified field variables explained 24 % (Pseudo R^2 = 0.2366) of the variability in the probabilities of adoption of hired labour for seedbed preparation; household variables, 11 % (Pseudo R^2 = 0.1110); and village variables, also 11 % (Pseudo R^2 = 0.1105) (Table 4).

The probability of the use of hired labour in seedbed preparation was significantly correlated in the combined equation with the percentage of harvest designated for sale; significantly related in field and combined equations with field size and with age of household head and with size of household in the combined equation; positively related with household size in the household equation and with field size and distance to urban markets in the village and combined equations.

Purchased seed yam: In combination with country and agro-ecology zone dummies, specified field variables explained 14 % (Adjusted R^2 = 0.1449) of the variability in the probabilities of use of purchased seed yam; household variables 7 % (Adjusted R^2 = 0.0708); village variables 17 % (Adjusted R^2 = 0.1696); and all the variables combined 48 % (Adjusted R^2 = 0.4792) (Table 5).

The percentage of harvested yam designated for sale showed a significant relationship with the probability of use of purchased seed yam in the field and combined equations. Age of household head is significant in the combined equation. The relationship is positive between household size in the household equation and with field size and distance to urban market in the combined variables equation. The country-specific variable was negatively significant indicating that population and socio-economic characteristics present in Ghana favoured the use of purchased seed yam more than in Nigeria.

Rented or purchased farmland: Jointly with country and agro-ecology dummies, specified field variables explained 21 % (Pseudo R^2 = 0.2116) of the variability in the probability of use of renting or purchasing farmland; household variables also 15 % (Pseudo R^2 = 0.1510); village variables 26 % (Pseudo R^2 = 0.2580); and all the variables combined 44 % (Pseudo R^2 = 0.4403) (Table 6).

Table 4: *Estimates of parameters of explanatory variables of probability of use of hired labour for seedbed preparation in yam production in Nigeria and Ghana.*

Variable name	*Variable level*			
	Field	*Household*	*Village*	*Pooled*
Intercept	0.2909 (-1.50)	1.9455 (0.76)	-1.0283 (-0.62)	18.9009 (1.93) **
FSIZE	1.3660 (1.87) *	–	–	2.1673 (2.21) **
PSALE	-0.0495 (-1.50)	–	–	-0.2099 (-2.12) **
HHSIZE	–	-0.0193 (-0.45)	–	-0.2309 (-1.81) *
AGEHH	–	-0.0375 (-1.53)	–	-0.1600 (-1.86)
DISTURB	–	–	0.0989 (1.17)	0.1137 (0.77)
NIGERIA	-0.1017 (-0.12)	0.3496 (0.46)	0.7079 (0.52)	-2.1314 (-0.87)
HFREST	3.5239 (1.92) **	2.6200 (1.87) *	2.2814 (1.57)	7.2564 (2.06) **
DSAVA	1.7557 (1.59)	1.2823 (1.26)	1.2878 (1.31)	0.2157 (0.12)
Statistics				
χ^2	14.21	6.71	4.88	24.88
Prob > χ^2	0.0144	0.2429	0.3001	0.0016
Pseudo R^2	0.2366	0.1110	0.1105	0.5640

Notes: Figures in parentheses are t-ratios in the case of linear and z-ratios in the cases of Logit models.
*** denotes $P \leq 0.01$, ** denotes $0.01 \leq P \leq 0.05$, and * denotes $0.05 \leq P \leq 0.10$
Source: YIIFSWA Baseline Survey (2013).

Table 5: *Estimates of parameters of explanatory variables of probability of use of purchased seed yam in yam production in Nigeria and Ghana.*

Variable name	*Variable level*			
	Field	*Household*	*Village*	*Pooled*
Intercept	114.6887 (4.10) ***	77.1965 (2.53) ***	99.3006 (3.89) ***	238.5976 (6.18) ***
FSIZE	-1.3414 (-0.51)	–	–	0.7673 (0.32)
PSALE	-1.0536 (-2.21) **	–	–	-2.0915 (-5.05) ***
HHSIZE	–	0.2693 (0.36)	–	-0.0020 (0.00)
AGEHH	–	-0.1800 (-0.45)	–	-0.8683 (-2.13) **
DISTURB	–	–	-0.5223 (-0.49)	0.3868 (-0.35)
NIGERIA	-33.6840 (-2.90) **	-35.8575 (-2.97) **	-62.6033 (3.89) ***	-71.4172 (-4.62) ***
HFREST	-2.8819 (-0.51)	-7.3258 (0.33)	-11.0606 (-0.52)	-5.8731 (-0.35)
DSAVA	-13.4084 (-0.72)	-13.4370 (-0.68)	-10.4288 (-0.58)	-26.6384 (-1.78) *
Statistics				
χ^2	3.00	1.91	3.14	5.83
Prob > χ^2	0.0184	0.1066	0.0250	0.0001
Adj R^2	0.1449	0.0701	0.1696	0.4792

Notes: Figures in parentheses are t-ratios in the case of linear and z-ratios in the cases of Logit models.
*** denotes $P \leq 0.01$, ** denotes $0.01 \leq P \leq 0.05$, and * denotes $0.05 \leq P \leq 0.10$
Source: YIIFSWA Baseline Survey (2013).

Table 6: *Estimates of parameters of explanatory variables of probability of renting or purchasing farm land for planting yam in Nigeria and Ghana.*

Variable name	*Variable level*			
	Field	*Household*	*Village*	*Pooled*
Intercept	0.6945 (0.38)	-0.8772 (0.55)	0.7806 (0.48)	2.9828 (0.78)
FSIZE	0.4739 (1.58)	–	–	1.8503 (1.84) *
PSALE	-0.0581 (-1.56)	–	–	-0.1316 (-1.54)
HHSIZE	–	-0.0317 (-0.80)	–	-0.0995 (1.26)
AGEHH	–	0.0097 (0.45)	–	0.0308 (0.66)
DISTURB	–	–	-0.1615 (-1.58)	-0.2326 (-2.03) **
NIGERIA	1.7883 (2.39) **	1.4643 (2.12) **	0.4629 (0.39)	1.4840 (0.92)
HFREST	-0.8347 (-0.70)	-1.0217 (0.92)	-0.7062 (-1.58)	-1.6354 (-0.96)
DSAVA	1.1019 (1.02)	1.2143 (1.15)	2.7318 (1.84) *	3.3643 (1.790)*
Statistics				
χ^2	15.86	11.66	12.03	20.54
Prob > χ^2	0.0073	0.0398	0.0171	0.0086
Pseudo *R*2	0.2116	0.1510	0.2580	0.4403

Notes: Figures in parentheses are t-ratios in the case of linear and z-ratios in the cases of Logit models.
*** denotes $P \leq 0.01$, ** denotes $0.01 \leq P \leq 0.05$, and * denotes $0.05 \leq P \leq 0.10$
Source: YIIFSWA Baseline Survey (2013).

Field size and distance to urban market are significantly correlated with the probability of renting or purchasing farmland for yam production only in the combined equation. But the relationship with field size is positive in the field and combined equations and with age of household head in the household and combined equations.

3.4 Yam production utilisation

Five main categories of yam utilisation were identified: sold, used as in-kind payments, used as seeds, given out as gifts/donations, and consumed (Fig. 2). Utilisation of the yam production household level does not vary significantly between the two countries. The proportion for sale is the most important, followed by the proportion allocated for seeds and then the proportion for home consumption.

About 30 % of the output is allocated for seeds and an important proportion of the harvest after discounting for seeds was designated for sale in both countries (Fig 2). The farmers' pre-harvest estimates of the proportion of yam they plan to sell varied from a minimum of about 30 % in Nigeria to a maximum of 90 % in Ghana. The means were about the same, 58 % in Nigeria and 60 % in Ghana. Yam was sold from all surveyed fields, i.e., none of the yam crops served exclusively as subsistence food. However, the results showed that the practice of selling yam is more common in areas remote from urban markets and in less populated zones than in areas close to urban centres.

4 Discussion

The purpose of this study was to assess key production factors as a way of increasing output and incomes of yam farming households in West Africa at the example of Nigeria and Ghana.

In agreement with Nwosu & Okoli (2010), almost all households in the surveyed communities were male-headed and this dominance of male headship in rural areas is characteristic for most developing countries. Furthermore, the headship of households should be understood in the proper context of the surveyed areas. Often by tradition, in most parts of both countries the oldest male member of a household is its head, whether he is an old man past working age in a household with economically active men and women or an underage boy in a household with economically active women.

The context of little or close to zero formal education among yam producers should be of primary concern in R&D efforts aimed at promoting yam production. In corroboration of the findings by Ackah *et al.* (2014), yam production especially in Ghana was shrouded in superstition. The problem of superstitious and ritual practices could have implications for the management of yam production as a business. The ritual materials entail expenditure of resources, including cash. Although, farming households in both countries were characterised by large household size the use of hired labour was prominent in both countries. This was in agreement with Agbaje *et al*. (2005) and could be attributed to high labour requirements for yam production occasioned by tedious nature of its farming system.

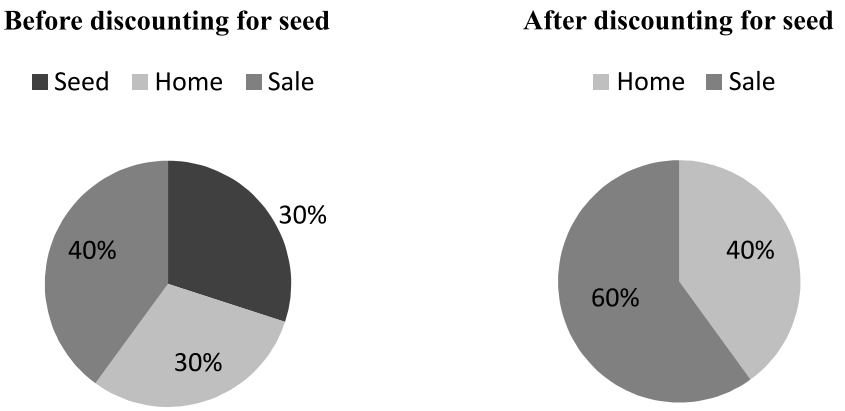

Fig. 2: *Share of farming households' yam for seeds, sale and home consumption.*

Yam was produced with local technologies as demonstrated by little usage of mechanical equipment. This result was in agreement with Zaknayiba & Tanko (2013) and Ibitoye & Onimisi (2013) which indicated that yam was produced with crude equipment. This was even aggravated by poor road networks to the farms especially in Ghana. Farmers were able to accomplish on-farm transportation through forest tracks by bicycles and motorcycles. Moreover women commute long distances on foot daily with head loads of firewood and crops over bush tracks.

Yam was widely produced with a range of purchased inputs depending on the farmers' need to supplement family supplies, access to the inputs (distance to markets), and their assessment of cost implications of the purchased inputs. Among the purchased inputs, frequency of use of purchased or rented farmland was the lowest as farmland was widely available from family sources. In addition to purchased seed yam, a significant proportion of farmers use own produced seed yam. This might be connected with low availability of purchased seed yam which was always about three times more expensive than ware yam at harvest. Hired labour is the most frequently used purchased input in yam production among the farmers surveyed because more is needed than the family can supply. In fact, not all the available family labour was engaged in yam production as yam production was dominated mostly by men as shown by Ibitoye & Attah (2012). This is also in agreement with Ajibefun *et al.* (1996) who found in his study in Nigeria that hired labour contributes 88 % of the total labour use on farms. In addition, hired labour, though expensive, is available locally. But even the hired labour from outside the community is also accessible locally because seasonal migrants reside in the area through the cropping season. The use of purchased inputs, in short supply from family sources and accessible to the farmers, is convincing evidence that yam is produced in both countries as a cash crop since farmers invest cash in the production of those commodities expected to yield cash in return.

Analyses of determinants of use of purchased inputs reveal three serious impediments to expansion in yam production: high cost of hired labour, shortage of suitable land in spite of farmland availability and poor farm roads also from the village to the markets. As employment opportunities for unskilled labour in urban centres are presently expanding, increased yam production will be hard to achieve without labour-saving technologies for at least some of the production tasks, especially seedbed preparation and weeding, and without improvement in farm roads. In Ghana, extra labour is needed as yam is often cultivated in newly cleared fields. This assertion was supported by Ezeh (1998) and Kushwaha & Polycarp (2001). In Nigeria, where land pressure is higher than in Ghana, the short fallow period can not fully restore soil fertility and therefore yam production will need further inputs like organic fertiliser in order to retain a certain production. According to Manyong *et al.* (1996), yam production in Nigeria has been expanding but the traditional production systems are under increasing pressure to adapt to short fallow periods owing to limited availability of new lands to support shifting cultivation. This calls for effective deployment of technologies that will permit production under intensive methods and reduce farmers' need to search for young fallow lands that rarely assure good yield due to shortness of fallow period.

In both countries, yam is produced as a cash crop. Production for sale is more common in areas remote from urban markets and in less populated zones than in areas close to urban centres and more populated zones because the crop requires fertile land. A better fertility will lead to a higher production so the percentage sold would always be higher in rural areas as the production per hectare is higher.

5 Conclusion and recommendation

In both countries, yam is produced more for sale than for home consumption. The extensive use of purchased inputs which are in short supply from family sources and accessible to farmers support the contention that yam is produced as a high value crop. This conclusion is based on the high input demand for production which is pre-conditioned by expectations of a high return in cash. Expansion of production will be dependent on improvements in farming methods, increased mechanisation, better rural infrastructure and markets. R&D efforts at improving farming method should include the deployment and facilitation of use of land-enhancing technologies such as inorganic fertilizers to reduce heavy dependence on fallow lands. Increased mechanisation of yam production that reduces drudgery and labour constraints associated with yam production should be pursued. Policy thrust should also be directed at providing better road networks in rural area to aid transport from rural homes and farms to markets. This would facilitate marketing of yam output thereby engendering better returns to yam farmers. However, any successful policy targeted at increased yam production should focus on proper education of farming households on yam farming system.

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