Technical note: Changes in adoption decisions of storage innovations in southern Benin

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Introduction

Storage pest damage is a serious constraint for food security and household income in sub-Saharan Africa. Lack of appropriate pest control measures causes losses to maize which is the major staple food in Southern Benin. The storage of grain treated with Sofagrain® in improved wooden granary has been proved to be effective to reduce pest damage in maize storage. Many farmers have adopted these innovations and factors that influence adoption and modifications decisions have been studied. However empirical evidence reveals that about 48.57% and 61.45% of farmers who have tried improved wooden granary and Sofagrain®, respectively are currently not using them. Therefore this study is designed to identify which kind of maize producers are likely to sustain the adoption and discontinue the use of the storage innovations in southern Benin. Few studies deal with the abandonment of new technologies .

Empirical model

The decision to abandon a storage innovation is only observed for farmers making the decision to adopt and not for the entire population of maize producers. Thus, the conditional probability that a farmer will abandon, given that he has already adopted is:

$$\Pr ob\left(y_{i2}=1 \middle| y_{i1}=1\right)=\frac{\Phi_2\left(\beta_1' x_{i1}, \beta_2' x_{i2}, \rho\right)}{\Phi\left(\beta_2' x_{i2}'\right)},$$

where β'_1 , β'_2 and ρ are parameters to be estimated; x_{i1} , x_{i2} are the explanatory variables for the adoption and abandonment equations; y_{i1} and y_{i2} are dependent variables and stand for the adoption decision and for continuing use of a storage innovation, respectively; ρ represents the correlation coefficient.

A bivariate probit model is used to correct for sample selection bias and obtain efficient parameters for the adoption and abandonment equations. A Wald test is used to test for the presence of the selection effect against the null hypothesis that ρ equals zero. The rejection of this hypothesis implies that the adoption and abandonment equations are independent and may be estimated with separate probit specifications.

The expected signs of the explanatory variables are drawn from the adoption-perception literature and the extensive review of adoption studies.

Data

The data used in the empirical analysis were derived from a two years period surveys of maize producers in southern Benin. The first survey data were collected in 2002 on a sample of 743 maize producers randomly drawn from 30 villages. From this first survey, the 523 maize producers who were aware of the storage innovations were surveyed in 2008. They are used to estimate the bivariate probit models. However, because the decision whether to abandon is inherently conditional on having initially adopted the storage innovations, only observations who reported having adopted during the first survey are included in the disadoption bivariate probit model. This leaves 205 observations of improved wooden granaries and 229 observations of Sofagrain® from the 523 in the abandonment equations.

Wooden granary

Traditional granary

Results

The correlation coefficients between adoption and disadoption equations are significant in improved wooden granary and Sofagrain® (Table 1). This implies that the probit with sample selection model is appropriate to estimate efficiently the factors which explain disadoption of the two innovations. Furthermore, the high significance of the Wald statistics in the specified models suggests that the explanatory variables together contribute to explain the observed disadoption decisions. In addition, the percentage of correct predictions is good in Sofagrain® and satisfactory in wooden granary.

Table 1. Estimated results of the disadoption equation for improved granary and Sofagrain

Parameter	Granary			Sofagrain®		
	Estimate	Standard error	p-value	Estimate	Standard error	p-value
Constant	1.293	0.675	0.056	1.327	0.599	0.027
Education of the farmer (NINST)	0.104	0.202	0.607	0.031	0.188	0.867
Quantity of maize produced (PROMA)	0.020	0.112	0.859	0.055	0.109	0.615
*Access to the village (*ACCES)	-0.521	0.150	0.001	-0.662	0.165	0.000
Availability of family labor (FTRAV)	0.184	0.049	0.000	0.128	0.047	0.006
Access to credit (ACRED)	0.280	0.220	0.204	0.268	0.204	0.190
Contact with extension (CONT)	-0.236	0.253	0.349	0.070	0.246	0.774
Effectiveness of innovations (EFPE)	-0.005	0.222	0.982	0.343	0.197	0.082
Experience in maize production (EXMP)	-0.185	0.159	0.244	-0.314	0.146	0.032
Availability of Sofagrain® *and granaries' building materials* (AGMS)	-0.005	0.279	0.986	0.567	0.371	0.126
Correlation coefficient	-0.517	0.266	0.095	-0.745	0.158	0.004
Log likelihood	-442.647			-419.565		
Wald Chi2 (9)	28.73		0.001	22.67		0.007
Correct prediction (%)	66.34			76.42		
No. of observations	205			229		

Note: The variables PROMA and EXMP are included in logarithm forms in the two models.

The variable **ACCES** has a significant and negative effect on the probability that a farmer continues to adopt the storage innovations (Table 1). Thus, farmers located in villages with good access every seasons are likely to discontinue the use of storage innovations. Also, the family labor (**FTRAV**)) is significantly and positively related with the decision to continue using the storage innovations (Table 1).

Contrary to all expectation, years of experience in maize production (**EXMP**) has a negative effect on continued to adopt but significant only in the Sofagrain® . This negative sign can be interpreted as a result of better knowledge acquiring about the storage innovations that leads to the high rate of disadoption.

The estimated parameter of **EFPE** was positive as expected in the Sofagrain® model. This indicates that because farmers confirm after initial adoption their perception of the effectiveness of Sofagrain® in controlling the pests, they were more likely to continue using it. However, the estimated parameter of this variable is negative and not significant in the improved wooden granary model.

The estimated coefficient of **AGMS** is not significant in improved wooden granary model and had the unexpected negative sign. However it is significant at 15% ($p < 0.126$) in the Sofagrain® model and had the anticipated positive sign (Table 1). Thus, farmers were more likely to continue if the Sofagrain® is available. The remaining variables in the analysis are not significant. The most surprising of these are the variables **ACRED, PROMA** and **CONT,** although the cost and low maize production have been reported as main reasons for not using the storage innovations, in particular the wooden granary. However the coefficients of **ACRED** and **PROMA** have positive sign as expected in the two models. The insignificance of the variable **ACRED** suggests that borrowing cash does not affect the decision to continue to adopt storage innovations.

Peasant woman in her maize field

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Conclusions and implications

This study provides some insight into factors that influence the adoption and the disadoption of storage innovations in southern Benin. Results highlight the importance of road conditions and family labor availability in the probability of disadoption of storage innovations. This study also reveals that Sofagrain® is scarce even if its effect is less significant on the probability of its abandonment. Two main implications can be drawn from these results. First, the insecticide protectant, Sofagrain®, should be supplied again or an alternative method of protection of stored grains should be found. Second, because farmers living in communities with better road access are likely to abandon the storage innovations, the promotion efforts of extension service could benefit from tailoring efforts toward remote rural areas.

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