Assessing the determinants of adoption of improved cassava varieties among farmers in the Ashanti Region of Ghana

E. DONKOR & V. OWUSU*
Department of Agricultural Economics, Agribusiness and Extension,
Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
**Corresponding author's email: vowusu.agric@knust.edu.gh*

ABSTRACT

The study examined the adoption of improved cassava varieties among 350 cassava farmers in the Sekyere South District of Ashanti Region of Ghana. The improved cassava varieties introduced into the district were 'Bankye Hemaa', 'Bankye Esam' and 'Bankye Afisiafi'. Among the respondents, 15 per cent have adopted at least one of the improved cassava varieties and 85 per cent were non adopters. The determinants of adoption and number of improved cassava varieties adopted by the farmers were analysed with the Probit and Tobit model. The results of the Probit model showed that extension services, access to credit, education, marital status, farmer based organization, and household size have significant positive effect on the probability of farmers to adopt improved cassava varieties. The Tobit estimates indicated that farmer based organization, household size, farm size, and extension contact positively influence the number of improved cassava varieties that farmers adopt. Age had negative influence on number of improved cassava varieties adopted. 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.

Original sciencitic paper. Received 01 Nov 11; revised 29 May 12.

Introduction

Cassava (*Manihot esculenta*) is emerging as a dominant staple food 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 per cent of GDP and employs a large proportion of the population. Ghana's production of cassava is estimated to be over 12 million tonnes per annum (SRID, 2009). The greatest agricultural production emanates from root and tuber crops including cassava, yams and cocoyam, contributing about 46 per cent to the agricultural GDP, and nearly 76 per cent of total major crop production.

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 in Africa, and 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, whilst 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 realisation that millions of people still lack reliable access to sufficient quantities of food. This realisation has caused increased attention to be directed towards technology development (Morris & 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, the extent of adoption is actually the most critical criterion in the adoption process (Adesina & Baidu-Forson, 2008).

Cassava has a lot of potentials which can improve the 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*., 2006). 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 slow. The adoption rate of improved cassava varieties in the southern part of Ghana has been proved to be 9 per cent. The adoption intensity which was measured in terms of the area under cultivation of the improved varieties was 37 per cent in the 2001 crop season (Dankyi & Agyekum, 2007). This is evidence that adoption of agricultural technology is actually a problem in the country, and this hinders the growth of agricultural development and productivity.

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). 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 per cent. According to WAAP (2009), it is due more to expansion of area under cultivation which increased by 45.8 per cent from 592,000 ha 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 t ha^{-1} and in 2008, it was 12.8 t ha^{-1}.

In 2009, 6770 ha of land was under the cultivation of cassava in the district with an average yield potential of 12.00 t ha^{-1}. About 81,240 t of cassava was produced from the 6,770 ha of land in the district in 2009 (SRID, 2009). If the improved cassava had been planted by farmers, 3,508,260 t of cassava roots should have been obtained from the 6,770 ha of land. Farmers obtain average yield of 12 t ha^{-1} from cassava production, but the improved cassava varieties have average yield potential of 30 t ha^{-1} (SRID, 2009).

As a result of the low productivity of cassava production in the country, Sekyere

South District was chosen among some other districts in the country to benefit from the root and tuber improvement and marketing programme (RTIMP), which was a follow up project of root and tuber improvement programme (RTIP) to be implemented over a period of 8 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. Although farmers were aware of the improved varieties, they were not growing them (RTIMP, 2008).

The objective of the study, therefore, was to examine the 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. Supplementary objectives include determining the factors that influence farmers' decision to adopt the improved cassava varieties, and factors that influence the number of improved cassava varieties adopted.

Materials and methods

Data type, source and sampling

The study population comprised all cassava farmers in the Sekyere South District. Among the 26 districts in the Ashanti 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 randomly selected, whereby each operational area was coded with a number ranging from 1-13. The numbers were written on pieces of paper, folded and put together in a container which was shaken properly. Five of these pieces of paper were randomly picked. The selected communities were Tano Odumase, Kona, Agona East, Agona West, and Jamasi. About 350 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, and it is also an appropriate way by which each cassava farmer in the district could have an equal chance of selection. It also gives an accurate generalisation 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 characteristics such as age, educational level, marital status, farmer based organisation, credit access, household size, children above 15 years, ethnicity and religion of the farmers in the area. Age was computed in years and age squared was divided by 100 because the coefficient becomes infinitesimal when using age square but when divided by 100, it becomes large. Respondents' educational level was 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 on 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 gathered with the questionnaire. Secondary data collected for the study were basically from the KNUST Library, Faculty of Agriculture Library, MoFA – Sekyere South District and on the Internet.

Empirical model

It is assumed that for a farmer to make decision on whether or not to adopt the improved cassava varieties, he examines the benefit obtained from the adoption $[C_A]$ and benefit derived from non-adoption $[C_N]$. A farmer is likely to adopt a new technology if the utility derived from adoption is greater than the expected utility from non-adoption $[C_N]$, that is, if $[C_A] > [C_N]$. The specifications of the Probit and Tobit model used in the analysis of data are provided below.

Probit model

To model the adoption of improved cassava varieties, following Kavia, Mushongi & Sonda (2007), the equation was specified as:

$$ADC = \beta_0 + \beta_2 (EL) + \beta_2 (AGE) + \beta_3 (AGE^2) + \beta_4 (CA) + \beta_5 (FBO) + \beta_6 (GE) + \beta_7 (EC) + \beta_8 (HS) + \beta_9 (MS) + \beta_{10} (FL) + \beta_{11} (FS) + \mu_i \quad (1)$$

ADC = Adoption of improved cassava varieties (ADC = 1 if farmer adopts the improved cassava varieties, ADC = 0 if otherwise).

EL = Educational level of farmers (number of years of formal education)

AGE = Age of the farmer (years)

AGE^2= Age squared divided by 100 (years)

CA = Credit access (1 if farmer acessed credit in 2010 and 0 if otherwise)

FBO = Farmer based organization (1 if farmer is a member of a farmer based organization and 0 otherwise)

GE = Gender (1 if farmer is male and 0 female)

EC = Extension contact (1 if farmer received extension service in 2010 and 0 otherwise)

HS = Household size (number of people in the household)

MS = Marital status (1 if a famer is married and 0 otherwise)

FL = Family labour (1 if family labour and 0 otherwise)

FS = Farm size (hectares)

$\beta_1, \beta_2, \beta_3, ... \beta_{11}$ = Coefficients of the variables

μ_i = Standard errors capturing all factors unknown to the researcher

Empirically, the Tobit model is specified as:

$$ADC = \beta_0 + \beta_2 (EL) + \beta_2 (AGE) + \beta_3 (AGE^2) + \beta_4 (CA) + \beta_5 (FBO) + \beta_6 (GE) + \beta_7 (EC) + \beta_8 (HS) + \beta_9 (MS) + \beta_{10} (FL) + \beta_{11} (FS) + \varepsilon_i \quad (2)$$

NIA = Number of improved varieties adopted

EL = Educational level of farmers (number of years of formal education)
AGE = Age of the farmer (years)
AG = Age squared (in years) divided by 100
CA = Credit access (1 if farmer accessed credit in 2010 and 0 if otherwise)
FBO = Farmer based organization (1 if farmer is a member of a farmer based organization and 0 if otherwise)
GE = Gender (1 if farmer is male and 0 female)
EC = Extension contact (1 if farmer received extension service in 2010 and 0 otherwise)
HS = Household size (number of people in the household)
FS = Farm size (hectares)
β_0 = Constant term and $\beta_1, \beta_2, \beta_3, ... \beta_9$ denote the coefficients of the variables
ε_i = Standard errors capturing all factors unknown to the researcher

Results and discussion

The level of adoption of the improved cassava varieties by the farmers sampled are shown in Table 1. It can be seen that the majority of the adopters (25%) were from Tano Odumase, probably because of the predominance of gari processing activities in the community. The cassava farmers in the community tend to produce cassava to feed the cassava processing factory located there. About 62.27 per cent of the adopters cultivate 'Bankye Hemaa' because of its higher yield, suitability for consumption and gari processing. About 22.64 per cent cultivate 'Bankye Afisiafi' probably due to the availability of planting materials in the area. Only 3.77 per cent of adopters were growing 'Bankye Esam' probably due to unavailability of planting materials. To reduce risk of adopting only one variety, some farmers decided to adopt two varieties. For instance about 9.43 per cent of cassava farmers had adopted 'Bankye Hemaa' and 'Bankye Afisiafi' whilst about 1.89 per cent adopted 'Bankye Afisiafi' and 'Bankye Esam' (Table 2).

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%)

Table 2

Summary Statistics of Number of Improved Varieties Adopted

Varieties	*Frequency*	*Per cent*
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

Amongst the sampled farmers who were aware but were not growing the improved cassava varieties, almost 52.88 per cent gave the reason that the planting materials given by Ministry of Food and Agriculture (MoFA) were inadequate, which prevented them from adopting the improved cassava varieties. Furthermore, 26.18 per cent were of the view that the improved cassava varieties were unsuitable for preparing 'fufu' because of the high moisture content. Similarly, some (13.06%) complained that the varieties contain too much starch, especially 'Bankye Afisiafi' and are not suitable for 'ampesi'. Again, inadequate information about the improved cassava varieties discouraged some farmers (5.23%) from adoption (Table 3).

Sources of planting materials

The adopters gave various sources of planting materials for cassava cultivation. As indicated in the Table 4, 82.02 per cent obtain their planting materials from the MoFA office in the district. Only 5.66 per cent specified that they purchased their planting materials from Mamponteng Research Centre. The finding is contrary to the study by Twum-Barima (2005) and Bekor (2011), who found that most farmers obtain improved cassava planting materials from friends and relatives.

Table 3

Reasons for non Adoption of Improved Cassava Varieties

Reasons	*Frequency*	*Per cent*
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

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 explains 88 per cent of the variations in the explanatory variables in predicting the adoption of improved cassava varieties. 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.

Table 4

Source of Planting Materials

Sources	*Frequency*	*Per cent*
MoFA	44	83.02
Friends	5	9.43
Relatives	1	1.89
Others	3	5.66

Age squared is positively related to adoption of improved cassava varieties and is significant at the 10.0 per cent level. This implies that as a farmer advances in age, the likelihood of adopting improved cassava varieties decreases but up to 100 years. The marginal effect is 0.00613. This suggests that the likelihood to adopt improved cassava varieties increases by the 0.613 per cent. At 100 years, the farmer would not be able to cultivate large acres of land but wishes maximum cassava output so, therefore, resort to the new varieties to obtain high yield. The coefficient of marital status is significant at the 10 per cent 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

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
Credit access	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^2		0.88	
Log-likelihood function		-17.3801	
Number of observation			

*, **, *** Significant at 10 per cent, 5 per cent and 1 per cent, respectively.

likelihood of adoption of improved cassava varieties increases by 2.76 per cent. The empirical finding, however, runs counter to a study by Amao & 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 5 per cent 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 is 0.0239 implying that each year of schooling increases the probability of adoption by 2.39 per cent. 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 utilise information relevant to technology. The empirical result is consistent with a study by Agyemang (2008), who found a positive significant relationship between education and probability to adopt improved technologies for maize production. Empirical evidence provided by Kudi *et al*. (2011) on adoption of maize varieties in Kwara State of Nigeria also gave similar result.

Access to credit also has a positive coefficient and is significant at 10.0 per cent level. This indicates that adoption of improved cassava varieties increases as farmers' access to credit increases. That is, they are likely to have adequate capital for the procurement of inputs such as improved cassava planting materials, agrochemicals and payment for labour required in the use of the new technology. Hence, the level of adoption of improved cassava varieties increases as farmers have access to credit. These findings are in line with that of Lawal *et al.* (2004). The marginal effect is 0.0224 implying that farmers' access to credit increases the probability of adoption by 2.24 per cent. The empirical finding contradicts result by Omonona, Oni & Uwagboe (2006), 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 access to credit is positively related to the probability to adopt improved maize varieties in Kwara State of Nigeria.

The coefficient of farmer based organisation is significant at 1.0 per cent 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 organisation significantly increases the likelihood of adopting the improved cassava varieties by 4.79 per cent. The empirical result contrasts the finding of Kuunyem (2000), who indicated that farmer-based organisation had no significant relationship with the likelihood to adopt agricultural technologies in Nandom district of Ghana.

The coefficient representing household size is significant at 1 per cent, and positively related to the likelihood to adopt improved cassava varieties. This suggests that large household size increases the probability to adopt improved cassava varieties. The marginal effect is 0.0103, indicating that as farmer household size increases, the probability to adopt improved cassava varieties also increases by 1.03 per cent. Large households provide family labour required for the cultivation of improved cassava varieties. The empirical result contradicts the findings of Omonona, Oni & Uwagboe (2006), who stated that household size is not a significant factor in adoption of technology. Similarly, the empirical finding disagrees with the results of Amao & Awoyemi (2009), who also stated that household size had negative influence on adoption of improved cassava varieties.

The extension contact variable is significant at 5 per cent 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 & Kahn (2005). 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 per cent. This empirical result is consistent with a study by Agyeman (2008), who found a positive relationship between extension contact and the probability to adopt improved technologies in maize production. 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 show a positive relationship with the probability to adopt improved cassava varieties. The coefficients of age and family labour have negative sign.

Extent of adoption of improved cassava varieties

The results of the Tobit estimates on the number of improved cassava varieties adopted are shown in Table 6. The maximum likelihood estimates showed a pseudo R^2 of 0.7030, which implies that the model explains 70 per cent of the variations in the explanatory variables in predicting the adoption of improved cassava varieties. The age of the farmer, farmer based organization, household size, farm size, and extension

Table 6

Tobit Estimates on the Extent of Improved Cassava Varieties Adopted

Variable	*Marginal effects*	*t-values*
Age	-0.0439***	0.000
Age^2 /100	0.0081	0.464
Gender	0.0045	0.974
Education	0.0261	0.216
Creditaccess	0.2051	0.220
FBO	0.4690**	0.040
HHS	0.0809***	0.000
Farm size	0.1076***	0.000
Extension contact	0.1081***	0.000
Pseudo R^2	0.7030	
Log likelihood function	-60.2863	
Number of observations	350	

*, **, *** Significant at 10 per cent, 5 per cent and 1 per cent, respectively.

have significant influence on the probability to increase the number of improved cassava varieties adopted by farmers.

The coefficient of age is significant at 1 per cent level and has the expected negative sign. This suggests that as farmer advances in age, the risk aversion increases, and the likelihood to increase the number of improved varieties adopted becomes less. The marginal effect is -0.0439, implying a year increase in farmer's age causes a reduction in the number of improved varieties adopted by 4.39 per cent. The empirical result contradicts the findings of Kavia, Mushongi & Sonda (2007), who indicated that age did not have any relationship with number of improved varieties adopted in Lake Zone-Tanzania. Farmer based organization variable is significant at 5 per cent level and has a positive relationship with number of improved cassava varieties adopted. The marginal effect is 0.4690, which implies that membership in a farmer based organization increases the likelihood to increase the number of improved varieties adopted by 46.90 per cent. Extension agents use farmer based organization to demonstrate technologies to farmers (Katungi & Akankwasa, 2010).

The coefficient representing household size is significant at 1 per cent and positively related to the number of improved varieties adopted. This implies that as household size increases there is a probability that the farmer increases the number of improved cassava varieties adopted. The marginal effect is 0.0809, suggesting that an increase in farmer's household size increases the number of improved varieties adopted by 8.09 per cent. Farm size variable is found to be significant at 1 per cent level and has the expected positive sign. It is observed that the number of improved varieties adopted by the farmer increases with an increase in farm size. The marginal effect is 0.1076, which suggests that a hectare increase in farm size by cassava farmer increases the number of improved varieties adopted by 10.76 per cent. This empirical result is contrary to the findings of Kavia, Mushongi & Sonda (2007), who indicated that farm size did not have any relationship with number of improved varieties adopted in Lake Zone-Tanzania.

The coefficient of extension contact is significant at 1 per cent and has a positive relationship with the number of improved varieties adopted. The marginal effect is 1.0812, which suggests that farmers who receive extension service concerning improved cassava varieties are most likely to increase the number of improved varieties adopted by 10.81 per cent more than the farmers who receive no extension services.

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 (RT-IMP), namely 'Bankye Hemaa', 'Bankye Esam' and 'Bankye Afisiafi'. Amongst the 350 cassava farmers sampled, 15 per cent have adopted the improved cassava varieties whilst 85 per cent are non adopters. It was 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. Similarly, household size, farm size, extension contact, and age were the significant factors that influence the number of improved cassava varieties adopted.

The study showed that in order to enhance adoption of improved cassava varieties, extension services should be intensified, farmers should join farmer-based organizations and register with the Credit Unions 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. Extension services to farmers should be intensified.

REFERENCES

Adesina, A. A. & **Baidu-Forson, J.** (2008) Farmer's perceptions and adoption of new agricultural technology: Evidence from analysis in Burkina Faso and Guinea. *West Africa Agricultural Economics* **13**, 1 – 9.

Agyeman, K. (2008) *Adoption of improved technologies in maize production. A case of Akuapem North District* (BSc Dissertation). Department of Agricultural Economics, Agribusiness and Extension, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Amao, J. O. & **Awoyemi, T. T.** (2008) Adoption of improved cassava varieties and its welfare effect on producing households in Osogbo Adp Zone of Osun State. *Gene Conserv.* **29**, 520 – 542.

Bekor, G. F. (2011) *Farmers field for and the adoption of improved cassava technologies: A case study of RTIMP in the Mampong Municipality* (BSc Dissertation). Department of Agricultural Economics, Agribusiness and Extension, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Caviglia, J. L. & **J. R. Kahn.** (2005) Diffusion of sustainable agriculture in the Brazilian rain forest: A discrete choice analysis. *Economic Development and Cultural Change* **49**, 311 – 33.

Dankyi, A. A. & **Adjekum, A. A.** (2007) Determinants of the adoption of improved cassava varieties in southern Ghana - logistic regression analysis. *Proceedings of the 13th ISTRC Symposium*, pp. 641 – 647.

Derkyi, N. S. A., Sekyere, D., Darkwa, N. A & **Yartey, J. G.** (2008) Effect of cassava flour as urea-formaldehyde adhesive extender on the boding strength of plywood. *Ghana Journal of Forestry* **23** (24), 25 – 34.

EIU (2007) *Country Profile: Ghana*. Economic Intelligent Unit, London.

FAOSTAT (2007) Food security statistic database, the food production-distribution chain. *Agriculture and Rural Development* **9** (1), 12

– 16.

Hendershot, C. H. (2004) *A literature review and research recommendations on cassava* (*Manihot esculenta*, Crantz) (PhD Thesis). University of Georgia, Athens, Georgia, USA,

Katungi, E. (2007) *Social capital and technology adoption on small farms: The case of banana production technology in Uganda* (PhD Thesis). University of Pretoria, Pretoria.

Kavia, F. Y., Mushongi, C. C. & **Sonda, G. B.** (2007) Factors affecting adoption of cassava varieties: A case of cassava mosaic disease tolerant varieties in Lake Zone Regions – Tanzania. *African Crop Science Conference Proceedings* **8** (187), 51 – 87.

Kormawa, P., Tshiunza, M., Dixon, A., Udoh, E. & **Okoruwa, V.** (2001) Varietal characteristics of cassava: Farmers' perceptions and preferences in semi-arid zone of West Africa. *Proceedings of the 8th Triennial Symposium of International Society of Root and Tuber Crops-African Branch held in Ghana, 12-16 November 2001.*

Kudi, T. M., Bolaji, M., Akinola, M. O. & **Nasa, I. D. H.** (2011) Analysis of adoption of improved maize varieties among farmers in Kwara State, Nigeria. *International Journal of Peace and Development Studies* **1** (3), 8 – 12.

Kuunyem, Y. M. (2000) *Socioeconomic factors affecting adoption of introduced agricultural technologies in the Nandom area* (BSc Dissertation). Department of Agricultural Economics, Agribusiness and Extension. Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Tweneboah, C. K. (2000) Modern agriculture in the tropics with reference to Ghana. *Food crops.* **5**, 25 – 35.

Lawal, B. O., Saka, J. O., Oyegbani, A. & **Akintayo, J. O**. (2004) Adoption and performance assessment of improved maize varieties among small-holder farmers in southwest Nigeria. *Journal of Agricultural Food Information*, **6**(1), 35 – 47.

McDonald, J. F. & **Moffit, R. A.** (1980) The uses of Tobit analysis. *Review Economics and Statistic* **62**, 318 – 321.

RTIMP (2008) New cassava varieties for southern Ghana. *Handbook on cassava*. MoFA, Accra, Ghana.

MoFA (2008) *Rural Livelihood in Ghana. Baseline and sector indicators at the beginning of FASDEP II. Ministry of Food and Agriculture.* **2**, 73 – 80.

Moses, E. (2008) Identification of cassava diseases. *Cassava Production Guide* **1**, 5 – 7.

Omonona, B. T., Oni, O. A. & **Uwagboe, A. N .O.** (2003) Adoption of improved cassava varieties and its welfare impact on rural farming households in Edo State, Nigeria. *Journal of Agricultural and Food Information* **61**, 25 – 36.

PPMED (2007) *Production estimates for some major crops in Ghana*. Policy, Planning, Monitoring and Evaluation. Ministry of Food and Agriculture, Accra, Ghana.

RoG (2007) *Food and agriculture sector development policy (FASDEP II)*, Ministry of Food and Agriculture, Republic of Ghana, Accra, Ghana.

RTIP (2004) *Cassava processing in Ghana*. Root and Tuber Improvement Programme, MoFA, Accra, Ghana.

SRID (2009) *Statistics, Research and Information Directorate*. Ministry of Food and Agriculture, Accra, Ghana.

Twum-Barima, A. (2005) *Adoption of improved planting materials of cassava by cassava farmers in the Wenchi District, Ghana* (BSc Dissertation). Department of Agricultural Economics, Agribusiness and Extension. Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. .

WAAPP (2009). *Baseline Survey Report, Ghana.* West African Agricultural Productivity Programme, Ghana.