Farmers' perceptions, profitability, and factors influencing the adoption of improved maize varieties in the Guinea Savannas of Nigeria

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Abstract

The paper analyzes farmers' perceptions, profitability, and factors influencing the adoption of improved maize varieties (IMV) in the Guinea savannas of Borno State, Nigeria. A multistage sampling design was used to select 232 households. Respondents were interviewed using a structured questionnaire. Descriptive statistics, budgetary techniques, and Tobit Model were used as analytical tools. Results show that early maturity and high grain yields of IMV positively increased adoption by 66.4% among farmers. The gross margin results indicated that IMV was highly profitable with a mean gross margin of ₦65,289 (€384)/ha as against local varieties with a mean gross margin of 34,691 (€204)/ha. The Tobit result shows that statistically (ρ = 0.05) factors that influenced the adoption of IMV (with expected signs) included farm size, extension contact, access to credit, fertilizer, farming experience, and household size. Policies that enhanced farmers' access to credit facilitated adoption through increased access to IMV seeds and purchase of complementary fertilizer input enhanced the intensity and adoption rate.

Keywords: Farmers' perception, improved maize varieties, profitability, adoption, Tobit, savanna, Nigeria.

Introduction

Maize is one of the major cereal crops grown in the Guinea savanna zones of Nigeria. It accounts for approximately 20% of domestic food production in West and Central Africa. It has also achieved the highest growth rate of major crops since the 1970s (Kamara et al., 2006). Despite its high yield potential, maize faces numerous constraints. One of these is drought both at the beginning and during the growing season, significantly reducing grain yield. Therefore, early maturing varieties that are tolerant to drought or extra-early maturing varieties that could escape drought are desirable. The International Institute of Tropical Agriculture (IITA) has developed drought-tolerant and extra-early maize varieties that are adapted to the Guinea savannas of West Africa. Decreasing susceptibility of maize to drought, while increasing yield in a good rainfall year will reduce chronic food shortages, stabilize rural income, and lessen farming risks.

In 2003, improved maize varieties (IMV) were promoted in the drought-prone savannas of Borno State, Nigeria. So far, no attempt has been made to measure adoption and examine factors influencing adoption of these IMVs in the area.

Study objectives

The study aims to link farmers' perceptions, profitability, and factors influencing IMV adoption. Since drought is the major cause of yield loss in lowland tropics, farmers in the Guinea savannas of Borno State need to adopt new improved *Striga*-resistant and early-maturing varieties tolerant to drought to avoid food shortages. Study results will help agricultural policymakers to formulate policy that addresses factors influencing the adoption of IMV technology.

Study area and sampling technique

The study was based on farm-level data of maize farmers in the Guinea Savanna of Borno, Nigeria. It covered the Guinea Savanna, where conditions are suitable for maize production and where improved maize technology had been widely disseminated. The Guinea Savanna covers l4,442.4 km^2 and has a population of approximately 1.1 million, of which 95% are small-scale farmers (National Population Commission 2006).

The study used mainly primary data. The multi-stage random sampling technique was used to select 232 maize farmers. Data collected include maize area under cultivation (ha), family labor, hired labor cost, quantity of fertilizer used, quantity of herbicides used, price of maize, and socioeconomic variables such as age, sex, farming experience, level of education, contact with extension agents, credit availability, and market access.

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Analytical techniques

Gross Margin Analysis and the Tobit Model were used to determine the profitability of IMV and measure the intensity of adoption, respectively (McDonald and Moffit 1980, Tobin 1958, Kristjason et al. 2005, James et al. 2006). Intensity of IMV adoption is defined as the proportion of total area planted with IMV to total maize area. In this case the dependent variable is 1 for adopters of IMV and 0 otherwise.

The Empirical Tobit Model is expressed as:

$Y = X\beta + \mu_i$ if $X\beta > \mu_i$, 0 if $X\beta = \mu_i$ (1)

Where:

X_i = vector of the explanatory variable

β = vector of the coefficient

μ, = random error term (independently distributed with mean 0 and variance σ^2)

The dependent variable, i.e., adoption of IMV, was expected to give a value ranging between 0 and 1, signifying that a certain proportion of the maize area is planted to IMV.

Results and discussion

Results show that early maturity, high grain yield, and tolerance for drought were perceived positively (rated 1st, 2nd and 3rd, respectively), influencing 66.4% adoption among respondent farmers. The ability of IMV to tolerate drought and the fact that it matures earlier than existing local varieties limits the effects of drought on crop yield, and thus enhances productivity and food security. Other advantages of IMV identified by respondents were good cooking taste, lower operational costs, and ease of harvest (4th, 5th, 6th, respectively).

Table 1 presents the Gross Margin of adopters and nonadopters of IMV.

The total variable cost (TVC) incurred by IMV adopters and nonadopters were ₦36,740/ha and ₦19,922/ha respectively. Fertilizer accounted for 55% of the TVC for adopters and 38% of the TVC for nonadopters. The total revenue per hectare for adopters and nonadopters was ₦102,029 and ₦54,613, respectively, and their gross margins were ₦68,656/ha and ₦34,115/ha, respectively. The higher revenue derived from IMV is attributed to two factors. First, IMVs have higher yields per hectare compared with local varieties. Secondly, IMVs fetch a higher market price. Thus, IMV production is profitable, which influenced its adoption by 66.4% of respondent farmers.

Table 1. Gross margin of adopters and nonadopters of IMV.

	Adopters (N = 154)		Nonadopters (N = 78)	
Total maize revenue	102,029.0		54,6130	
variable costs	Value (Naira)	% of TVC	Value (Naira)	% of TVC
Fertilizer	20,158.0	54.9	7,520.0	37.8
Hired labor	8,260.6	24.0	8,260.6	32.3
Family labor	3,857.4	10.5	3,984.5	20.0
Herbicides	2,648.0	7.2	1,840.0	9.2
Total variable cost (TVC)	**36,740.0**		**19,922.0**	
Gross margin/ha	**68,656.0**		**34,115.0**	

The Tobit result shows the relationship between respondents' socioeconomic characteristics and the rate of IMV adoption in the study area. Table 2 shows the estimated coefficients and t-ratios.

The Tobit Model (R^2) coefficient was 0.857. This implies that an Table 2. Maximum likelihood estimates (MLE) of the Tobit Model showing the rate of IMV adoption in the Guinea Savannas of Borno State, Nigeria

Explanatory variables	Coefficients	Standard error	T-ratios	P>/t/
Constant	-0.0473992	0.1264734	-0.37	0.708
Age	0.0005593	0.002259	0.25	0.805
Gender	0.0102244	0.048354	0.21	0.833
Educational status	0.0068136	0.0038972	1.75	0.081**
Household hired labor	0.00000188	0.000000825	-2.28	0.023**
Household labor	0.0071422	0.0052145	0.19	0.172
Membership of farmers' group	0.0028221	0.00152455	11.50	0.853
Frequency of extension visit	0.38355	0.0333503	-1.80	0.0000***
Family size	-0.0094476	0.005254	-8.15	0.074*
Farm size	-0.3218876	0.0394868	9.29	0.0000***
Farming experience	0.0056779	0.0026649	-3.22	0.034**
Amount of credit obtained	0.00000273	0.000000484	1.17	0.001***
Other production costs	0.0000234	0.0000199	2.00	0.242
Profit	0.00000283	0.000000141	2.00	0.047**
Quantity of fertilizer used	0.0003839	0.0001176	2.13	0.001***
Quantity of herbicides used	-0.0046372	0.0070245	0.51	0.510
Log likelihood	-33.552			
Sigma	0.2424			
R^2	0.857			

*** Significant at 1%; ** at 5%; * at 10% .

85.7% variation in IMV adoption was due to the independent variables considered in the model.

The coefficient of educational status is positive and significant at 10%. This means that there is a direct relationship between IMV adoption and educational status, where the adoption rate increases as farmers' educational status increases.

Total amount of hired labor per hectare is another significant factor influencing adoption rate. This is because most farmers depend on hired labor for farm activities, especially for weeding and harvesting.

The coefficient of contact with extension agents is positive and significant at 1%. This corresponds to the a priori expectation that there is a positive significant relationship between extension contact and IMV adoption in the study area. The positive relationship suggests that IMV adoption increases as extension contact between extension agents and farmers becomes more frequent.

The coefficient of family size was negative and significant at 10%. This suggests that the greater the family size the lower the IMV adoption rate. It is likely that farmers with larger families attach greater importance to nonfarm activities than smaller households. The coefficient of farming experience was also positive and significant at 5% and agrees with the a priori expectation. This suggests that the more experienced the farmer, the higher the rate of IMV adoption.

The farm size coefficient was negative and significant at -1%. This implies an inverse relationship: as farm size increases, IMV adoption decreases and vice-versa. The larger the farm size, the lower the potential of IMV adoption.

Access to credit also had a positive coefficient and was significant at -1%. This suggests that IMV adoption increases when farmers have adequate capital for procuring inputs such as fertilizer, improved seeds, chemicals, and payment for labor. The study found that only 11% of respondents had access to credit during the 2006 farming season, indicating that limited access to credit could affect their adoption potential. Also, the coefficient of the amount of fertilizer used by IMV adopters was positive and significant at 1%, agreeing with the a priori expectation. This implies that IMV adoption increases along with farmers' increased access to fertilizer.

Conclusion

The study revealed that adoption of IMV is profitable. Extension contact was identified as the key factor influencing IMV adoption in the study area. Farming experience, education, quantity of fertilizer used by farmers, and access to credit were other determinants of adoption rate. Policy should focus on providing maize farmers with improved access to credit, fertilizer, and IMV seeds. In addition, policy that provides adequately trained and equipped extension workers to disseminate technology information can increase the adoption rate of IMVs.

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