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Effects of Adoption of Improved Maize Seed on Household Food Security in Gwoza Local Government Area of Borno State, Nigeria

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Abstract - This study analyzed the effects of adoption of improved maize seed on household food security in Gwoza Local Government Area of Borno State. The study utilized primary data collected through questionnaire administered to 180 respondents selected through multi-stage sampling procedure. Data were analyzed using descriptive statistics (frequencies and percentages) and inferential statistical tools (the Probit model). The results revealed a preponderance of economically active respondents as the majority **(73.33%)** were between the ages of 26 and 55 years with most **(87.78%)** being male. While majority of the respondents **(64%)** had formal education, **36.67%** of the respondents had no formal education. Majority of the respondents operate at small-scale **(≤ 2ha).** Analyses of determinants of adoption revealed that education and extension contact significantly influenced the likelihood of the adoption of improved maize seed **($\rho \leq .01$).** Access to credit also influenced the adoption of improved maize seed. The study also found that adoption of improved maize varieties reduced the incidence, depth and severity of food insecurity among farming households in the study area.

Keywords : *Adoption, improved seeds, food security, Gwoza, Nigeria.*

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Abstract - This study analyzed the effects of adoption of improved maize seed on household food security in Gwoza Local Government Area of Borno State. The study utilized primary data collected through questionnaire administered to 180 respondents selected through multi-stage sampling procedure. Data were analyzed using descriptive statistics (frequencies and percentages) and inferential statistical tools (the Probit model). The results revealed a preponderance of economically active respondents as the majority (73.33%) were between the ages of 26 and 55 years with most (87.78%) being male. While majority of the respondents (64%) had formal education, 36.67% of the respondents had no formal education. Majority of the respondents operate at small-scale (≤ 2ha). Analyses of determinants of adoption revealed that education and extension contact significantly influenced the likelihood of the adoption of improved maize seed ($\rho \leq .01$). Access to credit also influenced the adoption of improved maize seed. The study also found that adoption of improved maize varieties reduced the incidence, depth and severity of food insecurity among farming households in the study area. The study therefore concludes that level of education and extension contact influenced adoption of improved maize seed among farmers in the study area while adoption of improved maize varieties significantly reduced food insecurity among farming households in the study area. Based on the findings of this study, it was recommended that adult education programmes/campaigns be strengthened in order to expose farmer to opportunities including knowledge about improved crop varieties, improved technologies should be made available to farmer while farmers should be linked to sources of credit.

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I. Introduction

A significant proportion of the population in sub-Saharan Africa, including Nigeria is food insecure and malnourished. Food security is one of the main concerns in many developing countries (FAO, 1996; IFPRI, 1996). Food crisis is most acute in sub-Saharan Africa, where the attainment of food security is intrinsically linked with accelerating agricultural growth rate (Cleaver and Schreiber, 1994; Matata et al., 2008).

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Agricultural growth has also been found to be four times more effective in reducing poverty, including food insecurity than growth in other sectors (UN, 2008). Consequently, the implementation and scaling-up of initiatives to improve agricultural productivity, particularly among smallholder farmers enhance food security and more efficient food distribution. Nigeria's development policy recognizes agriculture as a pillar of the economy, with priority centered on ensuring food security and increased export earning aimed at diversifying the economy. This zeal is further strengthened by the worsening food crisis of the 2007/2008 which saw the prices of staple food almost doubled. Due partly to high population pressure, farms and farmlands have become smaller and fragmented. This is further exacerbated by the fact that population growth has outstripped agricultural output growth (Lawal and Oluloye, 2008), thus the issue of food insecurity and subsequent food crisis. Low adoption of improved agricultural production technologies that can increase farmers' productivity is generally known to lead to reduced agricultural output. The low rate of adoption of improved agricultural technologies could be due to low expected benefits from the practice or could be due to other factors such as farmers' characteristics or institutional factors which may not encourage the adoption of technologies by farmers (Seyoum et al. 1998; Obwona 2000; Ajibefun 2006). Declining soil fertility and use of local crop varieties are also recognized as major impediments to the growth of African agriculture (Yates and Kiss, 1992; Valnauwe and Giller, 2006). This is further evidenced by low and declining yield per hectare of major crops in Nigeria (NBS, 2006).

Maize is a dominant staple food in Borno State in particular and Nigeria in general. The average annual per capita maize output for 2000-2005 is 85kg (NBS, 2006), while the per capita maize consumption is 175kg (FAO STAT, 2005). As a result, maize has received substantial research and extension attention. This also calls for the need to intensify effort on adoption of improved agricultural technologies for improved productivity and ensure food security. Even though several adoption studies explored technology adoption decision in developing countries (Feder et al., 1985; Rauniya and Goode, 1992; Ouma et al., 2006; Ojaiko et al., 2007; Idrisa, 2009), the studies fall short of

addressing the effect of adoption of improved seed technology on food security status of farming households.

The main objective of this study was therefore to examine the effect of adoption of improved maize variety on household food security in Gwoza Local Government Area of Borno State. The specific objectives of the study were to:

1) examine the socio-economic characteristics of the respondents;
2) analyze the factors influencing the adoption of improved maize seed among the respondent; and
3) analyze the effects of adoption of improved maize seed on household food security in the study area.

II. Materials and Methods

The study was conducted in Gwoza Local Government Area of Borno State. Multistage sampling procedure was used to draw sample for the study. In the first stage, three districts were purposively selected: Dure, Ghambaktha and Takwambare. These are the major maize producing districts in Gwoza Local Government. In the second stage, two communities were randomly selected from each district. Finally in the third stage, 30 respondents were randomly selected from each of the selected six communities, giving a total of 180 respondents used for the study. Data were collected from primary sources using structured questionnaires. The questionnaire elicited information from respondents pertaining to their personal characteristics, characteristics of their farms, their use of improved maize seed and access to agricultural services such as extension and credit.

Model specification

The discrete-discrete and discrete-continuous choice models were used to evaluate the effects of adoption of improved maize variety on household food security in the study area.

The discrete-discrete choice model

Bivariate probit model is most appropriate for assessing whether a farm household will adopt a high yielding maize variety, and whether conditional on adoption, the household risk of falling into food insecurity will reduce.

Let M denote characteristics of the farmer and Z the characteristics of the technology; and let K be the new technology and I the existing technology. The probability of adopting a new maize technology can be implicitly expressed as:

$$P(\mathbf{K}) = \rho(U_{\mathbf{K}}(M, Z_K) + e_k > U_I(M, Z_I) + e_I) \quad (1)$$

Where:

U_k and U_i are perceived net benefit associated with the adoption of improved technologies k and i, respectively, and e is the stochastic disturbance term. From equation (1), a binary Probit model of technology choice can be formulated on the assumption that the disturbance term is normally distributed (Maddala, 1986).

Equation (1) can be used to predict the probability that household i will adopt improved maize technology k given its characteristics (M) and attributes of the technology (Z). The equation can also be used to assess the effect of technology adoption on food insecurity. Specifically, the predicted probability from equation (1) can be used as a regressor in the food insecurity status equation to examine whether or not household food insecurity and adoption are negatively correlated. The food insecurity status of a household can be computed using the following expression as used by Mwabu et al. (2000), Mwabu et al. (2006) and Idrisa et al. (2008).

$$P_{\acute{\alpha}} = 1/N^* \Sigma_p((S-Y_i)/S)^{\acute{\alpha}} \quad (2)$$

Where,

$P\acute{\alpha}$= a measure of overall food insecurity;

Y_i= total Calorie consumption of household i per adult equivalent (i = 1…N);

S= food insecurity baseline: i.e Calorie requirement of household

N= total number of households;

p = total number of households facing food insecurity;

$\acute{\alpha}$= interpreted as a measure of food insecurity aversion, for $\acute{\alpha}\geq 0$.

Note that if $\acute{\alpha}=0$, the food insecurity measure, p0 becomes the headcount index, which indicates the percentage of household below food security line. For $\acute{\alpha}=1$, p_1 is the average food insecurity gap and for $\acute{\alpha}=2$, p_2 is the severity index, which is the weighted sum of food insecurity gaps.

Once the poverty status of the household is determined using equation 2, a Probit model of the probability of being food insecure can be estimated along the line of equation (1) and it is given as:

$$P_r(C_i < C_y) = f(X, ß) \quad (3)$$

Where:

P_r = probability that a household consume calorie lower than the required calorie.

C_i = total calorie consumption of household i.

C_y = food insecurity baseline.

X = a vector of determinant of food insecurity, a subset of M in equation (1).

ß = predicted probability of adoption, derived from equation (1), the coefficient of which shows the effect of technology adoption on food security.

2.2 Discrete – Continuous choice model.

Equation (3) may be written as:

$$W_i = f(\acute{\alpha}, ß) \quad (4)$$

Where :

W_i = food insecurity depth of household i. Thus dependent variable in this equation is now continuous rather than discrete as in equation (1).

The square of equation (4) measures the severity of food insecurity. apriori, it expected that level of education, income, extension contact and access to credit will have positive and significant influence adoption of improved maize seeds while age of farmers is expected to have negative but significant influence on adoption of improved maize seed by farmers. Similarly, level of adoption of improved seeds maize seeds is expected to have positive and significant influence on food security among farming households in the study area.

III. Results and Discussion

a) Socio-economic characteristics

Entries in Table 1 revealed that majority (73.33%) of the respondents were between 26 years and 55 years of age. This implies that the respondents have the required physical strength to engage in food production. Mass participation in food production has great capacity to reduce the incidence of food insecurity at both household level and community level. The majority (87.78%) of the respondents were also male with more than half (63.34%) of the respondents having attained formal education. However, 85% of the respondents operate at small-scale, having no more than two hectare of farmland.

It also determines the rate of application of innovations through counseling and demonstration by extension agents (Lawal and Oluloye, 2008). Nkonya et al. (1997) also opined that exposing farmers to extension services has great effect on reducing food insecurity through the adoption of improved farming practices by farmers and hence, increased yields. In the same vein, Onu (2006) found that farmers who had access to extension adopted improved farming technologies 72% greater than those who had no access to extension services.

Table 1 further shows that majority (62.22%) of the respondents had no access to credit facilities during the study period. Only 37.78% of the respondents had access to credit facilities. Access to credit enhances farmers' capacity to adopt improved production technologies which in turn increases productivity of farmers. As recognized by Ouma et al. (2006), most farmers in developing countries are cash-trapped. They need financial assistance to purchase the technologies and their complementary inputs. This suggests why linking farmers to sources of credit can go a long way in reducing food crisis particularly in developing countries.

Table 1 : Distribution of respondents based on their socio-economic characteristics

Variable	Frequency	Percentage
Age(years):		
≤25	30	16.67
26-40	60	33.33
41-55	72	40.00
>55	18	10.00
Gender:		
Male	158	87.78
Female	22	12.22
Educational qualification:		
No formal education	66	36.67
Primary education	54	30.00
Secondary education	50	27.78
Tertiary education	10	5.56
Farm size (ha.):		
≤1.0	68	37.78
1.1-2.0	86	47.78
2.1-3.0	24	13.33
>3.0	2	1.11
Access to extension services:		
Had access	126	70.00
Had no access	54	30.00
Number of extension visit received:		
≤3	38	21.11
4-6	72	40.00
7-9	59	32.78
>9	11	6.11
Access to credit:		
Had access	68	37.78
Had no access	112	62.22
Yield of maize per hectare (kg):		
≤500	44	24.44
501-650	52	28.89
651-800	50	27.78
>800	34	18.89

Source: Field Survey, 2008

b) Factors affecting the adoption of improved maize seed

The socio-economic characteristics that influenced the adoption of improved maize seeds by farmers include level of education of respondents, yield of maize, access to credit by respondents and extension contact. These factors were statistically significant at 1% and 5%, respectively (Table 2).

Level of education : Table 2 shows that the level of education of the respondents was a very important factor ($\rho \leq 0.01$) that influenced the extent of their adoption of improved maize seeds. The positive and significant relationship between level of education and extent of adoption in this study of maize seed also agrees with earlier studies (Feder et al., 1985; Awe, 1999) that literacy level positively influenced the adoption of fertilizer technology in southwestern Nigeria and Berkeley, USA, respectively. It should be noted that the influence of education on adoption of innovation is more likely to prevail in economies where farm production is modernizing and where farming communities are being exposed to educational opportunities compared to economies where agriculture has attained high level of modernization and almost all farmers have attained the necessary levels of education (Asfaw and Admassie, 2004).

Yield of Maize : Yield of maize was found to be a very important factor that influenced the adoption of improved maize seed among farmers in the study area. The yield variable was found to be positive and significant at 5% level of probability (Table 2). Yield is a direct measure of the seed's performance and a crop variety that is high yielding stands to be adopted by farmers since high yield would raise the output for food security and subsequent gross earning. This finding agrees with Ojiako et al., (2007) that yield of soybean was significant in influencing the adoption of improved soybean in northern Nigeria. Adesina and Zinna (1993) also reported that yield significantly influenced farmers' decision to adopt improved mangrove swamp varieties of rice in Sierra Leone.

Table 2 : Determinants of adoption of improved maize seed

Adoption	Coefficient	Standard error	Z	p>|z|
Age	.0846594	.0576184	1.47	0.142
Gender	-.2507744	1.403885	-0.18	0.858
Education	.6974936	.6455236	1.08	0.000***
Farm size	.5305544	.4560774	1.16	0.245
Income	.4824732	.303217	1.59	0.112
Yield	.0219869	.00774879	2.94	0.003**
Access to credit	4.841265	1.947661	2.49	0.001**
Extension contact	3.590882	1.954888	1.84	0.000***

** Significant at 5%
*** Significant at 1%

Alimi (1991) observed that one of the main problems facing agricultural production in developing countries is low yield. The practice of planting traditional/low yielding variety of crops by farmers may partly be responsible. This necessitated the development of high yielding varieties of crops by agricultural research institutes with the hope that these improved varieties of crops will be adopted by farmers so as to improve their yield. To that effect, a crop variety that has the capacity for high yielding also has high chances of being adopted. The likelihood of adoption is even higher if the crop variety does not depend so much on complementary inputs such as fertilizers and pesticides.

Access to credit : Table 2 also reveals that access to credit was found to be important in influencing the likelihood of adoption of improved maize seed among farmers in the study area. The variable was found to be statistically significant ($\rho \leq 0.05$) and positively related with the likelihood of adoption. Most farmers fear trying improved technologies because they do not have the necessary financial resources to adopt the technologies (Ouma et al., 2006; Omolehin et al., 2007). This is partly explained by the fact that most agricultural technologies require complementary inputs such as fertilizers and pesticides. These complementary inputs are difficult to come by due to the cash-trapped nature of farmers (Idrisa and Ogunbameru, 2008). Access to credit helps farmers out of their predicaments thereby influencing them to adopt innovations. Access to credit also encourages adoption of technologies among farmers in the sense that credit, especially those from formal sources are most likely covered by insurance. This also reduces the level of risk associated with adoption of technologies on the side of farmer, thereby increasing the likelihood of adoption.

c) Effects of adoption of improved maize seed on household food security

Table 3 presents the incidence, depth and severity of food insecurity among the respondents. The yard stick used for categorizing the respondents was the percentage of land devoted to the cultivation of improved maize variety. The result shows that 12.80% and 27.40% of the adopters who devoted 10 – 30% and 31 – 50% of their land to improved maize cultivation have

food insecurity incidence of 71% and 66% respectively, with the food insecurity depth of 0.38 and 0.32 respectively. The results also show that the same category of respondents had food insecurity severity of 0.24 and 0.18, respectively. This implies that as the level of adoption increases, the incidence of food insecurity is likely to decrease. This is attributed to devotion of more land to improved maize variety.

The result also shows that 12.80% of adopters that devoted 10 – 30% of their total land area to improved maize cultivation had food insecurity incidence of 71%, food insecurity depth of 0.38 and food insecurity severity of 0.24 while about 16.70% of the adopters that devoted more than 70% of their land to improved maize cultivation had food insecurity incidence of 53%, food insecurity depth of 0.19 and food insecurity severity of 0.09. This implies that as the level of adoption increases, food insecurity incidence, depth and severity tend to decrease.

Table 3 : Effect of Adoption of Improved Maize seed on the Incidence, Depth and Severity of Food Insecurity among Farming Households

			Food Insecurity		
Percentage of land under improved Maize variety	Number of Adopters	Percentage of Adopters	Incidence (%)	Depth	Severity
10 - 30	15	12.80	71.00	0.38	0.24
31 – 50	32	27.40	66.00	0.32	0.18
51 – 70	40	22.20	68.00	0.24	0.12
71 and above	30	16.70	53.00	0.19	0.09

Source: Synthesis of Field Data.

IV. Conclusion and Recommendations

The results of the study revealed that level education, access to extension services, yield and access to credit were key determinants of adoption of improved maize seed variety. The study also found that adoption of improved maize variety had significant effect on food security status in the study area.

Based on the findings of this study, the following recommendations were proffered:

- Farmers should be exposed to adult education programmes. This will go a long way in changing the attitude and orientation of the farmers towards innovations in particular and modernized agriculture in general.
- Extension services should be strengthened so as to teach farmers the need to adopt improved technologies, how to apply these technologies and how best to utilize the outcomes of these technologies so as to reduce poverty and improve food security.
- Farmers should be linked to sources of affordable credit so as to enable them purchase these inputs and their complementary needs.

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