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Farmers' Perception, Profitability and Factors Influencing the Adoption of Improved Maize Varieties in the Guinea Savannas of Nigeria

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Abstract
The paper analyses farmers' perception, profitability and factors influencing the adoption of IMV in the savannas of Borno State, Nigeria. A multistage sampling design was used to select 232 households, subsequently interviewed by means of structured questionnaire. Descriptive statistics, budgetary techniques and Tobit model were used as analytical tools. Farmers' perception shows clearly that early maturity and high grain yields of IMV were the positive perceptions that influenced 66.4% adoption. The gross margin results indicated that IMV was highly profitable with mean gross margin of ₦65,289 (€384) per hectare as against the local varieties with a mean gross margin of 34,691 (€204) per hectare. The Tobit result shows that statistically ($\rho = 0.05$) factors that influence the adoption of IMV, with expected signs include: farm size, extension contact, access to credit, fertilizer, farming experience and household size. Policy that enhances farmers' access to credit will facilitate adoption through increased access to seeds of IMV and purchase of complimentary fertilizer input will enhance the intensity and rate of adoption.
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Key words: Framers, perception, improved *maize varieties, profitability, adoption, Tobit, savanna, Nigeria*

I. Introduction
Maize is one of the major cereal crops grown in the guinea savannah zones of Nigeria. It currently account for approximately 20% of domestic food production in West and Central Africa. It has also achieved the highest growth rate of the major crops since the 1970s (Kamara et al.., 2006). Despite the high yield potential of maize; its production is faced with numerous constraints. One of these is drought both at the beginning and during the growing season, which significantly reduces grain yield. Therefore, early maturing varieties that are tolerant to drought or extra-early maturing varieties that could escape drought are desirable in the region. 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 the chronic food shortages, stabilizes rural income and lessening the risk of farming.

In 2003, improved maize varieties (IMV) were promoted in the drought-prone savannas of Borno State, Nigeria. Since then, there was no attempt to measure adoption and examine the factors influencing the adoption of these IMV in the area.

2. Study objectives
The objective of the study was to link farmers' perception, profitability and factors influencing the adoption of IMV in Guinea savannas zone of Borno State, Nigeria. Drought, being the major cause of maize yield loss in the low land tropics, it is desirable for farmers in the Guinea savanna of Borno State to adopt the new improved *striga* resistant and early-maturing varieties that are tolerant to drought so as to bridge the gap between food demand and supply. Therefore, the outcome of this study will enable agricultural policy makers to design policy that will address factors influencing the adoption of IMV technology.

3. Study area and sampling technique
The study was based on the farm level data of maize farmers in the Guinea Savanna of Borno, Nigeria. The State covers an area of 69,435 km^2 and four agro-ecological zones namely: southern and northern guinea savannah in the south, sudan savannah in the south and central, and the sahel in the north. The survey covered the Guinea Savanna, because maize is prominently produced due to its suitable environmental conditions and improved maize

technology has been widely been disseminated. The Guinea Savanna of Borno State covers land area of about l4,442.4 km^2 and a population approximately 1.1 million out of which 95% are farmers (National Population Commission 2006). Majority of the farmers are small scale producers characterized by small farm size, use of simple farm implements and the use of limited capital inputs.

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

4. Analytical technique

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

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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 give a value ranging between 0 and 1, signifying that certain proportion of maize area is planted to IMV.

5. Results and discussions

Farmers' perception shows that early maturity, high grain yield and tolerance to drought were the positive perceptions, rated 1st, 2nd and 3rd respectively that influenced 66.4% adoption among the respondent farmers. The ability of the IMV to tolerate drought and the fact that it matures earlier than the existing local varieties limits the effects of drought on crop yield, and therefore enhances productivity and food security. Other advantages of the IMV identified by the respondents were good cooking taste which ranked 4th, while lower operational cost and ease of harvest ranked 5th and 6th respectively.

The Gross Margin of adopters and non-adopters of improved maize varieties (IMV) is presented in Table 1.

Table 1: Gross Margin of Adopters and Non-adopters of IMV

	Adopters (N = 154)		Non-Adopters (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 labour	8,260.6	24.0	8,260.6	32.3
Family labour	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 per ha	**68,656.0**		**34,115.0**	

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

The Tobit result shows the relationship between socio-economic factors of the respondents and the intensity of adoption of IMV in the study area. The estimated coefficients and t-ratios are presented in table 2.

Table 2: Maximum Likelihood Estimates (MLE) of Tobit Model showing the intensity of adoption of IMV 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 cost of production	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% level; ** at 5% level; * at 10% level

The coefficient of Tobit model (R^2) was 0.857. This implies that 85.7% variation in the adoption of IMV was due to the independent variables considered in the model.

The coefficient of educational status is positive and significant at 10%. The positive coefficient of educational status means that there is a direct relationship between adoption of IMV and educational status, whereby as educational status increases, adoption level also increases among farmers.

Total amount of hired labor per hectare is a significant factor influencing the intensity of adoption. The reason could be associated to the fact that most farmers depend on hired labor for farm activities, especially for weed and harvesting activities.

The coefficient of contact with extension agents is positive and significant at 1% level. This agrees with the *a priori* expectation that there is a positive significant relationship between extension contact and adoption of IMV in the study area. The positive relationship suggests that, adoption of IMV increases as extension contact between the Extension Agents and farmers become more frequent.

Family size coefficient was negative and significant at 10% level of significance. The negative coefficient suggests that the greater the family size the lower the intensity of adoption of IMV. It is likely that farmers with relatively larger family sizes attach greater importance to other non-farm activities than relatively smaller households. The coefficient of farming experience was also positive and significant at 5% level and agrees with the *a priori* expectation. This suggests that the more the farming experience the higher the intensity of adoption of IMV.

The coefficient of farm size was negative and significant at 1-% level. The negative coefficient implies an inverse relationship that as farm size increases, adoption of IMV decreases and vice-versa. In order words, the larger the farm size, the lower the potential of the intensity of adoption.

Access to credit also has a positive coefficient and significant at 1-% level. The positive coefficient suggests that adoption of IMV increase as farmers have adequate capital for the procurement of inputs such fertilizer, improved seeds, chemicals and payment for labor. The study investigated that only 11% of these respondents had access to credit during the 2006 farming season. This indicates that farmers in the study area have limited access to credit, which could affect their adoption potential. Also, the coefficient of the amount of fertilizer used by adopters of IMV was positive and significant at 1% level and also agrees with the *a priori* expectation. This implies that the level of adoption of IMV increases as farmers have access to adequate quantity of fertilizer.

6. CONCLUSION

The study revealed that, adoption of IMV is profitable. Extension contact has been identified as the key factor influencing the adoption of IMV in the study area. Farming experience, education, quantity of fertilizer used by farmers, and access to credit were other determinants of the intensity of the adoption. Policy should target at strengthening maize farmers to have improved access to credit, fertilizer and seeds of IMV. In addition, policy that provides adequately trained and equipped extension workers for disseminating technology information has the potential to increase the intensity and rate of adoption of the improved maize technology.

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