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Full Length Research Paper

Willingness to adopt the vine multiplication technique in seed yam production in the forest savanna transition agro-ecological zone, Ghana

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Yam is a vital crop in Ghana both at the domestic and export markets. It contributes about 17% of agricultural gross domestic product (GDP) and plays a key role in household food security with more than 2 million tons harvested each year. However, the inadequacy of planting materials is a major constraint in yam production. The cost of planting materials alone constitutes about 50% of total cost of production. The newly developed technique of propagating yam through vine cuttings (vine multiplication technique) has been introduced by Council for Scientific and Industrial Research-Crops Research Institute (CSIR-CRI) and its partners to farmers. To assess the willingness of farmers to adopt the vine technology, a study was conducted in the forest-savannah transition zone of Ghana in 2010 involving a total of 375 yam farmers (324 males and 51 females). The study used the probit model to assess framers' willingness to adopt the vine technique. The results show that age, farm size, experience, yield, cost of adoption, ease of adoption, visits to a demonstration field and the expectation of obtaining more seed yams influenced farmers' willingness to adopt the vine technique. It is recommended that the technology should be promoted targeting younger experienced farmers with larger farm sizes and higher yields

Key words: Ghana, probit model, vine technique, willingness to adopt, yam.

INTRODUCTION

Yam production is one of the main agricultural activities in West Africa region which contributes between 90 and 95% of world production (FAO, 2009). In Ghana, yam is one of the major staple food crops. The crop is the most important food crop in terms of output value. It contributes about 17% of agricultural gross domestic product (GDP) and also plays a key role in guaranteeing household food security (Kenyon and Fowler, 2000). The crop occupies 11.61% of the total cropped area of Ghana and annual production was estimated to be 5.7 million metric tons in 2009 (MoFA, 2010).

Despite the important role of yam in the economy of Ghana as a source of food and job creation, as much as 30% of the previous harvest that should have been sold for income or eaten is reserved for the next cropping season (Orkwor and Asadu, 1997; Kambaska et al., 2009). This clearly shows how farmers are constrained in terms of availability and cost of material for planting. The cost of planting materials alone constitutes between 33 and 50% of the total production cost of yam in sub-Saharan Africa (Asare-Bediako et al., 2007; Kambaska et al., 2009).

The seed system of yam in Ghana include the traditional system where the yams are milked after the first six months of planting and left in the soil to allow for the formation of the sets which would be used for planting in the next season. The harvested ware yams are often

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physiologically immature and have short shelf life.

The yam minisett technique is another system through which farmers obtain seed yams. In this technique, one yam tuber can be cut into approximately 40 pieces, setts of about 50 to 100 g each. The setts are dipped into fungicide and nematicide which kills any infections already present before planting and prevents disease from appearing once planted. The advantage of the mini-sett technology is that farmers do not need to use the whole of their second harvest as seed, thus increasing the availability of yam for food or income. However, the technique is more complex (and costly) than the traditional method of seed yam production (Kenyon and Fowler, 2000).

It is in this regard that the newly developed technique of propagating yam through vine cuttings (vine multiplication technique) was developed by Council for Scientific and Industrial Research-Crops Research Institute (CSIR-CRI) in partnership with and introduced to farmers since 2008. The success and the eventual adoption of this new yam growing technique will substantially reduce the volume of the root crop used as seed and, in effect, increase the amount of yam available for sale or for consumption. Apart from its economic and food security benefits, the new technique will also substantially decreases or even eliminate the transmission of diseases (nematodes), which is the main cause of low yields in yams (IITA, 2009).

Research on the vine technique has been going on in Ghana since 2008 and this study seeks to assess the extent to which farmers in the forest-savannah transition agro-ecological zone in Ghana are willing to adopt it.

By examining farmers' willingness to adopt the vine technique in Ghana, this study comes in handy with the quest for such understanding. A farmer is said to be willing to adopt the technology when after observations from a demonstration or an explanation of how the technology works, he/she expresses the interest to use the technique. Adoption of any technology is dependent on numerous factors. It is therefore important for policy makers, researchers and development partners to understand these factors, and their effect on farmers' willingness to adopt the vine multiplication technique in Ghana. With this information, the deployment of the technology will be properly targeted to ensure effective adoption.

METHODOLOGY

Study area

This study was conducted in the forest-savannah transition agro ecological zone in Ghana. This zone is one of the major yam growing areas and is the area where yam is celebrated most in Ghana. It lies within latitudes 7°36'N and 8°45'N and longitude 1°5'W and 2°1'E. The greatest part of the zone is in the Brong Ahafo region and extends to the Ashanti region. Four districts were selected purposively for the study; these districts are the Kintampo North and South Districts, Nkoranza District and Atebubu/Amantin District of the Brong Ahafo region, and Ejura Sekyedumasi District of the Ashanti region (Figure 1).

This agro ecological zone was selected because it is one of the major yam producing agro ecologies in the country. Yam is one of the most important food security and cash crop in this part of the country. It also has the major yam markets in the country; most of the yams exported out to neighboring countries are produced in this area. Yam is so important in these areas to the extent that, it is the only crop that is celebrated annually by the inhabitants of the communities. There are vast tracts of farmland suitable for the production of the crop. Commonly cultivated crops especially include yam, cassava, millet, sorghum, cowpea, rice, groundnut, watermelon, cashew, mango and tobacco.

Sampling procedure and data collection

The field survey was carried out between September and October, 2009. Multi-stage sampling technique was employed to select the sample points. In the first stage, two agro ecological zones were selected. The second stage involved the selection of four districts from a list of major yam producing districts in each zone. Ten rural communities were then randomly selected in each district. From the list of yam growers obtained in each community, between 5 and 10 respondents were then chosen. Using simple random sampling technique and in proportion to the total number of yam farmers in the communities, a total of 375 respondents were interviewed.

in all, primary data were collected from a cross section of 375 respondents using a structured questionnaire. Data collected include respondents' socio economic characteristics such as age, household size, sex and educational level; land management techniques, yield, family labour, farm size as well as problems constraining yam production activities.

Preliminary information obtained during reconnaissance visits revealed that some of the farmers had the opportunity of visiting a vine technique demonstration field while others have not. In assessing their willingness to adopt the technique, a thorough description of the technique was made with a strand of vine and a medium after which farmers were asked whether they are willing to adopt the technique or not.

Theoretical framework

According to von-Neumann-Morgenstern, when farmers are faced with dichotomous choices to adopt the vine technique for seed yams production or to continue with the traditional way of seed yam production, they consider the expected benefits associated with the alternative choices before a decision is made. For example, the decision to continue using the traditional approach $(y_i = 0)$ or to adopt the vine technique $(y_i = 1)$ would be based on a comparison of profits associated with both practices. A farmer will be willing to adopt the new technology if the expected profit associate with it is more than that of the traditional technology. This decision rule of the rational farmer can be derived as follows;

$$y_i = \begin{cases} 1 \text{ if} E[\Pi_v - \Pi_c] > 0 \\ 0 \text{ if} E[\Pi_v - \Pi_c] \leq 0 \end{cases} \quad (1)$$

where E is, the expectation operator; Π_v= , the profit from using the vine technique; Π_c= , the profit from using the traditional approach. However, these profit levels are not directly observable since the technology has not actually been adopted by farmers. The

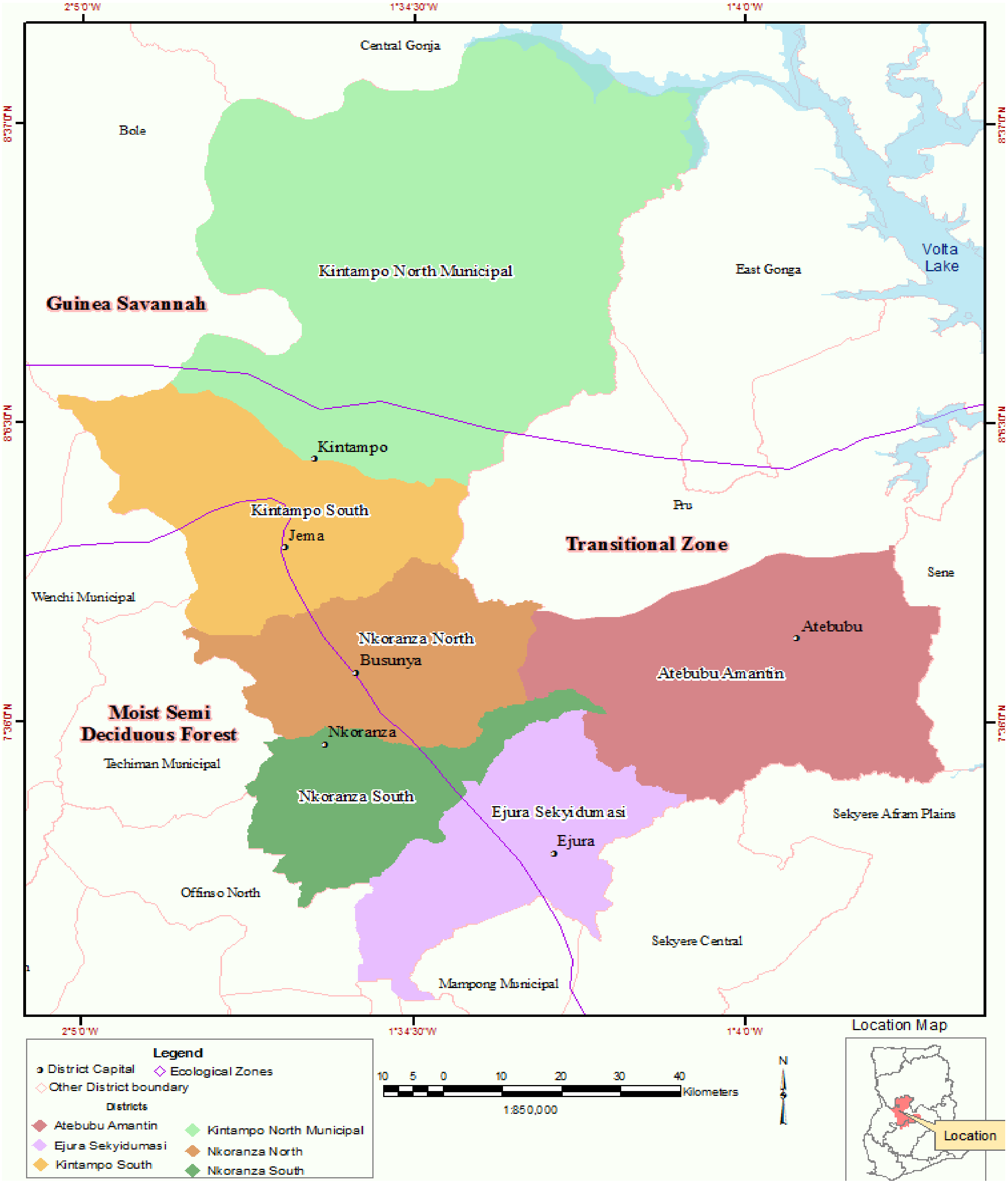

Figure 1. A map of Ghana showing the study area.

observables include the vectors of variables describing the attributes of the technology, a and household/farmer characteristics and farm level characteristics (x). The profit equation assumes that the profit derived by farmer i from the product with attributes a can be expressed as:

$$\Pi_{ai} = TR_{ai} - TC_{ai} + \varepsilon_{ai} \quad (2)$$

(2)where Π_{ai} is, the profit level attained by the i^{th} farmer from choosing the product attribute a; TR_{ai} , the total revenue obtained from choosing the technology with attribute a; TC_{ai} , the total cost incurred for choosing the technology with attribute a; TR_{ai} and TC_{ai} are, the explainable part of the profit level that depends on the technology attributes, farmer and farm level characteristics; ε_{ai} , the 'unexplainable' random component. The profit maximizing yam farmer will be willing to adopt vine technology if and only if:

$$\Pi_v + \varepsilon_v > \Pi_c + \varepsilon_c \quad (3)$$

Since ε is unobservable and stochastic in nature, the farmers' choice is not deterministic and cannot be predicted exactly (Maddala, 2005). Instead, the probability of any particular outcome can be derived. The probability that farmer i will adopt the vine technology is given by:

$$P_i = \text{Prob}(\varepsilon_c - \varepsilon_v < \Pi_v - \Pi_c) = \text{Prob}(\varepsilon_i < \Pi_v - \Pi_c)$$

(4)

To empirically implement the above theoretical framework, it is assumed that ε_i is normally and independently distributed (that is, $N(0, \sigma)$) in which case $\varepsilon_i = \varepsilon_c - \varepsilon_v$ follows a normal distribution (Maddala, 2005. The indicator variable y_i for the ith farmer (that is, the willingness to adopt the vine technology) is regressed as a function of his or her personal characteristics, socioeconomics and product attributes as follows:

$$y_i = \beta_i x_{ij} + v_i \qquad i = 1,2, \ldots, \quad (5)$$

where x_{ij}, (is a vector of j independent variables which includes the technology, farmer and farm specific characteristics) of the ith farmer; $\beta$is, the parameter vector to be estimated; v_i is, the disturbance term. $y_i = 1$ if the farmer is willing to adopt the technology or $y_i = 0$ if the farmer is not willing to adopt the technology. Common models for estimating such parameters include probit (standard normal) or logit (logistic) (Maddala, 2005).

The model

The study adopted the probit model partly because of its ability to constrain the utility value of the decision to join variable to lie within 0 and 1. It also has the ability to resolve the problem of heteroscedasticity.

Following Maddala (2005), the probit model adopted for the study is specified as:

$$P_i = P(y_i^* < y_i)$$

$$P_i = P\left(y_i^* < \beta_0 + \beta_j X_{ji}\right) = F(y_i)$$

$$P_i = F(y_i) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{Z_i} e^{\frac{-s^2}{2}} ds \quad (6)$$

where P_i is, the probability that an individual will make a certain choice (is willing to adopt or not); s is, a random variable normally distributed with mean zero and unit variance; y_i is, the dependent variable (willing to adopt); y_i^* is, the threshold value of the dependent variable.

To obtain an estimate of the index Z_i the inverse of the cumulative normal function is used:

$$yi = F^{-1}(P_i) = \beta_0 + \sum \beta_{ki} x_{ki} + u_i \quad (7)$$

The parameters estimates β_s of the probit apart from the information on the effect of changes in the explanatory variable on the probability of adoption, and also provide information on the relative effect of each explanatory variable on the likelihood that a farmer will prefers an improved variety. The latter can be obtained as follows:

$$\frac{\partial P_i}{\partial x_{ij}} = \beta_{ij} * f(Z_i) \quad (8)$$

where P_i is, the mean dependent variable whose value is given in the probit results and:

$$f(Z_i) = F^{-1}(P_i) \quad (9)$$

The elasticity of the predicted probability is then computed as:

$$\frac{\partial P_i}{\partial x_{ij}} = \beta_{ij} * f(Z_i) * \frac{\overline{X}}{P_i} \quad (10)$$

Guided by related studies (Ayamga, 2006; Hodinott, 1992; Nzomoi, 2007), socio-economic attributes were identified and hypothesis was constructed regarding the individual's willingness to adopt the vine technique. The socio-economic and other factors either had a bearing on the individual (farmer) or on the vine technique and therefore policy. The variables include age, gender (sex), level of education, yield, farm size, household size, family labour, ease of adopting cost of implement, expected increased in seed yam production, extension contact and visit to a vine demonstration field.

Most males are involved in yam production than females because of the drudgery involved and the labour intensive nature of yam production (Andriene et al., 2010). Hence, it is likely for more males to be willing to adopt the vine technique than females. A value of 1 was assigned to males and 0 to females. If this is true, the sex variable (SEX) is expected to be significant. Farmers with higher yam yields will demand more seed yams for their farm since higher yield is an incentive for increasing production (Orchard et al., 2010). Hence, farmers with high yields will be willingness to adopt the vine technology than their counterparts with low yields.

The farm size is expected to have positive effect on willingness to adopt. This is because larger farm sizes will demand more seed yams hence, their desire for alternative means of producing more seed yams to plant the entire farm. Farmers with larger farm income will be willing to adopt the vine technology because they would want to have more income in subsequent years.

Older people are thought of to be more risk averse and thus, are less likely to be willing to adopt the vine technique (Ayamga, 2006). Younger farmers on the other hand tend to be more flexible in their decisions and they are more eager to learn new things. Given the divergence in the effect of age, it is assumed that age has a quadratic effect. Therefore in order to assess the age level at which willingness to adopt peaks, the square of the variable age is also introduced. The first order derivative equated to zero will be taken to obtain such age value. Participation in field demonstration (DEMO) is expected to provide the farmers with adequate information about the technique and is expected to have a positive influence on farmers' willingness to adopt the vine technique.

The ease of adopting (ESADOPT) variable is measured as a dummy, 1 is assigned if the farmer perceive the technique to be easy to implement and 0 if otherwise. This variable is expected to have a positive influence on farmers' willingness to adopt the vine technique. Similarly, farmers' perception about cost of adopting the technique (PRSCOST) is likely to positively influence their willingness to adopt the technique. This variable is again measured as a dummy and assigned 1 if the farmer perceives it to be cheap to implement and 0 if otherwise. The expectation that the vine technique will produce more seed yams than the conventional method (MSDYMS) is expected to have a positive influence on farmers' willingness to adopt the vine technique. This variable is a dummy variable and assigned 1 if the technique is expected to produce more seed yams and 0 if otherwise.

Availability of family labour (FAMLAB) is expected to have a positive influence on the willingness to adopt the vine technique (Mussei et al., 2001; Shield et al., 1993). Yam production is naturally labour intensive. The availably of relatively cheap and reliable family labour resources is expected to contribute effectively to willingness to adopt. Farmers who are educated at least to the basic level are expected to understand the concept better and to be more willing to adopt the vine technology:

$$\log\left(\frac{P_r}{1-P_r}\right) = \beta_0 + \beta_1 AGE + \beta_2 AGE^2 + \beta_3 FINCM + \beta_4 FAMLAB + \beta_5 FEDUC + \beta_6 FRMSZE + \beta_7 HHSIZE + \beta_8 SEX + \beta_9 DEMO + \beta_{10} YLD + \beta_{11} PRSCOST + \beta_{12} ESADOPT + \beta_{13} EXT + \beta_{14} MRSDYMS + v_i \quad (11)$$

where P_r is, the probability of willingness to adopt the vine is technique and $\frac{P_r}{1-P_r}$ is the odds ratio in favour of being willing to adopt the vine technique. The dependent variable is the farmers' willingness to adopt the vine technology or otherwise and it takes the value of 1 if the farmer is willing to adopt and 0 if he/she is not willing to adopt.

RESULTS

Description of sampled respondents

The respondents have been differentiated by their willingness to adopt the yam vine technology. Overall, 71.47 percent of the farmers are willing to adopt the vine technology. About 89.93 percent of the respondents who are willing to adopt the technology are males with about 22.43 females. Similarly over 10.07.percent of the farmers who are not willing to adopt are males while 77.57 are females.The average age of the respondents is about 41.25 years. The farmers who are willing to adopt the technology are about 34.64 years while those who are not willing to adopt are about 57.80 years old. The respondents managed an average household size of about 9 persons, about 7.92 persons are managed by those are not willing to adopt and 8.74 by those who are willing to adopt. On the average, about 4 persons are useful sources of family labour resources for their farming activities. For the 2009 production season, the farmers obtained about GH ₵ 1105.2 from farming (Table 1).

Yam production is undertaken on an average of about 5.7 ha of land, about 3.48 ha for those who are not willing and 6.58 ha for those who are willing to adopt the technology. The yields obtained by the respondents who are willing to adopt the vine technology is about 4 mt/ha while that obtained by the those who are not willing to adopt is about 3.4 mt/ha. More than 50 percent of the respondents have ever visited field demonstrations of the yam vine technology. About 61.57 percent of those who are willing have participated in such demonstrations. For those who are not willing to adopt, there are about 28.97 percent who have visited such demonstrations. In addition to the demonstrations, the respondents have about 7 extension visits per annum (Table 2).

On the whole, the majority of 63.73 percent of the respondents perceive the yam vine technology to be expensive relative to the traditional method of milking. Huge variations however exist between the two categories of farmers. For those who are willing to adopt the technology, 72.72 percent perceive the technology to be expensive. A relatively smaller proportion of those who are not willing to adopt, about 41 percent perceive it to be expensive (Table 3).

On the other hand, 63.73 percent of the respondents perceive the vine technology as easy to adopt. Again, the over 70 percent of those who are willing to adopt the technology perceive it as easy to adopt while 42 percent of those who are not willing to adopt perceive it as easy to adopt (Table 3).

A similar distribution is observed with the expectations about the amount of seed yam that could be generated with the vine technology. About 66 percent of the respondents who are willing to adopt the technology expect to obtain more seed yam from the technology. On the other hand, about 34 percent of those who are not willing to adopt the technology expect more seeds from the technology (table 3).

Model for willingness to adopt the vine technology

Age for instance is a continuous variable and is measured in years. Household size is also a continuous variable and measured as the number of persons living with the respondent. Other continuous variables are farm size, family labour, yield (ton/ha), extension contacts and yam income (Table 4). The discrete variables are all dichotomous in nature with a value of 1 for yes and 0 for no. they include sex, education, demonstrations visits and perceptions about cost, ease of adoption, expected seed yam (Table 4).

The probit model in Table 5, has a significant Likelihood Ratio (LR) statistic of 276.87 with 12 degrees of freedom. This means that at least one of the variables

Table 1. Characteristics of respondents and their families.

Characteristics	Not willing to adopt	Willing to adopt	Overall
Sample (N/%)	107 (28.53)	268 (71.47)	375 (100)
Female (%)	10.07	22.43	13.60
Male (%)	77.57	89.93	86.40
Age (years)	57.80	34.64	41.25
Household size (N)	7.92	8.74	8.50
Family Labour (N)	3.90	4.19	4.10
Farm income GH₵)[1]	923.76	1177.64	1105.2

[1]USD 1=GH ₵ 1.50.

Table 2. Characteristics of yam production activities.

Characteristics		Not willing to adopt	Willing to adopt	Overall
Farm size (Ha)		3.48	6.58427	5.70
Yield (mt/ha)		3.4	4.0	3.8
	Yes	28.97	61.57	52.27
Demonstration visits (%)	No	71.03	38.43	47.73
	Total	100	100	100
Extension contacts per annum (N)		7.78	6.54	6.90

Table 3. Perception about vine technology.

Characteristics		Not willing to adopt	Willing to adopt	Overall
Perception about cost (%)	Yes	41.12	72.76	63.73
	No	58.88	27.24	36.27
	Total	100	100	100
Easy to adopt (%)	Yes	42.06	72.39	63.73
	No	57.94	27.61	36.27
	Total	100	100	100
Expects more seed yams (%)	Yes	33.64	66.04	56.80
	No	66.36	33.96	43.2
	Total	100	100	100

Table 4. Description of explanatory variables used in the Probit model.

Variable	Unit of measure	Frequency/mean
Age of respondents	Years	41.24
Sex of respondents	Binary variable	0 = 51;1 = 324
Household size	Number of persons	8.5
Yield per ha	Number of tubers	1267.88
Farm size	Hectares	2.28
A visit to a demonstration field	Binary variable	0 = 33; 1 = 331
Education	Binary variable	0 = 145; 1 = 230

Table 4. Contd.

Family labour	Number of persons	4.12	
Extension contacts	Number of times	5.210959	
Farm income	Ghana Cedis	1105.19	
Perception about cost	Binary variable	0 = 136;	1 = 239
Easy to adopt	Binary variable	0 = 136;	1 = 239
Expects more seed yams	Binary variable	0 = 162;	1 = 213

Table 5. Probit estimates of determinants of farmers' willingness to adopt the vine technique.

Variable	Coefficient	Prob.	Std. error	Z statistic
AGE	0.1669733**	0.004	0.574241	-2.91
AGE2	-0.0010417*	0.077	0.005881	1.77
FINCM	0.0000973^{ns}	0.526	0.0001535	0.63
FAMLAB	-0.0034546^{ns}	0.925	0.0365144	-0.09
FEDUC	0.4265582*	0.079	0.2427466	1.76
FRMSIZE	0.0842733**	0.007	0.0314586	2.68
HHSIZE	0.0524063^{ns}	0.112	0.033014	1.59
SEX	-0.0501772^{ns}	0.85	0.2654158	-0.19
DEMO	0.5271457*	0.018	0.222711	2.37
YLD	0.0006176**	0.003	0.0002082	2.97
PRSCOST	0.6400277**	0.005	0.2310631	2.72
ESADOPT	0.6287688**	0.007	0.2269009	2.82
EXT	0.0124788^{ns}	0.267	0.0112403	0.267
MRSDYMS	0.8695988***	0.000	0.2254138	3.86
Log likelihood	-88.06359	Probability(LR stat)	0.000000	
LR statistic (12 df)	276.87	Pseudo R^2	0.6250	
Obs with Dep=0	106	Mead dependent var	0.70555	
Obs with Dep=1	257	Total sample	375	

*, ** and ***: significant at 10, 5 and 1% respectively; ^{ns}: not significant.

in the model has a significant effect on farmers' willingness to adopt the vine technique and that the explanatory variables jointly influence the farmers' willingness to adopt the vine technique.

All the explanatory variables, except family labour were found to be in conformity with the apriori expectations of the study. The coefficients of age (AGE) and the square of age (AGE2), formal education (FEDUC), farm size (FRMSZE), visit to a demonstration field (DEMO), yield (YLD), and perceptions about cost (PRSCOST), ease of adoption (ESADOPT) and expectation of more seed yams were all significant at 5 % and 10 % probability levels. The rest of the variables including yam income (FINCM), family labour (FAMLAB), household size (HHSIZE), gender (SEX) and extension visits (EXT) were not significant determinants of willingness to adopt the yam vine technology (Table 5).

Among the variables that showed significant effect on willingness to adopt the yam vine technology, AGE, FEDUC, FRMSIZE, DEMO, YLD, PRSCOST, ESADOPT and MRSDYMS positively affected willingness to adopt the vine technology. The square of however negatively affected the willingness of the respondents to adopt the yam vine technology (Table 5).

In Table 4 are two categories of variables (continuous and discrete) which are used as the set exogenous variables in the probit model for willingness to adopt the yam vine technology. The table in particular also describes how these variables are measured (Table 4).

DISCUSSION

After gaining full knowledge about the yam vine technology the majority (71.47 %) of the respondents indicated their willingness to adopt the technology. The yam production system was also shown to be dominated by males, an observation that has been documented by

Table 6. Marginal effects and average elasticities of significant variables.

Variable	Marginal effect	Mean	Average elasticity
AGE	0.0406091	41.248	2.3741
AGE2	-0.000254	1938.88	-0.698002
FEDUC	0.1039029	0.613333	0.090323
FRMSIZE	0.0203717	5.695187	0.16444
DEMO	0.126955	0.533333	0.095967
YLD	0.0001507	1267.883	0.27081
PRSCOST	0.1512939	0.637333	0.136666
ESADOPT	0.1551015	0.637333	0.140105
MRSDYMS	0.2108177	0.568	0.169718

Dependent variable: Willingness to adopt the vine technique.

studies of agricultural production systems in Ghana (Wiredu et al., 2011 and Wiredu et al., 2010). Obviously, the majority of the farmers who were willing to adopt the technology were also males.

The negative sign of sex in the probit models indicate that females were more willing to adopt the technology. The effect of sex was however not significant in the model implying promotional may not necessarily target females who represent the minority among the yam producers.

Age as a proxy for experience was shown to have a positive significant effect on the willingness to adopt the vine technique. However, when age was squared, the effect became negative and significant. The implication here is that younger farmers are more likely to be willing to adopt the vine technique and this likelihood of willingness to adopt the technique increases with age. Increasing the age of the farmer by 1 year increases the likelihood of adopting the vine technique by 4.06 percent (Table 6). However, the older the farmer gets the less likely he/she will be willing to adopt the technique. This means that there is an age threshold beyond which increasing age decreases the likelihood of adopting the vine technique. Both age variables were elastic.

From the above discussions, it is seen that the willingness to adopt the vine technique increases with age, however as the farmer gets older his willingness to adopt decreases with increase in age. To investigate further the particular age at which the decision to join begins to decrease with age, we differentiate the Probit equation with respect to age and set the resultant derivative to zero, by doing this and assuming all other things constant, the optimal age is 84 years. This is the age that the likelihood that a farmer to be willing to adopt the vine technique peaks. Beyond 84 years, this likelihood decreases.

Differentiating the probit regression equation with respect to the AGE2 give the result as:

$$0.181096 - 2(0.001076)\text{Age} = 0 \rightarrow \text{Age} = \frac{0.181096}{0.002152} = 84.1524 \cong 84 \text{ years}$$

This means that farmers willingness to adopt the vine technique generally increases with age since at age 84 and beyond, a farmer have already out lived his/her youthful years and may not to be interested in any new innovation or technology pertaining to farming.

This finding compares well with Ayamga (2006) who found that as age increases the probability of a farmer to participate in microcredit programmes in Northern Ghana decrease. According to him, however, the chances of older people being considered for credit are low, and are due to the low probability of success, coupled with the high risk of default. Again, Gockowski and Ndoumbe (2004) in their study of the decision to implement intensive mono-crop horticulture in Southern Cameroon also found that the age of the household head had a significant negative and elastic effect on adoption decisions. It also compare with Asante et al. (2011) who found a positive relationship between age and farmers decision to join Farmer based organization in Ghana.

Farm size of the respondents had the expected positive sign, was significant and elastic. Increasing a farmer's farm size by one acre increases the likelihood of their willingness to adopt the vine technique by 2.03 percent (Table 4). Most researchers have found a positive relationship between farm size and willingness to adopt a technology (Adimado, 2001; Kheralla et al., 2001 and Langyintuo and Mekuria, 2005). The implication here is that farmers with larger farm sizes will tend to require more support in terms of marketing, pricing and inputs than their counterparts with smaller farm sizes hence will be more willing to adopt a new technology so long as it will positively affect their farming activities.

Formal education had the expected positive sign and was significant. This implies that the educated farmers are more willing to adopt the vine technique than their uneducated counterparts. This is confirmed in Table 1, where about 68.3 percent of the farmers who were willing to adopt the vine technique had formal education. Access to formal education by farmers increases the likelihood of their willingness to adopt the vine technique by 10.39 percent. This finding compares with Nzomoi et al. (2007) who found a positive effect of education on studying the determinant of technology adoption found that education had a positive and significant effect on adoption of the production of horticultural export produce in Kenya. Gamba et al. (2002) also found a positive relationship between wheat farmers' willingness to adopt new wheat varieties and education in Kenya. Other researchers, such as Damianos and Giannakopoulos (2002) ;Udoh et al, (2008) and He-XueFeng et al (2007), have made similar observations. Educated farmers, who have exposure to new technologies and innovations are better able to appreciate information about an innovation from a range of sources than their uneducated counterparts are and are more willing to experiment and adopt new ideas.

The yield of the farmers significantly influenced the likelihood of their willingness to adopt the vine technique. Increasing the yield of the farmer by a unit increases the likelihood of his/her willingness to adopt the vine technique by 00.01. Langyintuo and Mekuria (2005) found a positive relationship between farm size and maize variety adoption in Mozambique. Mussei, et al (2001) also found a positive relationship between yield and adoption of improved wheat varieties in Tanzania The implication is that farmers with higher yield would want to increase their production in the subsequent year. Access to more seed yams is vital to increasing production hence farmers are likely to be willing to adopt the vine technique.

Participation in vine demonstration had a positive significant effect on farmers' willingness to adopt the vine multiplication technique and was elastic. Participation in vine demonstration field increases the likelihood of farmers' willingness to adopt the vine technique by 12.69 percent. Visit to a demonstration field of the vine technique brings the respondent more closely to the reality as far as the technique is concerned. Such respondents become much more convinced and are more willing to adopt the technique than their counterparts who have not had such experience. Langyintuo and Mekuria (2005) found out that increasing field demonstrations to show farmers the yield advantage of improved varieties over local ones in Mozambique are essential in improving the uptake of improved varieties, and this increased the adoption of an improved maize variety by 18 percent in Mozambique.

Farmers' perception on the ease of adoption had the expected positive sign and was significant. Ease of adoption of the vine technique increases the likelihood of farmers' willingness to adopt the vine technique by 15.51 percent. The implication here is that when farmers perceive the technique to be easy to adopt, it increases their enthusiasm in adopting the technique and hence their likelihood of adopting it. Farmers' perception of the technique being less expensive to adopt had the expected positive significant influence on their willingness to adopt the vine technique. Being less expensive to adopt increases the likelihood of farmers' willingness to adopt the vine technique by 15.51 percent. This is so because farmers like any other rational being will consider the cost implications of any new technology before deciding to adopt. Reducing the price of improved maize seeds to farmers would increase adoption and intensity of use of improved maize varieties by 24% (Langyintuo and Mekuria, 2005).

Farmers' expectation of the vine technique providing them with more seed yams than the conventional way was positive and highly significant. Expecting more seed yams than the conventional way increases the likelihood of farmers' willingness to adopt the vine technique by 21.08%. The results suggest that farmers always consider the expected benefit they are likely to obtain from a new technology and compares with that of the existing one before deciding to adopt the new one.

Conclusion

The results of this study indicate that there are a number of factors influencing the farmers' willingness to adopt the vine multiplication technique in seed yam production. The key factors are age, farm size, yield, farm income, formal educations, visit to a demonstration field. Farmers will be willing to adopt the vine technique if the they realize that it has the potential of increasing the number of seed yams they would obtain as compared to the convectional way of producing seed yams and at the same time not capital intensive. Access to formal education increased farmers' willingness to adopt the vine technique. Educated farmers are more open minded hence willing to explore a new technology. Farmers' expectation of the vine technique providing them with more seed yams than the conventional way of producing seed yams had a highly significant influence on their willingness to adopt the vine technique. Promotional activities should therefore target younger experienced farmers with larger farm sizes, and higher yields.

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