AAAE Conference proceedings (2007) 479-482

Development and Dissemination of Improved Cassava Varieties in Uganda: Analysis of Adoption Rates, Variety Attributes and Speed of Adoption

Steffen Abele1, Edgar Twine[1] Pheneas Ntawuruhunga[1], Yonah Baguma[2], Charles Kanobe[1] and Anthony Bua[2]

1International Institute of Tropical Agriculture (IITA-Uganda), Plot 15 East Naguru Road, Upper Naguru. P.O. Box 7878 Kampala, Uganda.

2National Agricultural Research Organization (NARO), Namulonge Agricultural and Animal Research Institute (NAARI), P.O. Box 7085, Kampala, Uganda.

Abstract

The transition out of extreme poverty and hunger in agrarian economies requires an understanding of how new agricultural technologies are adopted by poor farmers. In Uganda, improved germplasm from the cassava breeding program has generated new varieties that are increasingly being grown by farmers. Although considerable success has been achieved in adoption of these varieties in general, there is increasing pressure on breeding and technology dissemination programs to improve the targeting of their efforts. This paper identifies the specific cassava varieties adopted thus far and their desirable and undesirable attributes. In addition, it determines the adoption rates of these varieties and the factors that have influenced the speed of adoption of the most adopted variety. Results show that NASE 1, NASE 2, NASE 3, NASE 4, NASE 10 and NASE 12 are the varieties adopted so far. Farmers consider, *inter alia*, disease resistance, maturity period, taste and dry matter content in their decision to adopt new cassava varieties. From the Negative Binomial model, speed of adoption of NASE 3 was positively influenced by age of household head, household size and access to extension services. However, it was negatively influenced by number of hoes owned by a household. We conclude that there is need to continue breeding for adaptability to biotic stresses while improving on attributes that influence palatability and nutritive value of the crop. Strengthening the link between farmers and agricultural extension agents/service providers and improving the targeting of extension services will enhance the adoption of new cassava varieties.

Key words: Uganda, cassava, breeding, adoption, variety attributes

Introduction

The transition out of extreme poverty and hunger in agrarian economies requires an understanding of how new agricultural technologies are adopted by poor farmers. In Uganda, improved germplasm from the cassava breeding program has generated new varieties that are increasingly being grown by farmers. Although considerable success has been achieved in adoption of these varieties in general, there is increasing pressure on breeding and technology dissemination programs to improve the targeting of their efforts.

In an effort to improve and stabilize production of cassava following an outbreak of the cassava mosaic disease in 1988, the National Agricultural Research Organization (NARO) in collaboration with its partners mainly the International Institute of Tropical of Agriculture (IITA) and the East Africa Root Crops Research Network (EARRNET) has to-date developed and officially released a total of 12 improved cassava varieties with several attributes as shown in table 1. The adoption level of these varieties in general increased from about 20% in 1993 to about 80% in 1999 (Bua *et al.,* 1999). This breeding effort is arguably one of the most successful by NARO against low cassava productivity and hence food insecurity in Uganda.

However, several questions remain unanswered. For instance, (i) what improved varieties have so far been adopted and at what rate? (ii) Why have these varieties been adopted? Is it because of the attributes mentioned earlier or other variety-specific attributes yet unknown to breeders? (iii) What factors have influenced the speed of adoption of the most popular variety? This study aimed at answering these questions.

Methodology

The study was conducted in 16 districts of Uganda representing different regions and agroecological zones. These included Arua, Nebbi, Apac, Lira, Masindi, Nakasongola, Luwero, Wakiso, Mukono, Iganga, Bugiri, Tororo, Busia, Soroti, Pallisa and

Kumi. Thirty farmers were randomly selected from each district hence a sample size of 480 farmers. Primary cross-sectional data were obtained on farmers' demographic and socioeconomic characteristics such as household composition by age and gender, marital status, occupation and education level of household head, land holding, acquisition and tenure, labor availability, income sources and farming enterprises, cassava production history, current practices and constraints, awareness and adoption of cassava varieties as well as sources of information pertaining to the management of cassava varieties.

Negative binomial model specification

The negative binomial model is a count data econometric model. In this model, the dependent variable takes on only non-negative integer values. It is a compound derivative of the Poisson regression model. Following Edriss and Mangisoni (2004), the negative binomial model is given as

$$\Pr(Y = \gamma / \chi) = [\mu^{\gamma} \Gamma(\gamma + \alpha)(1 / (\alpha + \mu))^{\gamma+\alpha}] / \gamma!(\alpha)\Gamma(\alpha).(1 / \alpha)^{\alpha} \quad \text{……………} (1)$$

where Γ is the gamma distribution. This form of the negative binomial model is widely known as Negbin II and its parameters are estimated using the Maximum Likelihood technique. The simplified log-likelihood function is given as

$$\ln L_i = \ln \Pr(Y = \gamma_i) = \sum_{n=0}^{\gamma_i - 1} \ln(\alpha + n) - \ln \gamma_i! + \gamma_i \ln(1 - \theta_i) + \alpha \ln \theta_i \quad \text{…………………..} (2)$$

where, $\theta_i = \alpha / (\alpha + \mu_i)$

Since $\mu_i > 0$ and $\alpha > 0$, this implies that the variance is greater that the mean. The negative binomial model therefore allows for over-dispersion, unlike the Poisson regression model.

Results and discussion

Improved varieties adopted

Overall, 6 varieties have so far been adopted, to varying levels, out of the 12 that were released by NARO. These are: NASE 1, NASE 2, NASE 3, NASE 4, NASE 10 and NASE 12. NASE 3 (locally known as Migyera) was the most adopted variety, a result consistent with that obtained by Abele *et al.* (2005), who found that the same variety was the most adopted in western Kenya. Generally, the 6 varieties had 3 desirable attributes in common, namely: high resistance to diseases (especially to CMD), high storage root yields and short maturity period compared to local ones. With the exception of yield, NASE 3 was considered to have these qualities in relatively high levels hence its superiority. In addition, it was reported by majority of the farmers to have a high dry matter content and high market demand. However, it has relatively high cyanide content, bitter taste when eaten fresh and short period of underground storage.

Factors influencing speed of adoption of NASE 3

Explanatory variables thought to potentially influence the speed of adoption of NASE 3 were fitted into the model, the results of which are presented in table 3. The log-likelihood value suggests that the model adequately explained the data. Out of the 8 variables, 4 were statistically significant. These were: age of household head, size of household, number of hoes owned by a household and access to agricultural extension advice. With a negative binomial model, a negative sign implies that the variable encourages adoption. It means that an increase in the variable reduces the number of years it takes a farmer to adopt a given technology.

The relationship between age of household head and number of years taken to adopt NASE 3 cassava variety was negative and statistically significant at 10%. Older farmers were more likely to adopt faster than young ones. Age of household head can be taken as a proxy to farming experience. According to Nkonya and Featherstone (2001), if farming experience is viewed in terms of accumulation of knowledge, then it stimulates improved technology use. Older farmers may have had the opportunity to experiment with other improved varieties of cassava and observed their superiority over local ones. They may also know better methods of seed selection than the relatively young farmers. Consequently, they will be quicker to accept new cassava technologies than younger farmers. Dependent variable is log of the number of years taken to adopt NASE 3

The parameter estimate for household size had the expected negative sign and was significant at 1%. This result implies that household size was very influential in farmers' adoption behavior and increased the speed of adoption of the variety. This study postulates that a larger household has a higher demand and consumption of food than a smaller one. Faced with food insecurity, a larger household is likely to adopt improved agricultural technologies faster than a smaller one. The parameter on number of hoes owned by a household was positive and statistically significant at 1%. Number of hoes owned by a household was used as an indicator of either availability or the lack of farm implements. It was expected that households with adequate farm implements would adopt the variety much faster than those that are implement-constrained. However, the effect of this variable was positive implying that an increase in number of farm implements would increase the number of years it would take to adopt the variety. Though the result is seemingly counter-intuitive, a logical explanation is that a household, which is not constrained by farm implements may be less food insecure than one which is constrained. As a result, the former may not be in a hurry to adopt new agricultural technologies. As expected, access to agricultural extension services increased the speed of adoption of NASE 3. The coefficient was significant at 10%. Households that had received extension advice were assumed to be knowledgeable about the agronomic requirements of the variety as well as identification of its planting material. Households in possession of this knowledge found it easier to cultivate the variety hence adopting it earlier than those devoid of this knowledge.

References

Abele. S., P. Ntawuruhunga, M. Odendo, H. Obiero, E. Twine and J. Odenya. 2005. "Effectiveness of Breeding and Disseminating CMD-Resistant Cassava Varieties in Western Kenya," *African Crop Science Conference Proceedings*, 7: 233-237 (Eds) Tenywa, Adipala, Nampala, Tusiime, Okori and Kyamuhangire

Bua, A., G. Acola, R.L. Adupa, G.W. Otim-Nape, Y.K. Baguma and D. Ssemakula. 1999. *Adoption and Impact of Improved Cassava Varieties in Uganda*. Unpublished NARO Report

Edriss, A and J. Mangisoni. 2004. "Socio-Economic Factors Influencing the Adoption of CG7 Groundnut Technology in Malawi," *Eastern African Journal of Rural Development*, 20(1): 12-23

Mbwika, J.M., J.B.A. Whyte, A. Bua and D. Sserunkuuma. 2001. *Uganda Cassava Sub-sector Analysis: Report of a Literature Review*. EARRNET and NARO, Kampala, Uganda.

NARO. 2003. *Addressing the Challenges of Poverty Eradication and Modernization of Agriculture: Improved Technologies by NARO, 1992 – 2002*. Entebbe, Uganda

Nkonya, E.M. and A.M. Featherstone 2001. "Cross-Pollinated Crop Variety Adoption Studies and Seed Recycling: The Case of Maize in Tanzania," *Eastern Africa Journal of Rural Development*, 17(1):25-34

Table 1: Improved cassava varieties released by NARO to-date

Variety	Attributes and year of release
NASE 1 (TMS 60142)	Matures in 14 months, yields 23 t/ha, resistant to CMD, low in CNp; released in 1994
NASE 2 (TMS 30337)	Matures in 14 months, yields 27 t/ha, resistant to CMD, low in CNp; released in 1994
NASE 3 (TMS 30572)	Matures in 12 months, yields 26 t/ha, resistant to CMD; released in 1994
NASE 4 (SS4)	Matures in 12 months, yields 50 t/ha, resistant to CMD; released in 1994
NASE 5 (SS5)	Matures in 12 months, yields 40 t/ha, resistant to CMD, low in CNp; released in 1999
NASE 6 (TMS 4 (2) 1425)	Matures in 12 months, yields 35 t/ha, resistant to CMD, low in CNp; released in 1999
NASE 7 (CE 85)	Matures in 12 months, yields 45 t/ha, resistant to CMD, low in CNp; released in 1999
NASE 8 (CE 98)	Matures in 12 months, yields 40 t/ha, resistant to CMD, low in CNp; released in 1999
NASE 9 (TMS 30555-17)	Matures in 12 months, yields 45 t/ha, resistant to CMD; released in 1999
NASE 10 (00063)	Matures in 12 months, yields 35 t/ha, resistant to CMD, low in CNp; released in 2000
NASE 11 (TC 1)	Matures in 12 months, yields 35 t/ha, resistant to CMD, low in CNp; released in 2000
NASE 12 (MH95/0414)	Matures in 12 months, yields 40 t/ha, resistant to CMD, low in CNp; released in 2000

SOURCE: NARO, 2003

Table 3: Factors influencing speed of adoption of NASE 3

Variable	Coefficient	z-statistic	p-value
Distance to nearest trading center	0.00091 (0.00077)	1.19	0.233
Age of household head	-0.0076 (0.0045)	-1.69	0.091
Education of household head	0.00085 (0.00067)	1.28	0.202
Acreage	-0.010 (0.028)	-0.37	0.709
Household size	-0.0034 (0.0010)	-3.37	0.001
Full-time labor	-0.0030 (0.0024)	-1.23	0.217
No. of hoes	0.0024 (0.00087)	2.83	0.005
Extension advice	-0.0038 (0.0022)	-1.72	0.086
Constant	4.36 (0.33)	13.00	0.000
No. of obs = 216 LR chi2(8) = 26.20 Prob > chi2 = 0.0010 Pseudo R^2 = 0.0158 Log likelihood = -813.58			

Figures in parentheses are standard errors