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Assessing the Determinants of Adoption of Improved Cassava Varieties among Farmers in the Ashanti Region of Ghana.

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Abstract

This study has examined the adoption of improved cassava varieties among 350 cassava farmers in the Sekyere South District of Ashanti region, Ghana. The improved cassava varieties introduced into district were Bankye Hemaa, Esam Bankye and Bankye Afisiafi. Fifteen percent of the respondents adopted at least one of the improved cassava varieties and 85 percent been non adopters. The determinants of adoption were estimated with probit model. The results of the probit model showed that extension services, credit access, education, marital status, farmer based organization, and household size have significant positive effect on the probability of farmers to adopt improved cassava varieties. The study showed that in order to enhance adoption of improved cassava varieties, extension services should be intensified, farmers should form or join groups; farmers should also register with the credit union

in the district to have access to credit. Policy makers and crop breeders should come out with varieties that best suit farmers' objectives.

Keywords: adoption, improved cassava varieties, probit, technology

INTRODUCTION

Cassava (Manihot esculenta) is emerging as a dominant staple food crop of primary or secondary importance in many developing countries of the humid and sub-humid tropics in Africa. It is one of the major crops grown in most communities in Ghana (Moses, 2008). It contributes 22 percent of GDP and employs a large proportion of the population. Ghana's production of cassava is estimated to be over twelve million metric tons per annum (SRID, 2009). The greatest agricultural production emanates from root and tuber crops including cassava, yams and cocoyam, contributing about 46 percent to the agricultural GDP and nearly 76 percent of total major crop production. In terms of quantity produced, cassava is the most important root crop in Ghana followed by yams and cocoyam, but today cassava ranks second to maize in terms of area planted (SRID, 2009).

Due to its ability to withstand drought and thrive well on poor soils, it is sometimes a nutritionally strategic famine reserve crop in areas of unreliable rainfall (Hendershot, 2004). This gives it an advantage over yam and other root and tubers, grains or legume in Africa. Cassava is one of the most important staple food crops in Africa. Over 500 million people in the tropical world particularly Africa depend on cassava as one of their major staple food (RTIP, 2004). Cassava produces remarkable quantities of energy per day, even in comparison to cereals (Tweneboah, 2007). Sufficiency is achieved only in starchy staples such as cassava, yam and plantain, while rice and maize production falls far below demand (EIU, 2007; RoG, 2007).

The persistence of chronic malnutrition among a significant portion of the world's population has led to the realization that millions of people still lack reliable access to sufficient quantities of food. This realization has drawn much attention towards technology development (Morris and Cheryl, 2004). Among the many factors that contribute to growth in agricultural productivity, technology is the most important but its adoption has been a major problem in Africa. The

question of adoption or non-adoption is important. However, extent of adoption is actually the most critical criterion in the adoption process (Adesina and Baidu-Forson, 2003).

Moreover, cassava has a lot of potentials which can improve standard of living of farmers. Farmers in West Africa particularly those in Nigeria have adopted the improved cassava varieties which are improving their standard of living (Kormawa *et al*., 2001). But farmers in Ghana especially those in Sekyere South District have not yet taken advantage of economic potentials of the improved cassava varieties. As a result, adoption rate has been low. The adoption rate of improved cassava varieties in the southern part of Ghana has been proved to be 9 percent. The adoption intensity which was measured in terms of the area under cultivation of the improved was 37 percent in the 2001 crop season (Dankyi *et al.,* 2007). This is evidence proves that adoption of agricultural technology is actually a problem in the country. This hinders the growth of agricultural development and productivity.

Furthermore, the national output of cassava increased from 7.15 million tonnes in 1997 to 10.6 million tonnes in 2008 (WAAPP, 2009). This represents an increase of 48.3 percent. According to WAAP (2009), it is due more to expansion of area under cultivation which increased by 45.8 percent from 592,000 in 1997 to 840,000 ha in 2008 than from increases in yield per unit area. Yield per unit area during the period have remained almost the same. In 1997, it was 12.1 tonnes/ha and in 2008, it was 12.8 tonnes/ha. In 2009, 6770ha of land was under the cultivation of cassava in the district with average yield potential of 12.00 mt per ha. About 81,240 mt of cassava was produced from the 6,770 ha of land in district in 2009 (SRID, 2009). If the improved cassava had been planted by farmers, 3,508,260 mt of cassava roots should have been obtained from the 6,770 ha of land. Farmers obtain 12 tonnes per hectare from cassava production but the improved cassava varieties have average yield potential of 30 tonnes per hectare (SRID, 2009).

As a result this low productivity level of cassava production in the country, Sekyere South district among some districts were chosen in the country to benefit from a cassava project, dubbed 'RTIMP' (Root and Tuber Improvement and Marketing Programme) which was a follow up project of Root and Tuber Improvement Programme (RTIP) to be implemented over a period of eight years to build on the successes of the RTIP and also strengthen the provision of

marketing services to the development of roots and tubers (RTIMP, 2008). The project introduced improved cassava varieties which possess good varietal characteristics such as early harvest ability (ready to be harvested 6 months after planting), good plant type (tall and non- or less- branching), good stake quality (germination and storage duration), good root shape with white flesh, tolerant to major pests and diseases. Regardless of these superior qualities of the improved cassava varieties, extension officers reported that farmers are aware of the improved varieties yet are unwilling to grow them (RTIMP, 2008). It is against this background that the present study sought to examine adoption of improved cassava (Manihot esculenta) varieties and come-up with recommendations on ways of increasing its adoption in Sekyere South District of Ashanti Region. Other objectives include determining the factors that influence farmers' decision to adopt the improved cassava varieties.

METHODOLOGY

Data Type, Source and Sampling

The study population comprised of all cassava farmers in the Sekyere South District. Among the 26 districts in the region, Sekyere South District was intentionally selected for the study because of cassava project (RTIMP Project) which took place there as well as the district being noted for cassava production. For agricultural purpose, the district is divided into 13 operational areas namely; Agona East, Agona West, Jamasi, Dawu, Boanim, Wiamoase, Bepoase, Bipoa, Afamanaso, Domeabra, Tano Odumase, kona, and Asamang. Five of these operational areas were selected with assistance of simple random sampling. The selected areas were Tano Odumase, Kona, Agona East, Agona West, and Jamasi. Three hundred and thirty cassava farmers were randomly sampled from the population with 81, 93, 75, 35 and 66 cassava farmers selected from Tano Odumase, Kona, Agona East, Agona West, and Jamasi respectively. Random sampling technique was employed due to its simplicity in usage. It is also appropriate way by which each cassava farmer in the district could have an equal chance of selection. It gives an accurate generalization of results. But the problem with this sampling technique is that it does not guarantee that the sample drawn is a representation of the population since it does not include some of the sets of the population. Structured questionnaires were designed to collect primary data from the cassava farmers. The questionnaires captured information on the personal

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characteristics such as age, educational level, marital status, farmer based organization, credit access, household size, children above 15 years, ethnicity and religion of the farmers in the area. Age was computed in years. Respondents' educational level was examined on the basis of number of years of formal education. The educational levels included; no formal education, primary school, JHS/Middle school/O level/A level or tertiary level. Various questions were prepared to gather information household characteristics such as household size. Farm characteristics such as farm size (ha), soil type, extension contact and labour source were also captured in the questionnaire. Information on adoption of the improved cassava varieties were solicited with the questionnaire. The primary data was obtained from the cassava farmers using structured questionnaire. Secondary data collected for the study were basically from the University Library, Faculty of Agriculture Library, MoFA – Sekyere South District and the internet.

Empirical Model

We assume that for a farmer to make decision on whether or not to adopt the improved cassava varieties, he first examines the benefit obtained from the adoption $[C_A]$ and benefit derived from non-adoption $[C_N]$. A farmer is likely to adopt the new technology, if the utility derive from adoption $[C_A]$ is greater than the expected utility from non- adoption $[C_N]$. Thus, if $[C_A] > [C_N]$.

We employed the probit model which is binary choice model to examine the adoption of the improved cassava varieties among the cassava farmers. The probit model is specified as in (1):

$$ADC_i = \beta_0 + \beta_1(EL_i) + \beta_2(AGE_i) + \beta_3(AGE_i^2) + \beta_4(CA_i) + \beta_5(FBO_i) + \beta_6(GE_i) + \beta_7(EC_i) + \beta_8(HS_i) + \beta_9(MS_i) + \beta_{10}(FL_i) + \beta_{11}(FS_i) + \mu_i \quad (1)$$

where ADC denotes Adoption of improved cassava varieties ($ADC = 1$ if farmer adopts the improved cassava varieties, $ADC = 0$ if otherwise). EL denotes educational level of farmers (number of years of formal education). AGE represents age of the farmer (years). AGE^2 denotes age squared divided 100 (years). CA denotes credit access (1 if farmer accessed credit in 2010 and 0 if otherwise). FBO denotes farmer based organization (1 if farmer was a member of a farmer based organization and 0 otherwise). GE equals Gender (1 if farmer is male and 0 female). EC denotes extension Contact (1 if farmer received extension service in 2010 and 0

otherwise). *HS* denotes household size (number of people in the household). *MS* equals marital status (1 if a famer is married and 0 otherwise). *FL* denotes family labour (1 if family labour and 0 otherwise) *FS* denotes farm size (hectares) and $\beta_1, \beta_2, \beta_3 ... \beta_{11}$ represent the coefficients of the variables. μ_i denotes error term capturing all factors unknown to the researcher

RESULTS AND DISCUSSIONS

The majority of the respondents (70 percent) fall between 41- 60 years with mean age of 51 years. The mean household size of respondents was 8.27. Most cassava farmers had formal education and had either attained some primary education (39.7 percent), junior secondary or middle school (35.1 percent), secondary or O and A level (6.6 percent) or tertiary education (0.3 percent). Only (18.3 percent) had not attained any formal education. The results indicated that 15% of the cassava farmers adopted at least one of the improved cassava varieties. Averagely, 0.13ha of the farm was under the cultivation of the improved cassava varieties, which represented an intensity of 6% (defined as a ratio of the area under improved cassava varieties to farm size). The level adoption of the improved cassava varieties by the sampled farmers are shown in Table 1. Twenty five percent (25%) of the adopters were from Tano Odumase probably because of the predominant gari processing activities in the community. The cassava farmers in the community tend produce cassava to feed the cassava processing factory located there.

Table 1: Summary statistics on adoption of improved cassava varieties

Communities	Adopters (%)	Non- adopters (%)
Agona	12 (11)	98 (89)
Tano Odumase	20 (25)	61 (75)
Kona	12 (13)	81 (87)
Jamasi	9 (14)	57 (86)
Total	53(15)	297 (85)

Source: Survey Data, 2010

Sixty two percent (62.27%) of the adopters cultivated “Bankye Hemaa” because of its higher yield, suitability for consumption and gari processing. Twenty three percent (22.64) grew “Bankye Afisiafi” probably due to the availability of planting materials of this cassava variety in

the area. Only 3.77percent of adopters were growing "Bankye Esam" owing due to unavailability of planting materials. To reduce risk of adopting only one variety, some farmers decided to adopt two varieties. For instance, 9.43 percent of cassava farmers adopted "Bankye Hemaa" and "Bankye Afisiafi" while1.89 percent adopted "Bankye Afisiafi and "Bankye Esam" (Table 2).

Table 2: Summary statistics of number of improved varieties adopted

Varieties	Frequency	Percent
Bankye Hemaa	33	62.2
Afisiafi	12	22.64
Bankye Esam	2	3.77
Afisiafi/Bankye Hemaa	5	9.43
Afisiafi/Bankye Esam	1	1.89

Source: Survey data, 2011

Sources of planting materials

The adopters gave various sources of planting materials for cassava cultivation. Table 3 indicated that 82.02 percent obtained their planting materials from the Ministry of Food and Agriculture (MoFA) office in the district. Only 5.66 percent specified that they purchased their planting materials from Mampong Research Center.

Table 3: Source of planting materials

Sources of planting materials	Frequency	Percent (%)
MOFA	44	83.02
Friends	5	9.43
Relatives	1	1.89
Others	3	5.66

Source: Survey Data, 2011

Amongst the sampled farmers who were aware but were not growing the improved cassava varieties, 52.88 percent gave the reason that the planting materials given by Ministry of Food and Agriculture (MoFA) were inadequate which prevented them from growing the improved cassava varieties. Furthermore, 26.18 percent were of the view that the improved cassava varieties were unsuitable for preparing fufu because of the high moisture content. Similarly, 13.06 percent complained that the varieties contain too much starch especially Bankye Afisiafi. They indicated

that the variety is not suitable for ampesi. Again, inadequate information about the improved cassava varieties discouraged some farmers (5.23 percent) to abandon the varieties.

Table 4: Reasons for non adoption of improved cassava varieties

Reasons	Frequency	Percent (%)
Inadequate improved planting materials	101	52.88
High content of moisture	50	26.18
Inability to stay on the field for some period and rot	5	2.62
High content of starch and therefore cannot be consumed	25	13.09
Inadequate knowledge about improved cassava varieties.	10	5.23
Total	191	100

Source: Survey Data, 2011

Factors affecting the adoption of improved cassava varieties

The results of the probit estimates on the adoption of improved cassava varieties by the farmers are shown in Table 5. The maximum likelihood estimates gave a pseudo R-squared of 0.88 which implies that the model predicts correctly the adoption of improved cassava varieties for 88% of the sample. Amongst the 11 variables investigated in the probit model, seven were statistically significant. These include: age squared, marital status, education, credit access, and farmer based organization, extension and household size. All the variables had the expected signs except family labour. Age squared is positively related to adoption of improved cassava varieties and is significant at the 10 percent level. This implies that as a farmer advances in age, the likelihood of adopting improved cassava varieties decreases but up to say 100 years. The marginal effect of 0.00613 suggests that the likelihood to adopt improved cassava variety increases by the 0.613 percent. At 100 years, he would not be able to cultivate large acres of land but wishes to maximum cassava output so therefore resort to the new varieties to obtain high yield. The results is contrary to the finding of Abele et al. (2007) who observed that older farmers are more likely to adopt improved cassava varieties faster than the young ones. The coefficient of marital status is significant at the 10 percent level and has positive influence on the adoption of improved cassava varieties. This suggests that married farmers are more likely to adopt than unmarried farmers. As a farmer marries, the likelihood of adoption of improved cassava varieties increases by 2.76 percent. The empirical finding however runs counter to a study by Amao and Awoyemi (2008) on adoption of improved cassava varieties by farmers in Osogbo State of Nigeria which indicated that marital status is not a determinant of adoption.

The education variable is significant at the 1 percent level and has the expected positive sign. This suggests that as the number of years of schooling of farmer increases, the higher the probability to adopt improved cassava varieties. The marginal effect of 0.0239 indicates that each year of schooling increases adoption by 2.39 percent. Education improves managerial skills and human capital of farmers. It enlightens the individual with regard to farming activities, imparts the necessary knowledge of the new package and an understanding of how to use it. Again, a person's exposure to education tends to increase his ability to obtain, process and utilize information relevant to technology.

Empirical evidences provided by Abele et al. (2007) and Abdoulaye et al. (2014) on adoption of improved cassava varieties also gave similar result. Access to credit has a positive coefficient and significant at 10 percent level. This indicates that adoption of improved cassava varieties increase as farmers' access to credit increases. That is, they are likely to have adequate funds for the procurement of inputs such as improved cassava planting materials, agrochemicals and payment for labour required in the use of the new technology. This finding is consistent with that of Lawal et al. (2004). The marginal effect is 0.0224 implying that farmer's access to credit increase the probability of adoption by 2.24 percent. The empirical finding contradicts result by Omonona et al. (2003) which indicated that credit had negative relationship with the likelihood to adopt improved cassava varieties. The empirical result is also consistent with a study by Kudi et al. (2011) who found that credit access positively related to the probability to adopt improved maize varieties in Kwara State of Nigeria.

The coefficient of farmer based organization is significant at 1 percent and has positive relationship with the likelihood to adopt improved cassava varieties. The marginal effect is 0.0479 indicating that farmers' membership in at least one farmer organization significantly increases the likelihood of adopting the improved cassava varieties by 4.79 percent. The empirical result is consistent with a finding by Abdoulaye et al. (2014) who indicated that farmer based organization had a positive relationship with the likelihood to adopt improved cassava varieties in Nigeria. The coefficient representing household size is significant at 1percent and positively related to the likelihood to adopt improved cassava varieties. This suggests that large household size increases probability to adopt improved cassava varieties. The marginal effect is

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0.0103, indicating that as farmer household size increases, the probability to adopt improved cassava varieties also increases by 1.03 percent. Large households provide family labour required for the cultivation of improved cassava varieties. The study is consistent with finding of Abele et al. (2007). Again, large households are more likely to be food insecure and may have high consumption demand. The empirical result contradicts the findings of Omonona et al. (2003) who stated that household size is not a significant factor in adoption of technology. Similarly, the empirical finding disagrees with the result of Amao and Awoyemi (2008) who observed that household size had negative influence on adoption of improved cassava varieties.

The extension contact variable is significant at 1 percent level and has the expected positive sign. This suggests that farmer's contact with extension agents increases the likelihood of adopting the improved varieties. Access to information on new technologies is crucial to creating awareness and attitudes towards technology adoption as stated by Caviglia and Kahn (2001)**.** Extension agents, by interacting with farmers, are able to convince them to implement recommended farm technologies. Farmers' contact with extension services gives them access to information on technologies, advice on inputs and their use, and management of technologies. The marginal effect is 0.0661 which indicates that access to extension services by farmers increases the probability to adopt improved cassava varieties by 6.61 percent. This empirical result is consistent with a study by Abele et al. (2007) and Abdoulaye et al. (2014). Conversely, Kudi et al. (2011) found no relationship between extension contact and the likelihood to adopt improved maize varieties in Kwara State, Nigeria. The coefficients of age, gender, farm size and labour source were not significant factors in the adoption of improved cassava varieties, but farm size and gender showed a positive relationship with the probability to adopt improved cassava varieties. The coefficients of age and family labour had negative sign.

Table 5: Probit estimates on the adoption of improved cassava varieties

Variable	Coefficients	Marginal effect	*p*-values
Constant	-7.3242		0.014
Age	-0.0390	-0.00108	0.616
$Age^2/100$	0.2219	0.00613*	0.090
Gender	0.5428	0.0150	0.259
Marital status	0.9991	0.0276*	0.090
Education	0.8652	0.0239***	0.007
Creditaccess	0.8116	0.0224*	0.069
FBO	1.7351	0.0479***	0.001
Household size	0.3727	0.0103***	0.008
Extension	2.3924	0.0661***	0.003
Family labour	-0.0465	0.00129	0.950
Farm size	0.4137	0.0114	0.354
Pseudo R- squared	0.88		
Log-Likelihood function	-17.3801		
Number of observation	350		

*, **, *** Significant at 10 percent, 5 percent and 1 percent respectively. Source: Survey Data, 2011

CONCLUSION AND RECOMMENDATION

The study established the adoption level of the improved cassava varieties with cross sectional data collected among 350 cassava farmers in the Sekyere South District of the Ashanti Region of Ghana in December, 2010. Three improved cassava varieties were introduced in the district by Root and Tubers Improvement Marketing Programme (RTIMP) namely: *Bankye Hemaa*, *Esam Bankye* and *Bankye Afisiafi*. Amongst the 350 cassava farmers sampled, 15 percent adopted the improved cassava varieties while 85 percent are non adopters. It is observed that crucial factors such as age squared, marital status, education, credit access, farmer based organization, extension contact and household size were shown by the probit estimates to be the important variables that affect the adoption of improved cassava varieties.

The study showed that in order to enhance adoption of improved cassava varieties, extension services should be intensified, farmers should form or join farmer based organizations; farmers should also register with the credit union in the district to have access to credit. Policy makers and crop breeders should come out with varieties that best suit farmers' objectives as establishment of learning centres (like Agricultural Development centres) in strategic locations. Researchers and extension officers should encourage the broad participation of farmers in

technology development and transfer. Researchers and extension staffs should also evaluate the problems of available technologies with farmers who use them. Furthermore, more extension agents must be recruited to reduce the workload of the few extension officers in the district and motorbikes must be given to the extension officers to enable their visit.

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