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Analysis of Adoption of Improved Maize Production Technology among Farmers in Southern Borno, Nigeria

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Abstract
This study assesses the adoption of Improved Maize Production Technology among farmers in Southern Borno, Nigeria. The specific objectives were to analyze the relationship between socio-economic characteristics of the respondents and their adoption of improved maize technology and to determine innovation utilization and its effect on farmer's production. Data for the study were obtained from 360 respondents selected through multi-stage sampling procedure. Both descriptive and inferential statistical techniques were used to analyze the data. Gross margin was used to measure the profit of farm enterprises (effect of farmer's production) before and after utilizing the agricultural innovation, while Regression analysis (OLS) was used to establish relationship between socio-economic characteristics of the respondents and adoption of agricultural innovation. The result of the profitability analysis revealed that the gross margin per hectare of respondents before adoption of agricultural innovation was ₦59, 009.44, while the gross margin per hectare of respondents after adoption of agricultural innovation stood at ₦76, 003.43, translating to 29% increase in gross margin of the respondents. Level of education (P< 0.01), and gender (P< 0.01) were the most important factors that influenced adoption of agricultural innovation among farmers in the study area. Farm size (P< 0.01), age of respondents (P < 0.01), extension contact (P < 0.01), radio ownership (P< 0.01) and cosmopoliteness (P < 0.05) were also important in influencing adoption of agricultural innovation by farmers in the study area. Based on the findings of this study, it was recommended that farmers should be given more easy access to credit. In light of this, there is need to link farmers to sources of credit given its importance in the utilization of improved agricultural technology.
Key words: Adoption, Farmers, Technology, Southern Borno, Improved Maize.

1. Introduction

Agricultural productivity in the developing countries continues to be low and its generally believed that non-adoption of research results by majority of farmers is the main reason for this situation (Chaudhry et al., 2006). Recent adoption studies have identified farm and technology specific factors, institutional, policy variables and environmental factors to explain the pattern and intensity of adoption (Oladele, 2005). Rao and Rao (1996) found a positive and significant association between age, farming experience, training received, socio-economic status, cropping intensity, aspirations, economic motivation, innovativeness, information sources utilization, agent credibility and adoption.

Borno state of Nigeria is blessed with great potentials necessary for the production of food crops. Among many of the crops produced in this state are maize, soybean, groundnut, cassava, rice, sorghum and millet. However, one of the most important agricultural issues confronting Borno state, is the diffusion of innovations and the adoption of recommended farm practices by farming population, partly due to lack of awareness among farmers of the immense significance of the effect of such recommended practices. Usually, farmers will adopt a technology under the following conditions: if it is simple, has comparative advantage, is compatible with existing planting practices, is available and is affordable. The main focus of this study was to assess the farmers' adoption of improved maize production technology in southern Borno, Nigeria. The specific objectives include to:

i. analyze the relationship between socio-economic characteristics of the respondents and adoption of agricultural innovations;
ii. determine innovation utilization and its effect on farmers' production.

Hypothesis: There is no significant relationship between utilization of agricultural innovations (adoption) and farmers' production.

2. Methodology

The study was conducted in Southern Borno, Nigeria, where improved maize varieties and associated management practices are being promoted for both food and commercial crop by PROSAB. Multi-stage sampling technique was used to select sample for the study. In the first stage, three communities were randomly selected in each of the four LGAs of Biu, Damboa, Hawul and Kwaya-Kusar. In the second stage three improved maize producing communities were selected from each of the earlier selected LGAs, given a total of 12 communities used for the study. In stage three, 360 respondents were selected proportionately from 12 communities earlier selected as follows: Filin Jirgi 40, Mirnga 50, Tila 20, Azir 10, Sabon Gari 25, Kimba 15,

Yimirshika 45, Marama 75, Shaffa 30, Wandali 25, Ngabu 15 and Guwal 20, making a total of 360 respondents. The 360 respondents were administered the interview schedules.

Both descriptive and inferential statistics was used to analyze the data collected for the study. Gross margin was used to determine profit or loss of farm enterprises of the respondents. Regression (OLS) model was used in analyzing the influence of socio-economic characteristics of the respondents on their adoption of improved maize production technology while independent paired sample test was used to test the stated hypothesis.

The model specifies that:

Y = Adoption of agricultural innovation by the respondent

X_1= Age
X_2= Sex
X_3= Level of education
X_4= Farm size (ha)
X_5= Household size
X_6= Income (₦)
X_7= Extension contact
X_8= Access to credit
X_9= Radio ownership
X_{10}= Number of social organization belonged
X_{11}= Cosmopoliteness
βo = Constant
β_1-β_{11}= Coefficients
e = Error term

The Gross Margin is expressed as follows:

GM= GR- TVC

Where:

GM = Gross Margin (₦/ha)
GR = Gross Revenue (₦/ha)
TVC = Total Variable Cost (₦/ha)

3. Result and Discussion

3.1 Factors affecting adoption of agricultural innovation

The coefficient of age was found to be significant $P \leq 0.01$ and relates positively with adoption of agricultural innovation (Table 1). This finding is in contradiction with the a priori expectation that age was expected to have a negative relationship. This confirms that adoption of agricultural innovation increases with age of the farmer. The finding is in line with Ofuoku *et al.* (2006) who found that age is related to innovation utilization because the stage of life of farmers affects their attitude towards innovation usage. The older the farmers are the more likely they are willing to put farming related innovation into use. This finding does not agree with Lemchi *et al.* (2003); Asiabaka *et al.* (2001); Odoemenem and Obinne (2010) who stated that the older the farmer becomes, the more risk averse he/she is, to utilize agricultural innovation. Table 1 also shows that sex of the respondents was a very important factor $P \leq 0.01$ that influences adoption of agricultural innovation in the study area. The positive and significant relationship between gender of respondents and agricultural innovation utilization in this study also agrees with an earlier study (Onu, 2006) that gender plays significant role in utilization of innovation.

Result in Table 1 also reveals a positive and significant relationship between level of education and adoption of agricultural innovations. The value was significant at $P \leq 0.01$ level of probability. The positive and significant relationship between level of education and agricultural innovation utilization also agrees with earlier studies (Ofuoku *et al*., 2006; Abdul *et al*., 2003) that level of education of farmers has significant relationship with innovation utilization by them, because educational level influences innovation utilization.

Table 1 similarly shows positive and significant relationship between farm size and agricultural innovation utilization. The regression coefficient was positive and significant at $P \leq 0.01$ level of probability. Farm size has bearing on the capacity of farmers to utilize agricultural innovation and new farm practices. Farmers with large farm sizes can afford to devote part of their farms to try innovations they received without significantly affecting their total land area. This finding is in agreement with the findings of Onu (2006); Bamire and Manyong (2003); Surri (2005). They reported that farm size significantly influences farmer's innovation utilization.

The coefficient of extension contact was found to be significant $P \leq 0.01$ and relates positively with adoption of agricultural innovation (Table 1). Extension contact determines the information that farmers obtain on production activities and the application of innovations through counselling and demonstrations by extension

agents. The result is in consonance with findings by Onu (2006); Ouma *et al.* (2006) that the number of extension contact positively influenced the utilization of improved technology by farmers.

Results in Table 1 revealed that radio ownership had a positive and significant influence on the utilization of agricultural innovation by respondents P ≤ 0.01. Radio is one of the sources of information dissemination. Studies by Ani (2004); Buba 2003 and Ogunbameru (2001) indicated that radio cuts across the literacy barriers required in books, newspapers, journals, bulletins, pamphlets etc. Radio in essence often does not require higher educational qualification or background to be effective.

The coefficient of cosmopoliteness was found to be significant P ≤ 0.05 and relates with adoption of agricultural innovation (Table 1). Cosmopoliteness is the degree of orientation of the respondents towards outside the social system to which they belong. Interaction with people outside one's social system tends to expose him/her to have access to more information. The finding in this study corroborates the earlier finding by Abdul *et al*. (2003) who found that cosmopoliteness accounted for significant variation in communication behaviours of farmers and information utilization.

3.2 Estimated cost and returns of maize production before and after adoption of agricultural innovation on improved maize production technology

The profitability analysis presented in Table 2 shows that per hectare gross margin of respondents before adoption of agricultural innovation by respondents was estimated at ₦59, 009.44, while the gross margin per hectare of respondents after utilization of agricultural innovation stood at ₦76, 003.43. This shows an increase with a difference of ₦16, 994.03 after agricultural innovation was utilized by the respondents, and that had translated to 29% increase in gross margin of the respondents.

Based on the variable cost components, ₦2,247.78 was spent on buying seeds before the utilization of agricultural innovation, whereas after the adoption of agricultural innovation, ₦2,963.71 was expended, showing a difference of ₦715.93. This could be due to the high cost of improved seed variety compared to the local one. Considering the cost of fertilizer before utilization of agricultural innovation, ₦8, 827.05 was spent on fertilizer, while after adoption agricultural innovation a total of N11, 769.39 was spent on fertilizer, given an increase of ₦2, 942.34.

This increase could be due to the improved maize seed used, which may have higher fertilizer requirements. Repeat application could be a possible reason for the increase on expenditure on fertilizer. Likewise, there is a difference on expenditure on chemicals from ₦250.73 to ₦834.30 before and after utilization of agricultural innovation. Labour cost increased from ₦5, 267.05 to ₦9,231.86. Despite the differences in the variable costs, the gross margin was still positive with an increase of ₦16, 994.03 after agricultural innovation was utilized by the respondents; these have shown that adoption of improved maize production technology could be responsible for the positive gross margin.

The finding of this work therefore, corroborates the result of Ouma *et al.* (2006) and Agbamu (2006). Their findings showed that, there is a positive relationship between farmers' level of income and utilization of agricultural innovations.

3.3 Result of hypotheses testing

Table 3 shows the result of testing the relationship between utilization of agricultural innovation and farmer's production, before and after adoption of agricultural innovation. Independent sample t-test was used, which assumed equal variance.

The hypothesis which stated that there is no significant relationship between adoption of agricultural innovation and farmer's production was rejected. The mean difference between respondents' adoption of agricultural innovation before and after was 671.37862 which translate into 671.38 kg/hectare of maize, with t-value of 2.727 which is significant at 1% level of significance. This result can be substantiated with the result of the profitability analysis presented in Table 1 which shows that the per hectare gross margin of respondents before adoption of agricultural innovation was estimated at ₦59,009.44, while the gross margin per hectare of respondents after utilization of agricultural innovation stood at ₦76,003.43 which shows an increase with a difference of ₦16,994.03 after adoption of agricultural innovation by the respondents, and that had translated to 29% increase in gross margin of the respondents.

4. *Conclusion and Recommendations*

The high rate of population growth in Nigeria has led to continuous land fragmentation and degradation, which in turn has rendered the traditional farming method ineffective. There is the need therefore, for enlightening the farmers about the use of improved agricultural technologies, which will ensure high yields per unit land area in order for Nigeria to feed herself. Result of multiple regression analysis on factors affecting adoption of agricultural innovation by respondents' identified are: age, gender, level of education, farm size, extension contact, radio ownership and cosmopoliteness are positive and significant. This shows that variation in the dependent variable is explained by variations in the independent variables. Profitability analysis showed that,

gross margin per hectare of respondents after adoption of agricultural innovation, was positive and stood at 29% increase compared to the gross margin before adoption of agricultural innovation. Thus, utilization of agricultural innovation by farmers' increases agricultural production in the study area.

Based on the findings of this study, it's recommended that Farmers should be given more easy access to credit. In light of this, there is need to link farmers to sources of credit given its importance in the utilization of improved agricultural technology. Credit is very important in encouraging farmers to utilize improved technology; therefore, farmers should be linked to credit through establishing financial institutions such as the micro-finance banks in the rural areas.

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Table 1: Multiple regression analysis of factors affecting adoption of agricultural innovation by respondents

Variables	Estimated coefficients	P-value
(Constant)	0.881	.000***
Age	0.028	.000***
Sex	0.619	.004***
Level of education	0.046	.001***
Farm size	0.328	.003***
Family size	0.001	.975
Income	2.787E-7	.155
Extension contact	0.582	.000***
Access to credit	-0.108	.536
Radio ownership	0.412	.001***
Number of social organization belonged	0.147	.421
Cosmopoliteness	0.120	.022**
R^2	0.84	

Source: Regression extract, 2010
***Significant at 1%
**Significant at 5%

Table 2: Comparison of gross margin per hectare before and after adoption of agricultural innovation by respondents

	Before (₦ /ha)	**After(₦ /ha)**
Gross Revenue(GR)	**75,602.05**	**100,802.73**
Variable Costs:		
Seed	2,247.78(13.55)	2,963.71(11.95)
Fertilizer	8,827.05(53.20)	11,769.39(47.46)
Chemical	250.73(1.51)	834.30(3.36)
Labour	5,267.05(31.74)	9,231.86(37.23)
Total Variable Cost (TVC)	**16,592.61**	**24,799.26**
Gross Margin (GR-TVC)	**59,009.44**	**76,003.47**

Source: Field survey, 2010
-Values in parenthesis are the percentage contributions of the variable inputs to TVCs

Table 3: Independent paired samples t- test between maize production before and after adoption of innovation by respondents

Crop yield(kg/ha):	Mean differences	t_value	Sig
After and Before	671.37862	2.727***	.007

Source: Field survey, 2010
***Significant at 0.01 (1%)
-Equal variances assumed reject if significant, equal variances not assumed accept if significant

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