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Does Awareness influence Adoption of agricultural technologies? The case of Improved Sweet potato varieties in Ghana

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Abstract

The Government of Ghana together with donor agencies has in many years paid attention to the agricultural sector with special emphasis on staple crops especially root and tuber crops. Sweetpotato has particularly received a lot of research funding over many years to develop many varieties which have been disseminated. However, many farmers still depend on traditional varieties. The aim of the study was to determine the role of awareness in adoption of improved sweetpotato varieties. By using a cross- sectional data collected from 526 farmers and employing binary logit model, an analysis of factors influencing adoption of improved sweetpotato varieties adoption was evaluated. The results revealed that sixty five percent of farmers had adopted improved sweetpotato varieties. Eighty five percent of farmers were aware of the improved sweetpotato varieties. Empirical results revealed that apart from the standard farm and farmer characteristics and institutional factors that influenced adoption, awareness positively and significantly influenced adoption of improved sweetpotato varieties. Awareness creation and education of the improved varieties will encourage adoption. Government and donor agencies should support the extension services in terms of resources to conduct more demonstrations to

create awareness. Furthermore media could be engaged to support dissemination of improved varieties.

Key words: Dissemination, education, extension service, farmers, research,

1.0 Introduction

Worldwide, sweetpotato is the seventh most important food crop in terms of production (Loebenstein, 2009). It is grown on about 8.2 million hectares of land producing about 133 million tons (Waramboi et al., 2011) with 12.1 tons/ha as average yields (FAOSTAT, 2016). In Ghana the crop is the fourth most important root and tuber crop after cassava, yam and cocoyam in terms of production and occupies 96000 hectares of farmland (MoFA, 2016). It is an important food security crop for rural household and has a high yield potential that may be realized within a relatively short growing season. The crop is ideal for smallholder farmers due to its low-input requirement. Sweetpotato is well known as contributing to nutrition thus prompting support around the world. With increasing awareness of its nutritional value and the increasing population, demand is expected to increase significantly. This calls for increased production potential for domestic consumption and consequent marketing opportunities.

The crop is adaptable in many environments and it is mainly cultivated in the Guinea savannah, Coastal savannah and Forest Transition ecological zones of Ghana. Major Regions of cultivation include Central, Greater Accra, Volta, Eastern, Northern, and Upper East. Sweetpotato is grown by smallholders and it is produced for home consumption and for sale. The preparation for consumption in most families in Ghana involves boiling, roasting and deep-frying of the roots. The leaves are eaten as a green vegetable in some producing areas in the Northern part of the country. Sweetpotato is rich in complex carbohydrates, dietary fiber, beta carotene, vitamins A, B6 and C. (Kenyon *et al.*, 2006).

Against this background, the Government of Ghana together with donor agencies have in many years paid attention to the agricultural sector with special emphasis on staple crops especially root and tuber crops. Since 1998 sweetpotato in particular has received some more attention due to its nutritional values for both humans and animals. Several improved sweetpotato varieties and agronomic technologies to increase productivity have been developed. However the national average fresh root yield is 11.5metric tons (MT) per hectare compared to potential yields of 25 t/ha (MoFA, 2016). Several reasons have been attributed to low productivity in crop production in Ghana and those normally mentioned includes poor soil conditions, low and poor distribution of rainfall, diseases and pests, lack of improved planting materials and seed. There is also low adoption of existing technologies due to poor market incentives and inaccessibility to relevant inputs. Lack of appropriate technologies for processing, transporting, handling and storage of produce, and limited knowledge in post-harvest management, particularly of perishable produce have resulted in high post-harvest losses (MoFA, 2010). Literature is replete of factors that determine agricultural technology adoption (Katungi and Akankwasa, 2010; Conley and Udry, 2010; Loevinsohn et al., 2012; Adesina and Baidu-Forsen, 1995). Factors normally mentioned are economic including farm size, cost of adoption, access to credit, expected benefits from the adoption and the off-farm income generation activities; social including age of farmers, the level of education and the gender and institutional including extension access and market access. Farmers Awareness of agricultural technologies is least mentioned as limitation to adoption. However, some studies (Kaliba et al., 2000; Shiferaw et al., 2008; Feder and Slade, 1984) have reiterated the importance of awareness in agricultural technology adoption. The innovation diffusion theory assumes that innovations are well developed but the individual's inability to adopt is due to improper communication (Feder and Slade, 1984; Shampine, 1998; Smale *et al.*, 1994). To encourage adoption, the use of extension, experiment station visits, on-farm trials and other means of expression to transmit technical information were emphasized. This study seeks to include farmers' awareness to the farmer characteristics, farm characteristics and institutional characteristics that are known to condition adoption behavior to find out its effect on adoption of improved sweetpotato varieties in Ghana. It is expected that results obtained will contribute to literature on the role of awareness in technology adoption.

2.0 Conceptual framework and empirical model

This study takes the approaches of the innovation-diffusion model to analyze the adoption decisions of farming households. The process consists of a series of choices and actions over time through which an individual evaluates a new idea and decides whether or not to incorporate the idea into an ongoing practice (Feder et al., 1995). The farmer has to become aware of the improved sweetpotato variety and forms attitudes towards it before he can make a decision as to accept or reject it. Adesina and Zinnah (1993) and Rahm and Huffman (1984), find that the farmers decision to adopt new technology is based on the assumption of utility maximization which remains unobserved. Based on the unobserved nature of farmers utility three models have been frequently used to analyze technology adoption; linear probability, logistic function and the normal density (logit) function. These models use binary choice variable as the dependent variable. Linear probability models assume the response variable to be continuous in nature and assumes normal distribution of the error term, constant variance which are not appropriate in cases where the response variables are dichotomous (Hosmer and Lemeshow, 2000). Since the response variable in this study is dichotomous (adoption verses non-adoption), the logistic regression is used. Logistic model overcomes the problems associated with linear probability models and provides parameter estimates that are asymptotically consistent and computationally easier to use (Pindyck and Rubinfeld, 1981).

The probability, P_i, of a farmer adopting an improved sweetpotato variety is given by:

$$P_i = \frac{\exp^{Z_i}}{1+\exp^{Z_i}} \qquad (1)$$

where Z_i is a random variable (the stimulus index) that predicts the probability of the ith farmer adopting sweetpotato variety.

$$Z_i = In\frac{P_i}{1-P_i} = \beta_0 + \sum_{n=1}^{n} \beta_n X_{ji} \qquad (2)$$

where β is an unknown parameter, X is the identified factor contributing to the decision to adopt. The specific empirical model for the determination of factors influencing adoption is given as:

$$Y_i = \beta_0 + \beta_1 sex + \beta_2 Age + \beta_3 edu + \beta_4 association + \beta_5 Fsize + \beta_6 HHsize + \beta_7 awareness + \beta_8 dis\tan ce + \beta_9 extaccess + \beta_{10} extvisit + \beta_{11} plotowner + \varepsilon_i \quad (3)$$

3.0 Methods

3.1 Study area

The study was conducted in all sweetpotato growing regions in Ghana. They consisted of Brong Ahafo, Eastern, Central and Volta, Upper east and the Upper West regions of Ghana. Twenty three districts were selected throughout the country. The regions and the districts selected fall within four major agro ecological (Forest, Coastal savannah, Forest-Transition and Guinea Savannah) zones of Ghana. Figure 1 shows the map of the study area.

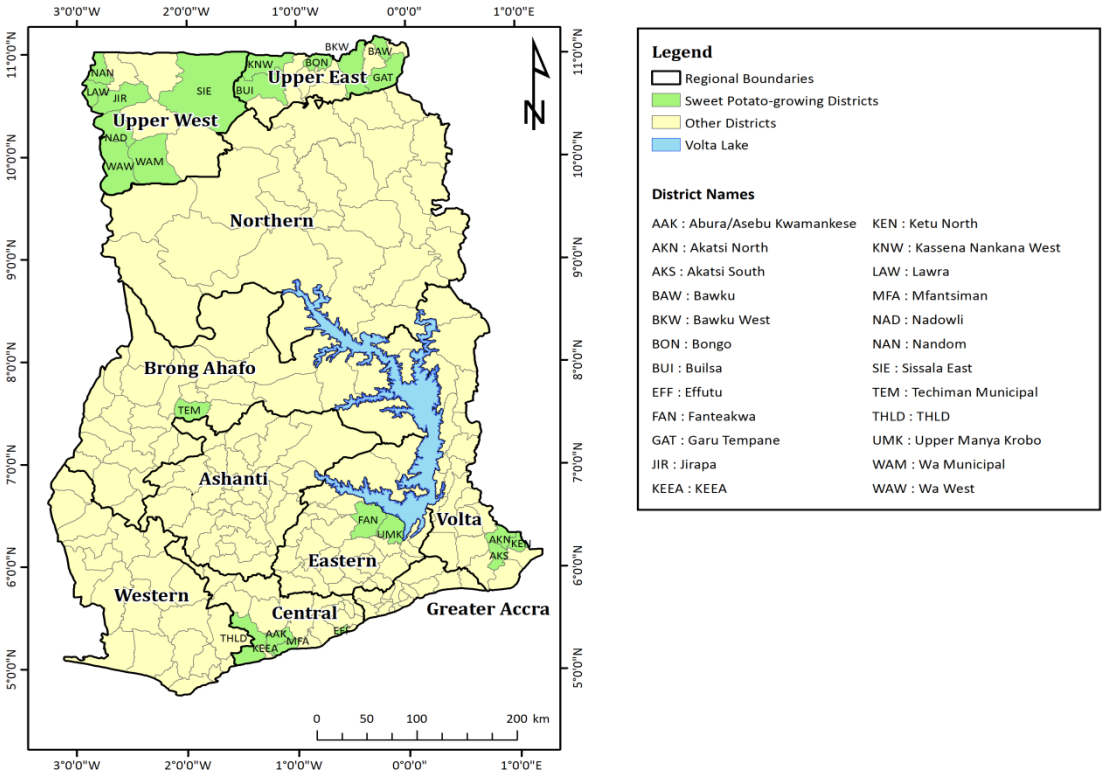

Figure 1. Map of the study area

3.2 Data Sampling, data collection and analysis

We employed Multistage sampling technique to sample the population for the study. Both purposive and random sampling techniques were used. Regions were purposively sampled, districts were purposively selected and communities were randomly selected. The sampling units (farmers) were also randomly selected. A total of 92 communities across the country were visited and 526 farmers nationwide were selected for this study.

Structured questionnaires were used to collect the data. Enumerators were trained and questionnaires pretested before actual survey was carried out. Both descriptive and inferential analyses were conducted. Data analysis was carried out with STATA 14 software.

4.0 Results and discussion

4.1 Farmers Demographic Structure

Females constituted 16% of sweetpotato farmers interviewed across Ghana (Table 1). The Coastal savannah ecological zone had the highest (33%) proportion of female farmers followed by the Forest ecological zone (26%), with the Guinea Savannah recording the least (4%). Generally, most of the farmers interviewed were married (90%), few were single (7%), and a very few, divorced (2%) or widowed (1%). Majority (about 90%) of the sweetpotato farmers were natives except for the Forest-Transition zone where majority of farmers (81-98%) were natives. Forty – seven percent of all the interviewed farmers had not attained any form of formal education, 32% had attained formal education up to the Junior High School level, 18% attained Senior High School level education, and about 3% had tertiary(university and other tertiary) level education. The Transition zone recorded the highest proportion (70%) of farmers that had no formal education, followed by the Guinea Savannah zone (56%), the Coastal savannah zone (35%), and then the Forest ecological zone (26%). None of the farmers of the Transition zone attained SHS or tertiary education. The Forest ecological zone had the highest proportion of farmers who had attained SHS or tertiary level

education, followed by the Coastal savannah, and then the Guinea Savannah agro-ecological zones (Table 1). The average age of sweetpotato farmer across all ecological zones was 45 years. While the Transition zone had older (51 years) farmers on the average, farmers of the Forest transition zones were averagely younger (41%). Average age of farmers from the Coastal savannah and Guinea savannah zones was 44 and 46 years respectively. An average household size of 8 members was recorded across the country. Farmers in the Guinea Savannah zone had the largest of 10 members in a household Farmers in the Transition zone had the least (6 members) number of members in a household. On the average, farmers across the country had cropped sweetpotato for at least 25 years. Farmers in the Guinea Savannah had more years (27 years) of experience in cultivating sweetpotato than farmers from the other agro-ecological zones.

Table 1. Socio-demographics characteristics of sweetpotato farmers by agro-ecology

Variable	Forest (N=35)	Transition (N=10)	Coastal savannah (N=199	Guinea savannah (N=282)	Pooled (N=526)
Gender (% of farmers)					
Male	74.29	90.00	67.34	96.45	83.84
Female	25.71	10.00	32.66	3.55	16.16
Marital status (% of farmer)					
Single	14.29	0.00	5.53	7.09	6.84
Married	77.14	90.00	88.94	91.84	89.73
Divorced	8.57	10.00	3.02	0.71	2.08
Widowed	0.00	000	2.51	0.35	1.33
Residential status (% of farmer)					
Native	82.86	40.00	80.90	98.23	89.54
Settler	17.14	60.00	19.10	1.77	10.46
Level of education (% of farmer)					
None	25.71	70.00	35.18	56.38	46.58
JHS	40.00	30.00	38.19	27.30	32.32
SHS	28.57	0.00	24.12	13.48	18.25
Tertiary (Excluding universities)	5.71	0.00	1.00	2.13	1.90
University	0.00	0.00	1.51	0.71	0.95
Other household characteristics (Mean)					
Age (years)	40.54	50.70	44.79	46.40	45.48

Household size	6.62	5.80	7.05	9.45	8.32
Experience	19.25	25.3	22.15	26.92	24.58
Education	7.57	3.22	6.98	3.31	4.99

Source; Survey Data 2016

4.2 Awareness and Adoption of improved sweetpotato varieties

Results revealed that majority (84.6%) of farmers across all ecological zones of Ghana were aware of the improved sweetpotato varieties (Figure 2). The Coastal savannah zone recorded the highest level of awareness of 95%, followed by farmers in the Transition zone with 90% awareness level. Farmers in the Guinea Savannah zone had the least level (77%) of awareness of sweetpotato improved varieties.

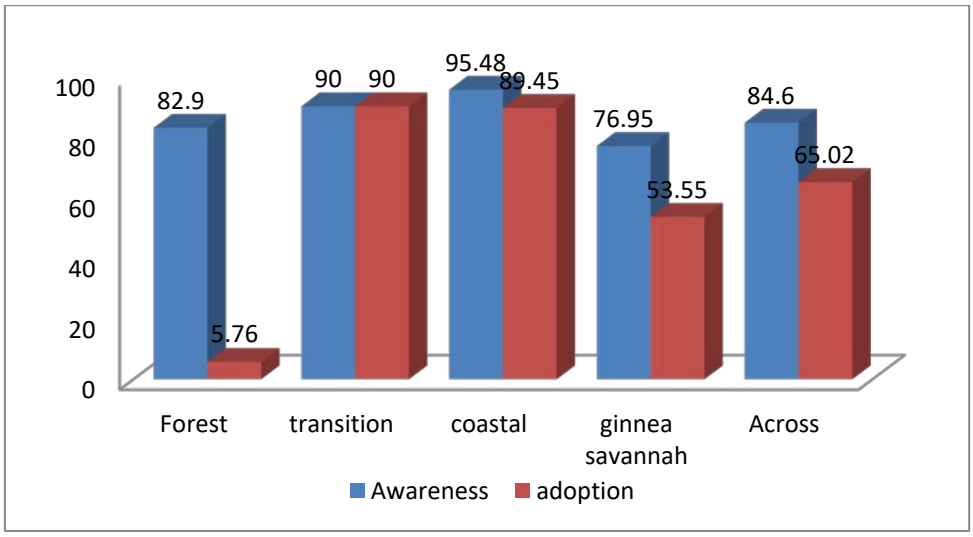

Figure 2: Awareness and adoption of improved sweetpotato varieties

On adoption of improved varieties, 65% of farmers across the study area had adopted improved sweetpotato varieties. Majority (89%) of farmers in the Coastal savannah had adopted the improved varieties. The Transition zone had 90% of farmers growing the improved varieties. Though, most (83%) sweetpotato farmers in the Forest ecological zone were aware of the improved sweetpotato varieties, only a few (6%) farmers cultivated the improved varieties. This result is very encouraging

and pointing to increased dissemination of improved sweetpotato technologies through awareness craetion.

4.3 Adoption of improved sweetpotato varieties

Fourteen new varieties have been released by CSIR-CRI since 1998 and they have all been promoted for adoption. The study sought to find out about those varieties that were widespread among farmers. It was revealed that *Sauti, Faara, Apomuden* and *Santom pona* were well known by farmers across Ghana (Table 2).*Sauti, Santom pona*, *Faara*, *Apomuden* and *Ogyefo* varieties were well known in the Coastal and Guinea Savannah ecological zones. *Sauti* and *Santom Pona* (released in 1998) were well known in the Transition zone, and *Sauti* and *Apomuden* were somehow known in the Forest zone. The newest varieties (released in 2012) namely *Patron, Bohye, Ligri* and *Dadanyuie* seemed not to be adopted much by farmers. With their superior qualities, increased awareness and education may help increase their adoption. Some farmers (8%) could not give the names of the improved varieties they planted, and they referred to them as *Agric/MoFA* varieties. The fact that some farmers did not know the names of the varieties they were growing suggests some weaknesses in the dissemination process. Either the extension agents responsible for dissemination did not know the varieties or farmers got varieties from other farmers who did not know the varieties themselves.

Table 2. Adoption of improved sweetpotato varieties by agro-ecological zone

Improved variety	**Forest (N=35)**	**Transition (N=10)**	**Coastal savannah (N=199)**	**Guinea savannah (N=282)**	**All zones (N=526)**
Sauti	2.86	20.00	19.60	15.96	17.02
Santom pona	0.00	10.00	22.61	1.42	9.61
Faara	0.00	50.00	17.09	9.57	12.84
Apomuden	2.86	10.00	25.13	5.32	13.03
Ogyefo	0.00	0.00	3.02	1.06	2.00

Patron	0.00	0.00	0.50	0.50	0.48
Okumkom	0.00	0.00	0.00	1.42	1.05
Dadanyuie	0.00	0.00	0.00	0.71	0.67
Agric/MoFA[1]	**0.00**	0.00	1.51	13.83	8.27
Improved varieties	**5.72**	**90**	**89.46**	**49.79**	**64.93**

Source; survey data 2016

The most popular regions of sweetpotato production were Upper East, Volta, Central and Upper West (Table 3). In the Upper East region the most popular improved varieties were *Agric/MOFA* varieties and they were cultivated by 20% of farmers. *Sauti* and *Faara* were cultivated by 14% and about 12% of farmers from the Upper east region. *Santom pona* and *Apomuden* were grown by about 33% and about 29% of farmers respectively from the Volta region. Central region had most (31%) farmers growing *Faara.* Therefore depending on the region a particular variety was common.

Table 3. Adoption of improved sweetpotato varieties by region

	Brong Ahafo (N=9)	**Central (N=98)**	**Eastern (N=35)**	**Northern (N=17)**	**Upper East (N=191)**	**Upper West (N=74)**	**Volta (N=104)**
Sauti	14.29	26.53	2.86	17.65	14.14	20.27	13.46
Santom pona	0.00	12.24	0.00	0.00	1.57	1.35	32.69
Faara	71.73	30.61	0.00	11.76	11.52	4.05	3.85
Apomuden	14.29	20.41	2.86	5.88	3.14	10.81	28.85
Ogyefo	0.00	4.08	0.00	0.00	0.52	2.7	1.92
Patron	0.00	0.00	0.00	0.00	0.00	0.00	0.96
Okumkom	0.00	0.00	0.00	0.00	1.05	2.7	0.00
Dadanyuie	0.00	0.00	0.00	5.88	0.00	2.7	0.00
Agric/MoFA	0.00	3.06	0.00	11.76	19.9	9.46	0.00

[1] Improved varieties that could not be named

Indigenous	85.71	3.06	94.29	47.06	48.17	47.94	18.27

Source; survey data 2016

4.4 Factors influencing adoption of improved sweetpotato varieties

The logit model estimates of the results of the factors influencing adoption of improved varieties are presented in Table 4. The results revealed that age affected adoption positively and significantly at 1% level. The implication is that the probability of adoption is more likely with the older farmers. Older farmers may have gained more experience, resources, and authority providing them with the possibility to experiment with new technologies ((Mignouna et al, 2011) Years of education was found to influence adoption of improved sweetpotato varieties positively and significantly at 1% level. The implication is that it is more likely for those with more years of schooling to adopt the improved varieties. The result is as expected as farmers with more schooling are able to make comparisons of different technologies and make more accurate assessment of differences in their performances, and will make more efficient adoption decisions (Abdulai and Huffman, 2005).

Table 4. Logit estimates of factors influencing adoption of improved varieties

Variable	Coefficient	Std. error
Age	0.017***	0.006
Education in years	0.023***	0.014
Household size	-0.011	0.016
Experience in sweetpotato farming	-0.024***	0.006
Marital status	-0.090	0.186
Membership of association	0.031	0.076
Farm size	0.003	0.009
Awareness	3.038***	0.423
Distance	0.001	0.010
Extension visit	0.014	0.043
Plot owner	0.171	0.171
Gender	-0.294	0.201
Extension	0.180	0.172
Constant	5.486***	1.120

N	526
Pseudo R-squared	0.31
Log likelihood	-226.06***

***significant at 1%

Technology awareness influenced the probability of adoption positively and significantly. Farmers need to know the existence of a technology, its benefits, and its usage for them to adopt it. Technology awareness reduces uncertainty about a technology's performance hence may change individual's assessment from purely subjective to objective over time (Bonabana- Wabbi 2002). Farmers that acquire knowledge about the new technology through extension services or other channels are more likely to adopt the technology (Abdulai and Hufmann, 2005). This further shows the importance of extension services and demonstration plots in the adoption of improved sweetpotato.

5.0 Conclusion and implication

The paper employs logistic model to examine factors influencing adoption of improved sweetpotato varieties. The paper paid attention to awareness in influencing adoption of improved sweetpotato varieties. The results showed that age significantly influenced adoption of improved sweetpotato varieties. It is therefore more probably for older farmers to adopt improved varieties. They may have more farm lands and may be willing to give out part of their land. During dissemination older farmers could be targeted in order to encourage adoption. The results revealed that education affected adoption significantly. The implication is that it is more likely for those with more years of schooling to adopt the improved varieties. Increase in education level of farm household members is assumed to have a significant influence on farm households' decision to adopt new technologies. Investments in rural education in Ghana will provide farmers with ability to obtain process and use information relevant to adoption of improved varieties.

Awareness influenced adoption of improved sweetpotato varieties significantly. The results therefore suggest the importance of awareness in technology adoption. Extension and awareness

creation through various means such as demonstrations, field days have been found to be a key aspect of technology adoption. Technology awareness influenced the probability of adoption positively and significantly. Farmers that acquire knowledge about the new technology through extension services or other channels are more likely to adopt the technology. Awareness creation and education on the improved varieties will encourage adoption. Government and donor agencies should provide funding to support the conduct of more demonstrations and organize more field days to create awareness. Also media such as radio and television could be engaged by government to include programmes on improved agricultural technologies to increase their awareness for increased adoption.

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