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EMPIRICAL ESTIMATES OF ADOPTION OF IMPROVED CASSAVA VARIETIES AMONG FARMERS IN AKWAIBOM STATE

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ABSTRACT
The study is aimed at estimating and explaining the parameters of the adoption process of the disease-resistant new improved cassava varieties, by farmers in Akwa Ibom State. The main purpose for the development of the varieties is to increase the yield of cassava, which is a famine-reserve crop and rural staple food in Nigeria. Like any other innovation, improved cassava varieties must endure a phase of dissemination. Innovators and policy makers need knowledge of the expected rate of adoption. In this study, a conceptual framework was developed for the decision to adopt or not to adopt and econometric analyses of the diffusion process are presented, using Logistic regression model. The study used a multi-stage sampling procedure to select 112 farmers from the sampled 120 for analyses. Important factors enhancing adoption were education, extension contact and access to improved varieties. To increase the rate of adoption in the study area, emphasis should be on the availability of the improved cassava stems to the farmers and provision of free and affordable education to enhance access and processing of innovations for increased adoption.

Keywords: Adoption, Improved Cassava Varieties, and Logit Model

Introduction

There has been much discussion on the need to increase productivity and sustainability in agriculture through adoption of modern agricultural production technologies (Adesina and Baidu, 1995; Akudugu *et al.*, 2012; Chilot *et al.*, 1996; Polson and Spencer, 1992; Nkonya *et al.*, 1997; Beshir *et al.*, 2012 etc). Increasing agricultural productivity is critical to meet expected rising demand and, as such, it is imperative to investigate the factors that influence farmers' decisions on modern technology adoption (Challa, 2013). Agricultural technologies include all kinds of improved techniques and practices which affect the growth of agricultural output (Jain *et al.*,2009). In the opinion of Loevinsohn *et al.*, (2013), the most common areas of technology development and promotion for crops include new varieties and management regimes; soil and soil fertility management; weed and pest management; irrigation and water management. By virtue of improved input/output relationships, new technology tends to raise output and reduce the average cost of production, which in turn, results in substantial gains in income (Challa, 2013). Adoption of improved technologies is believed to be a major factor in the success of the green revolution experienced by Asian countries (Ravallion and Chen, 2004). On the other hand, non-adopters can hardly maintain their marginal livelihood with socio-economic stagnation, leading to deprivation (Jain *et al.*, 2009).

Cassava is an important regional food source for 200 million people-nearly one-third of the population of sub-Saharan Africa. In Nigeria, it is one of the most important food crops. It is the most widely cultivated crop that provides food and income to over 30 million farmers and large numbers of processors and traders (Abdoulaye *et al.*, 2014). However, in Nigeria, Cassava Mosaic Disease (CMD) poses a serious threat (Alabi *et al.*, 2011). The most vulnerable areas are the South-South and South-East states, including the Niger Delta Region (Nweke *et al.*, 2002). Several initiatives were enacted to address the critical threat of a CMD outbreak in Nigeria and West Africa and to revitalize Nigeria's agricultural economy. Among these efforts was that of the International Institute of Tropical Agriculture (IITA) and national partners, which developed and disseminated high yielding and CMD resistant cassava varieties. Between 2002 and 2010, IITA implemented a research for development

(R4D) project called Integrated Cassava Project (ICP), to support the potential initiative (PI) for cassava, launched in 2002, to boost cassava production and processing. Through this project, IITA successfully introduced and promoted cassava varieties through the National Agricultural Research Services (NARS) and Agricultural Development Programs (ADPs) (Abdoulaye *et al.,* 2014). Based on the efforts made so far, there is therefore need to understand whether farmers are aware of the improved cassava varieties. Similarly, what is the adoption status of these technologies? Again, the introduced improved varieties were expected to give higher yields through better varieties with enhanced resistance to biotic stresses. What is the extent of the realization of such yield potentials in farmers' fields?

Quite a large number of studies have investigated the influence of various socio-economic, cultural and political factors on the willingness of farmers to use new technologies (Polson and Spencer, 1992; Adesina and Zinnah, 1993; Akudugu et al., 2012 etc). In many of the adoption behavior, the dependent variable is constrained to lie between 0 and 1 and the models used were exponential functions while uni-variate and multi-variate logit and Probit models, including their modified forms have been used extensively to study the adoption behavior of farmers and consumers. Shekya and Flinn (1985) have recommended Probit model for functional forms with limited dependent variables that are continuous between 0 and 1 and logit models for discreet dependent variables. In this study, the responses recorded are discreet (mutually exclusive and exhaustive) therefore, a uni-variate logit model was developed to analyze the adoption behavior of farmers to improved cassava varieties. The logit model, which is based on cumulative logistic probability functions, is computationally easier to use than other types of models and it also has the advantage to predict the probability of farmers adopting the technology. Given a policy change, comparison of the estimated number of adopters before and after policy change, provides a measure of its impact.

In the present study, we investigated the factors that influenced the decision on adoption of the disease-resistant improved cassava varieties by farmers in Akwa Ibom State, using the Logit model. The development of the improved cassava varieties was borne out of the need to increase the yield of cassava, which is a famine-reserve crop and rural staple food, for over 200 million people in sub-Saharan Africa and an important food and cash crop in several tropical African countries, especially Nigeria, where it plays a principal role in the food economy (Agwu and Anyaeche, 2007).

Methodology

The study area is Akaw Ibom State. Akwa Ibom State has 6 agricultural zones, namely, Oron, Abak, Ikot-Ekpene, Etinan, Eket and Uyo, and has very high potential for agriculture. A total of 120 farmers were selected, using a multi-stage random sampling technique. Four Local Government Areas (LGAs) were selected randomly in the first stage. Then 30 farmers were randomly selected from the list of cassava farmers in each of the four LGAs, obtained at the State Agricultural Development Program (ADP) office. The LGAs selected were Oron and Udung Uko (under Oron Agricultural zone) and Ikot Ekpene and NsitIbom (under Ikot Ekpene agricultural zone). However, 112 questionnaires were retrieved and used for data analysis.

Logit model

The logit model assumes that the underlying stimulus (Ii) is a random variable which predicts the probability of "improved cassava varieties" adoption:

$$Pi = \frac{e^{Ii}}{I+e^{Ii}} \quad (1)$$

Conceptually, the behavioural model used to examine factors including "new cassava varieties" adoption is given by:

$$Y_i = g(Li) \quad (2)$$

$$I_i = bo + \Sigma_{bj} X_{ji} \quad (3)$$

Where,

Y_i is the observed response for the i^{th} observation $(i.e,$ the binary variable, Y_i = 1 for an adopter, Y_i = 0 for non-adopter). I_i is an underlying stimulus index for the i^{th} observation (Generally, there is a critical threshold $\{I_i^*\}$ for each farmer, if $I_i < I_i^*$, the farmer is observed to be non-adopter and if $I_i \geq I_i^*$, the farmer is observed to be adopter); g is the functional relationship between the field observation (Y_i) and the stimulus index (I_i) which determines the probability of the "improved cassava varieties" adoption). $I = 1, 2, \ldots, m$ are observations on variables for the adoption model; m is the sample size; X_{ji} is the j^{th} explanatory variables for the i^{th} observation and $j = 1, 2, 3, \ldots, n; bj$ is an unknown parameter; $j = 0, 1, 2, \ldots, n,$ where n is the total number of the explanatory variables.

Empirical model specification

The dependent variable is measured by dichotomous variable: farmers who used the technology or are still using the technology were categorized as adopters while those not using were non-adopters. The definitions and measurement of variables and sample characteristics are presented in Table 1. The variables included in the logit model are: age, educational level, farming experience, farm size, access to improved varieties, farm distance, frequency of extension contact with farmers, and e_i, the random disturbance.

The model is explicitly expressed thus;

$$Y = bo + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + e \quad (4)$$

Where,

Y = Adoption (dummy variable; 1 for an adopter, Y_i = 0 for non-adopter)

X_1 = Age of the farmers (years)

X_2 = Farmers' educational attainment (1 if he is able to read and 0, otherwise)

X_3 = Farm size represented by farm area, measured in hectare

X_4 = Farmers' farming experience, measured in years

X_5 = Contact with extension agents, measured by the frequency of contact or participation at cooperative meetings

X_6 = Distance between homesteads to farm, measured in kilometres

X_7 = Access to cassava stems is measured in kilometres

b_0 = intercept

$b_1 - b_7$ = estimated coefficients

e = error term

Results and Discussion

A summary of the socio-economic characteristics of the sampled respondents in the study area reveals that actual mean estimates obtained for variables did not show much variation (Table 1). Most of the farmers were still within the productive age (43.0years), indicating they are young and energetic with high literacy levels (12.84years). The study further revealed that farmers usually look upon the extension agents to provide information and farm inputs. About 75% noted that extension agents within their locality were the primary source of information on the improved cassava varieties but since there was scarcity of the improved cassava cuttings, adoption sometimes becomes difficult. This may have affected adoption rate in the study area. The farmers were mainly small holder farmers with an average of about 0.72ha in the study area with long distance to source of cassava stems (10.76km),

The rate of adoption is the relative speed with which members of a social system adopt an innovation. It is measured as the number of individuals who adopt a new technology within a specified period. In measuring the rate of adoption of the improved cassava varieties, the proportion of farm land (proxy) related to cassava planting to the proportion of cassava cuttings received from the extension agents was used as criteria. The rate of adoption for the state was found to be 38.5 percent.

Logit regression analysis, using shazam software package shows that most of the coefficients are not consistent with hypothesized relationships and their tests of significance helped to indicate their importance in explaining adoption decisions of the farmers. The parameter estimates for the model was evaluated at 5% level of significance. Logit estimates for the survey location (Table 2) revealed that apart from age, years of farming experience, farm size and distance to farm, which were not found statistically significant in explaining improved cassava variety adoption; education, contact with extension agents and access to cassava stems (cuttings) were statistically significant at 5% level. The positive sign and significance of the extension contact variable implies that extension is an important factor that will promote farmers' adoption of improved cassava varieties in the study area. It was hypothesized that extension contact with the farmers will improve their access to innovation and farm productivity. This is expected because the level of interaction and rapport between the extension agents and the farmers will be high and more frequent, thereby creating a favourable environment for information dissemination between both parties. Famers are usually informed about the existence, as well as the effective use and benefit of new technology through extension agents. Extension agents act as a link between the innovators (Researchers) of the technology and users of that technology. This helps to reduce transaction costs incurred when passing the information of a new technology to a large population of farmers. The result is in consonance with the findings of studies carried out by (Abdoulaye *et al.,* 2014; Challa and and Tilahun, 2014).

Education was found to be positive and significant. Education was hypothesized to influence the adoption of new technologies positively, since, as farmers' acquires more knowledge, their ability to obtain, process and use new information improves and they are likely to adopt. The result is in line with those of studies carried out by (Challa and Tilahun, 2014; Orebiyi *et al.,* 2012; Abdoulaye *et al.,* 2014). Access to cassava stems was found to be positive and significant at 5 % level. If farmers have access to cassava stems of the improved cassava varieties, at reasonable and affordable prices, the likelihood that they will adopt will increase. The study revealed that the main source of technology is through the extension personnel. When cassava stems are not available, it could be attributed to non-domestic supply and non-accessibility in terms of quantity and time. The result is in line with the results from studies by Abdoulaye *et al.,* (2014) and Awotide *et al.,* (201), which revealed that accessibility to a technology, can facilitate its adoption.

As anticipated, access to cassava stems was found to be negative and also significant. The farther the source from the farm, the more difficult it becomes for farmers to get improved varieties. Lack of information about a technology as well as price, might contribute to low adoption. This result follows Idrisa *et al.*, (2012), which revealed that distance to the market is negatively related to participation in technology adoption by farmers.

Conclusion

This study showed that education, contact with extension agents and access to improved cassava varieties are significant variables that influence farmers' improved cassava variety adoption and use decisions. The results demonstrated further that for the technology to be successful, government and research institutes in charge of improved cassava variety distribution must ensure cassava cuttings availability in the right quantity and appropriate time. This provides a justification for government policies aimed at providing adequate infrastructure and institutional arrangements that will enhance the procurement and distribution of the improved cassava varieties. Technical guidance in the form of extension training will also enhance adoption of the technology.

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Table 1: Descriptive Statistics of some variables used in the empirical model

Variable	Mean value	Standard deviation
Age	43.00	11.15
Education	12.84	0.35
Farm size	0.72	1.44
Extension	1.76	1.93
Farming experience	10.89	3.42
Farm distance(km)	3.65	0.34
Access to cassava stems (km)	10.76	0.33
Adoption rate (%)	38.50	

Source: Data analysis, 2015

Table 2: Estimated results of farmer adoption model

Variable	Parameter Estimate	Asymptotic Standard error	t-ratio
Intercept	-0.0642	1.422	
Age	-0.1642	1.0565	0.1554
Education	0.0597	0.0197	3.0372*
Farm size	-0.5682	0.3777	1.5043
Extension	0.1863	0.0616	3.0234*
Farming experience	-5.4864	6.5600	0.8363
Farm distance	-3.3950	2.8424	1.1944
Access to cassava stems	-0.5923	0.2227	-2.6598*
Adoption rate	38.5%		

*Parameter estimate significant at 5%; Source: Field survey, 2015. Total number of cases = 120;
-2loglikelihood = 38.540. Cases correctly predicted = 93.33%; Chi square Statistics = 68.350*