Factors affecting the use of clay stores for maize in central and northern B?nin

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Abstract

Storage structures are key elements in post harvest systems in any country. In Northern Benin, West Africa research and extension services aim to improve storage to reduce post harvest losses, especially maize. The reported study was carried out to identify factors that affect the adoption of improved clay stores. The uni-variate probit analysis model was used to assess the combined effect of three kinds of variables: farmers' socio-economic factors, technology characteristics and the farm specific factors - on the adoption of improved clay stores. The results showed that farm specific factors, including market, were negatively correlated with adoption, while farmers' socio-economic factors such as the years of farming experience, access to extension service, were positively correlated with adoption. Technology characteristics affected adoption negatively as well as positively.

Key words

Probit model, improved mud granary, corn, adoption, diffusion, B?nin.

Media summary

Adoption of improved clay stores in Benin, West Africa, was negatively correlated with distance to periodical grain markets and to the area of clay source.

Introduction

Maize has a double function in Benin, as food and as a cash crop. Its production and consumption are increasing simultaneously in regions where it was considered only as cash crop. Because of the ineffectiveness of traditional stores and the appearance of formerly unknown pests, a high proportion of maize production is lost. Higher production results in higher losses recorded during storage. About two thirds of harvested products are stored at farm level (Compton et *al.*, 1993). There is a strong challenge to find new technologies to reduce losses, led research and extension services in Benin to take interest in traditional means of storage and improved clay storage structures. Originally from the north west of Benin, the clay store has been modified and introduced since 1992 in areas presenting climatic conditions similar to those of its area of source. The present study aims to identify and analyse, after a decade of popularization, factors determining the adoption of this clay store (attic) by maize producers.

Study area

This study was carried out in central and northern B?nin, which supply maize to the rest of the country. They are characterized by: i) a hot climate with a long dry season of more than 6 months (November to May) and a single rainy season averaging 900 mm per year (Sudan-Savannah). The main crops cultivated are millet, sorghum, maize, cowpea, cotton and groundnut; and ii) the Northern Guinea Savannah, wetter and more humid which supports crops like yam, maize, cassava, cotton.

Two types maize stores are used in these areas. Vegetable material attic's stores (Figure 1), used for maize 'out of ears or husks', and clay stores, traditional raised (Figure 2) or improved with sluice gates (Figure 3) for maize 'shelled or in dehusked ears'.

Figure 1?: Traditional vegetable store

Figure 2?: Traditional clay store

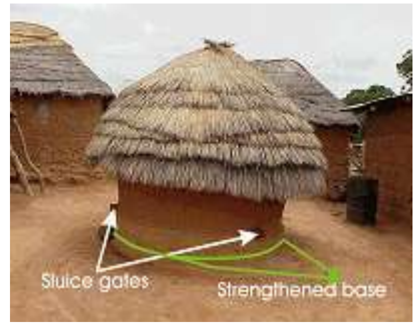

Figure 3?: Improved clay store

Methodology

Data collection

Data were collected in two phases: the first one consisted of an exploratory survey on investigation of farmers' perceptions of maize storage technologies using "focus-group" interviews. A check list of informal questions was used to explore issues to be investigated. The results helped to develop a structured questionnaire on farmers' perceptions of the improved clay store. The second phase consisted of carrying out the formal survey using the structured questionnaire with a stratified random sample of 225 farmers.

Conceptual and theoretical framework

The utility to draw from a technology depends on its adoption. The process of decision-making thus consists in theoretically maximizing this utility. An individual D (maize producer) faced with the alternative "improved clay store *vs.* traditional attic" decides to adopt the first one only when the combined effect of certain factors reaches a given value. By supposing that the combined effect of these factors is measured by an unobservable index I_D for this decision maker D and I^*_D the critical value of the index from at which adoption occurs, this situation is mathematically given by (Manyong et *al.*, 1996):

$$Y_D = \begin{cases} 1 \text{ si } I_D \geq I^*_D \\ 0 \text{ si } I_D < I^*_D \end{cases} \qquad (1)$$

In the Probit model, the probability that farmer D adopts the improved clay is defined by the equation below:

$$P(Y=1) = P(I^*_D \leq I_D) = F(I_D) = \int_{-\infty}^{I_D} \frac{1}{\sqrt{2\pi}} e^{-\frac{t^2}{2}} dt \qquad (2)$$

Rogers (1995) defines diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system. This progressive contact with the technology is conceptualized by Griliches (1957) by the logistic function: Y_t = K/(1+e-a-bt) (3)

Empirical model of adoption

The empirical specification (Adesina and Zinnah, 1992; Alavalapati et *al.*, 1995) was used to identify and analyse factors that could influence farmers' decision to adopt improved clay stores. The relations between these factors and the probability of clay adoption have been specified by a univariate probit model, through LIMDEP software (Green, 1991). The dependent variable (ADOPT) is binary and measures whether or not farmer adopts the improved store. This probability was specified as a function of maize producer's characteristics, farm specific characteristics and farmer's perceptions of improved clay. Variables and hypothesis related are tested in Table1.

Results

Diffusion of improved clay

The main diffusion channels are: extension services which passed information to 40% of potential adopters, farmers who ensured transmission of information to 40% of their colleagues. Research contributed to informing 12% about the improved store while rural development projects and NGOs accounted for 8% of transmission. A projection beyond 2002 of the diffusion process shows that the curve (Figure 4) begins to level off from 2020, meaning that half of the potential users in the social system will have adopted the improved stores.

Table 1: Statistic description of the independent variables used in the analyses

Variables	Description	Expected sign	Mean (N=210)	Standard deviation	Minimum	Maximum
ADOPT	Adoption of improved clay store 1=Adoption ; 0=Non adoption					
EXPER	Farmer's experience in agriculture (year)	+	15.49	11.42	0.00	60.00
CONTAC	Farmer in contact with research and extension services: 1=Yes?; 0=No	+	0.71	0.45		
HOLAB	Ratio of household dependents to available labour	+	2.94	2.37	0.36	24.00
MAPRO	Extent of maize production (in T x 1000)	+	2.27	2.72	0.00	23.25
SOLD	Portion of stock to be sold	+	3.73	3.46	0.00	10.00
STOPR	Farmer facing with storage problem: 1=Yes; 0=No	+	0.57	0.50		

PELOS	Clay store's ability to reduce losses: 1=Yes?; 0=No	+	0.83	0.37
COST	Improved clay store cost : 1=Cheap; 0=Expensive	-	0.84	0.36
AREPO	Area of popularization: 1= origin ; 0=new area	+	0.24	0.43
DIVIM	Distance from village to the nearest market : 1=<10km; 0=>10km	+	0.72	0.45

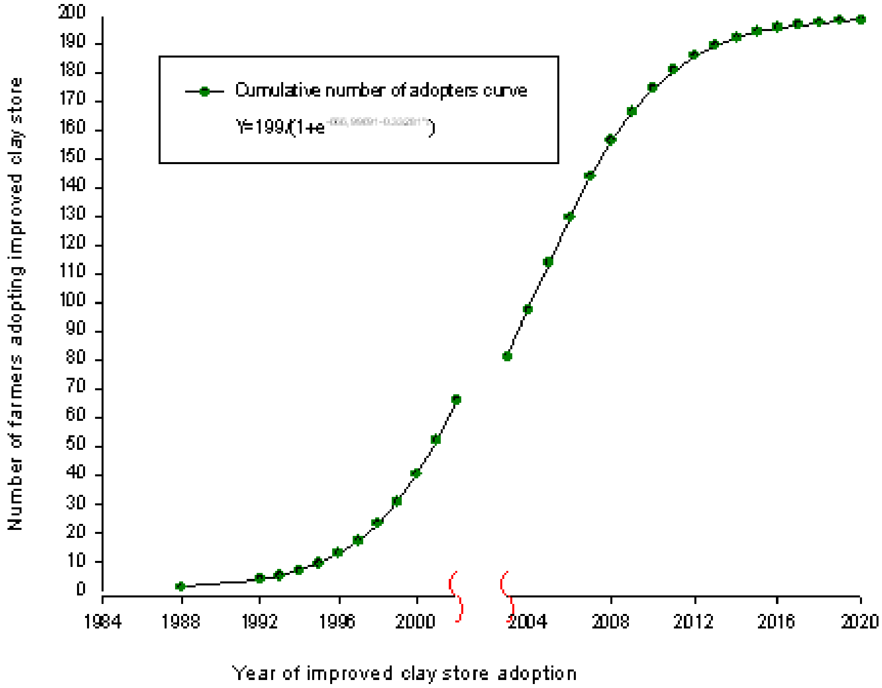

Figure 4 : Improved clay store diffusion curve

Factors determining improved clay store adoption

About 32% of farmers in the sample used the improved clay to store their maize. Experience in agriculture, ratio of number of dependents to unit of available labour, and the capacity of improved clay to reduce insect damage were positively correlated to its adoption. The proportion of the stock intended for market, the geographical area and the nearness of a periodical market to the village negatively affect the probability of adoption (Table 2).

Table 2: Probit model results of factors affecting adoption of improved clay store

Asymptotic

Variables	Coefficients	Standard Error	T-Ratio	Elasticity at the mean
Intercept	-1.88	0.57	-3.32***	-2.47
EXPER	0.14E-01	0.98E-02	1.53	0.28
CONTAC	1.05	0.31	3.35***	0.98
HOLAB	0.14E-03	0.52E-01	0.003	0.001
MAPRO	0.23	0.51E-01	4.24***	0.68
SOLD	-0.26E-01	0.34E-01	-0.75	-0.13
STOPR	0.27	0.23	1.18	0.20
PELOS	0.88	0.31	2.80***	0.96
COST	-0.61	0.28	-2.17**	-0.68
AREPO	-0.43	0.30	-1.44	-0.14
DIVIM	-0.69	0.25	-2.78***	-0.65

Sample size = 210 ; Chi-square (χ^2) = 79.39*** ;
Predicted correctly =79.52% ;Pseudo R^2 = 0.62**
***=Significant at 1%; **=Significant at 5%; *=Significant at 10%

Discussion and conclusions

The inverse relationship between portion of stock intended to be sold and adoption of improved stores is explained by the spread of maize post harvest operations. Farmers organize their timetable so as to harvest various crops simultaneously. Maize is shelled later when farmers are less busy, and sold early. Thus, they do not need improved granaries to store for long periods. Maize farmers sell 75 to 80% of their marketable surplus during the 3 months following harvest (Langyintuo, 1999). This negative relationship between marketable surplus and adoption is in conformity with the negative coefficient of the variable distance to nearest periodical market. This strongly corroborates the finding of Adesina (1996) but is opposite to those of Hassan et *al.* (1998). Producers having easy access to market are more willing to sell early after harvest. This is also related to the lack of financial means in these rural regions, considered the poorest in the country (Moustapha and Vodounou, 2002). The early sale is also explained by the uncertainty of the disorganised maize market. The safest option for small scale farmers with low incomes is to quickly sell the portion intended for market. Elasticity of -0.65 denotes that adoption probability would decrease by 6.5% for a reduction in market distance of about 10%. The zone of improved clay stores popularization negatively affected the probability of adoption, meaning that this technology is adopted more in new zones of introduction. The improved features (sluice gates and strong bases) of clay stores did not constitute stimulating factors in adoption.

Results revealed that improved clay stores were subject to auto-diffusion from farmer to farmer. However, the adoption rate remains relatively weak, because of combined effect of factors such as those related to the market and subsidies granted to the first experiment farmers. Maize acquires food crop function in areas where maize was once as a cash crop. It is essential to reorient extension towards producers and to family consumption.

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