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FACTORS INFLUENCING ADOPTION DECISIONS OF MAIZE FARMERS IN NIGERIA

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Abstract

The needs to develop improved varieties of maize have been in the heart of various researchers and institutions in Nigeria because of its strategic role in tackling food insecurity and poverty. Despite substantial efforts to improve maize varieties, the level of adoption of improved maize varieties (IMV) in Nigeria in still very low. Although previous adoption studies have indicated a number of socioeconomic and institutional/organizational variables as important factors influencing adoption of improved maize (crop) varieties in the country, whether these factors are the main issues of concern, and whether the inclusion of regional/agro-ecological variables in adoption model are also important in explaining what could drive farmers' adoption behaviour requires investigation. This study therefore examined factors influencing adoption of IMV among farmers in Nigeria using a selected portion of the Nigeria Living Standard Measurement Survey data collected by the National Bureau of Statistics and the World Bank for 2010/2011 cropping season with descriptive statistics and probit model as tools for data analysis. The results suggest, in line with some previous studies, that farm size, education level of farmers and access to extension services would significantly influence adoption of IMV. The results also indicate that farmers across the entire agro-ecological regions of country share some negative sentiments regarding adoption of IMV. Renewed emphasis on interventions that would enable farmers gain more access to farmland, and promote formal education and extension service are advocated. An attempt to incorporate variables that capture farmers' perception/experience on agro-climatic/ ecologically related concerns in adoption study could aid better understand of what drives farmers' adoption decisions across the country especially in the light of the emerging climate change issues and its implication on food production.

Key word: *Adoption decisions, Improved maize varieties, probit model, Nigeria*

1. Introduction

Agriculture still offers the leading source of livelihood, and contributes a great percentage to national income for most developing countries around the world. Statistics from ILO (2007) suggests that about 60% of Africa labour force still derive their livelihood from agriculture, making it the largest employer of labour in most developing countries.

Although global food (cereal) production has increased significantly as a result of adoption of agricultural innovations (improved crops varieties) and other associated technologies such as fertilizer, herbicides and pesticides (Tilman *et al*., 2002) with sub-Saharan African region making steady rise in agricultural productivity as a result of agricultural technology adoption (Nin-Pratt & Yu, 2010; Fuglie & Rada, 2013). There are still growing concerns about the ability of the existing traditional agricultural practices to feed the teeming population in the region, especially Nigeria which has the largest population in the region with high rate of poverty, food insecurity and malnutrition.

The need to develop improved varieties of maize (and crops) that are disease, pest or weed resistant with high nutritional content; and that can withstand changing weather (drought tolerant) has been in the heart of various researchers and institutions (Welch & Graham, 2004; Juma, 2010). This has become necessary in achieving food security, not only for yield increase but also for improved nutritional quality of crops by way of bio-fortification of some of African's major stables- most importantly maize (HarvestPlus, 2012). Maize cultivation is very popular among arable crops farmers in Nigeria (Bamire *et al*., 2010) because of its high socio-economic value and importance in tackling food insecurity and poverty. A number of studies**,** conducted in various parts of Nigeria suggest some factors (constraints) that are responsible for low level of agricultural technology adoption (Odoemenem & Obinne, 2010; Kudi *et al*., 2011; Idrisa *et al*., 2012). Some of the major constraints identified are credit facilities, education, extension services, farm size, land tenure system and labour availability. Most of these studies are limited in sample size, and confined to a particular region of the country and consequently have been unable to employ some of the underlying information regional factors could provide in understanding adoption process in the country. This suggests that more detailed empirical studies are still required to support existing findings or uncover some other factors that influence adoption of IMV across the country. For example, in Nigeria, there has not been any study of national scope that has attempted to examine the influence of regional/agro-ecologically related variables on adoption of technology. Thus, the main objective of this study is to examine the influence of some socioeconomic, institutional and regional/agro-ecological factors on adoption of IMV in Nigeria.

2. Review of Literature :A Brief Review of Agricultural Technology Adoption Studies

Agricultural technology adoption study has many policy implications in agricultural development. It serves as a tool for evaluating the distributional impacts of new innovations, for documenting the impact of an innovation or extension effort, for identifying and reducing the constraints to adoption, and as a research guide to focussing innovation priority (Feder & Slade, 1984; Adesina & Zinnah, 1993; Green & Ng'ong'ola, 1993; Doss, 2003; Langyintuo &Mungoma, 2008). The rate at which innovations are used by farmers is largely dependent on sensitisation, mentoring and demonstration by extension agents (Lawal & Oluloye, 2008). The work of Lawal *et al*. (2005) conducted in some villages in the Southwest Nigeria recorded high adoption rate (about 56.7%) of improved varieties of seeds. Other study in this area (Omobolanle & Samuel, 2006) reported low adoption rate of improved crops technology as a result of low research and extension outreach to farmers. Studies across the country showed that where awareness was high and extension contact was more than 60%, adoption of agricultural technology is usually more than 50%. In their studies, Holloway *et al*. (2007) and Langyintuo and Mekuria, (2008) identified neighbourhood effects as an important factor that can greatly influence farmers' adoption decision. They argue that as farmers make technological choices, they are influenced by the behaviour of neighbouring farmers or by agro-ecological characteristics. The wealth status of farmers has also been identified as

critical factors influencing adoption. The general belief is that wealth will positively influence farmers' adoption decision; this is because access to more resources increase farmers risk bearing ability (Morris *et al*., 1999). Doss (2003) share some perspectives on a number of indices that are often used to proxy farmers wealth status. They include livestock ownership, non-agricultural assets, and landholding. Another interesting characteristic of farmers that could have either positive or negative effect on adoption of agricultural technology as observed in some adoption literature is the age of the farmer. Adesina and Baidu-Forson (1995) share a thought about the expected effect of farmers' age on adoption, arguing that older farmers may have more experience in crop production and be more exposed to the potentials in modern technology than younger farmers. They however pointed out that they could as well be more risk averse than younger farmers and have a lesser likelihood of adopting improved technology.

In Nigeria, empirical studies on agricultural technology adoption suggest that factors such as socio-economic characteristics of farmers, access to credit or cash resources and information from extension and other media influence adoption rate of new agricultural technology among farmers (Ayinde *et al*., 2010; Idrisa *et al*., 2012). For example, Ayinde *et al*. (2010) found that education level of farmers; farming experience; farm size; access to extension agents and access to credit have significant and positive influence on adoption. In the study conducted by Kudi *et al*. (2011), farmers' awareness has considerable influence on the rate of adoption of agricultural innovation. Oladele (2006) noted that introduction of IMV is not enough without a suitable complementary practices such as, planting distance, seed dressing, method of fertilizer application, weed control method and storage technique to aid better performance of agricultural technologies.

3. Methodology

3.1. Description of Data for the Study

The data utilised for the study were extracted from the Nigeria Living Standard Measurement Survey. The data collected by the National Bureau of Statistics and the World Bank[1] during 2010/2011 cropping season. A combination of systematic and simple random sampling techniques was used to select the 5000 farm households of which about 3,025 households were headed by crop farmers. Among the crop farmers, 1,838 were maize farmers. Of the maize farmers, 1,000 selected across the six agro-ecological zones of Nigeria have adequate information that could be relied upon for analysis. The data contain, among others, information about the socio-economic characteristics of the farmers, production patterns, input used, farmers that had used improved seed varieties and associated technologies and the reasons for choosing the type of seeds used in the cropping season under review. Farmers' responses on the choice of seeds used suggest that some farmers prefer traditional varieties of maize seeds while some others obtained their seeds from either extension outlets or government input suppliers and are thus, classified as adopters of improved varieties of maize seeds.

3.2. Probit Model Specification

The probit model is often used in situation where an individual makes choices between two alternatives which in this case, decision to either adopt (or not adopt) improved maize varieties. From the economist perspective, an individual i makes a decision to adopt if the

[1] www.worldbank.org/lsms-isa

utility associated with that adoption choice (V_{1j}) is higher than the utility associated with decision not to adopt (alternative choice), (V_{0j}). Following Koop (2003), the different in utilities of the two alternative choices is stated as $y_j^* = V_{1j} - V_{0j}$ and the econometric specification of the model is given in its latent as:

$$y_j^* = X_j\beta + e_j \quad (1)$$

Where y_j^* is an unobserved (latent) random variable that defines farmer's binary (adoption) choices, X_j are sets of explanatory variables associated with individual j. β is a vector of coefficients associated with the explanatory variables while e_j represents the random error terms defined as: *e ~N(0, 1)*. The relationship between the unobserved variable y_j^* and the observed outcome (y_j) can be specified as:

$$y_j = 1 \quad if \ y_j^* \geq 0$$
$$y_j = 0 \quad if \ y_j^* < 0 \quad (2)$$

Description of the dependent and independent variables employed for analysis in this study is provided in Table 1.

Table 1. Description Of Variables Used in the Adoption Models

Variable		Unit	Variable Description
y	Adoption	Dummy	D = 1 if farmer adopts; 0 otherwise
X_1	Sector	Dummy	D = 1 if rural; 0 otherwise
X_2	Marital Status	Dummy	D = 1 if married; 0 otherwise
X_3	Sex HH	Dummy	D = 1 if male; 0 otherwise
X_4	Education	Years	Level of education of household head
X_5	Total fam Size	Hectare	Total farm size of the household
X_6	Use Pesticide	Dummy	D = 1 if use pesticide; 0 otherwise
X_7	Use Herbicide	Dummy	D = 1 if use herbicide; 0 otherwise
X_8	Use Fertilizer	Dummy	D = 1 if fertilizer; 0 otherwise
X_9	Member Ass	Dummy	D = 1 if member of association; 0 otherwise
X_{10}	Ext Vis Access	Dummy	D = 1 if access to extension visit; 0 otherwise
X_{11}	HH Labour	Number	Number of household labour force
X_{12}	TLU	TLU	Tropical Livestock Unit (Number owned)
X_{13}	Own Land	Dummy	D = 1 if land with collateral right;0 otherwise
X_{14}	South-South	Dummy	D = 1 farmers belong to the region, 0 otherwise
X_{15}	South-East	Dummy	D = 1 farmers belong to the region, 0 otherwise
X_{16}	South-West	Dummy	D = 1 farmers belong to the region, 0 otherwise
X_{17}	North-East	Dummy	D = 1 farmers belong to the region, 0 otherwise
X_{18}	North-Central	Dummy	D = 1 farmers belong to the region, 0 otherwise
X_{19}	North-West	Dummy	D = 1 farmers belong to the region, 0 otherwise

Table 2. Descriptive Statistics of Some Selected Variables

	Adopters		Non-Adopters		All Farmers	
Variables	Freq	Percent	Freq	Percent	Freq	Percent
Sector						
Urban	41	12.7	68	10.1	109	10.9
Rural	283	87.3	608	89.9	891	89.1
Age						
21-40	94	29.0	199	29.4	293	29.3
41-60	147	45.5	278	41.1	425	42.5
61-80	71	21.9	177	26.2	248	24.8
81-100	12	3.7	19	2.8	31	3.1
Education						
No secondary education	134	41.4	462	68.3	596	59.6
Secondary education	190	58.6	214	31.7	404	40.4
Fertilizer						
Use	146	45.1	389	57.5	535	53.5
Do not use	178	54.9	287	42.5	465	46.5
Farm size						
< 1 hectare	189	58.3	492	72.8	681	68.1
1-1.99 hectares	46	14.2	83	12.3	129	12.9
2-2.99 hectares	31	9.6	55	8.1	86	8.6
3-3.99 hectares	16	4.9	18	2.7	34	3.4
> 4 hectares	42	13.0	28	4.1	70	7.0
Extension						
No access	217	67.0	657	97.2	874	87.4
Have access	107	33.0	19	2.8	126	12.6
TLU*						
0.00	98	30.2	198	29.3	296	29.6
0.04	66	20.4	125	18.5	191	19.1
0.05	2	0.6	-	-	2	0.2
0.10	98	30.2	236	34.9	334	33.4
1.00	45	13.9	94	13.9	139	13.9
1.25	15	4.6	23	3.4	38	3.8
Total	324	100	676	100	1000	100

Source: Computed form NBS/World Bank Data (www.worldbank.org/lsms-isa)

**A TLU is an animal unit that represents an animal of 250kg live weight. It follows Runge-metzger, (1988) which assign 1.25 to bullock; 1.0 to cattle, sheep and goat 0.1, turkey 0.05, and chicken 0.04*

4. Results and Discussion

4.1. Socioeconomic Characteristics of Maize Farmers

The descriptive statistics of some selected socioeconomic characteristics of maize farmers examined in this study are presented in Table 2. The result revealed that approximately 67.6 % of the farmers under analysis were non-adopters of improved maize varieties. The majority (89.1%) are located in the rural areas while almost 71.7 % of the

respondents were between the ages of 21 and 60 years. This age bracket has physical strength to actively engage in farming activities. The maize farmers' population were dominated by men (about 88%). This agrees with the result of Bamire *et al*. (2010) that reported high percent (99.4%) of men maize farmers in Nigeria. The majority (59.6 %) of the farmers do not have secondary education and about 87.4% do not have access to extension service.

Furthermore, approximately 81.0% of the maize farmers cultivate less than 2 hectares of maize farm. Approximately (47.5%) of the farmers reported that they had access to and used fertilizer on their farms. Given the needs to frequently replenish the soil nutrient, access to fertilizer could increase area of land cultivated with improved varieties. Yiljep's (2001) result revealed that about 80% of sampled farmers in Nigeria reduced the land area cultivated with improved varieties of maize as a result of low level of fertilizer usage and about 39% shifted to local varieties. In terms of livestock ownership, about 83.3% of the farmers have TLU of 0.19; suggesting a relatively low wealth status of the majority of maize farmers in Nigeria.

4.2. Factors Influencing Adoption of Improved Maize Varieties

The parameter estimates of the probit model used to identify the factors influencing farmers' decision to adopt IMV are presented in Table 3. The results suggest in line with previous studies (Lawal & Oluloye 2008; Bamire *et al*., 2010; Odoemenem & Obinne, 2010) that farmer's education, farm size, fertilizer usage, and access to extension service exert positive and significant influence on adoption of IMV. In terms of the magnitudes of the estimated coefficients, the results (marginal effects) show that a unit increase in years spend in acquiring formal education, farm size, access to fertilizer and extension service would increase the probability of adoption of IMV by 0.01, 0.02, 0.05 and 0.47 respectively. Likewise, the results suggest that farmers that have access to fertilizer and extension services are more likely to adopt improved maize varieties than their non-adopter counterparts. The entire regional level/agro-ecological variables examined are significant and exert negative influence on the probability of adoption of IMV. This is contrary to expectation as at least one of the regional level/agro-ecological variables is expected to exert positive influence on rate of adoption. One explanation is that the maize farmers could be involved in rain-fed/upland agriculture. It has been reported in some studies (Ransom et al., 2003; Paudel & Matsuoka, 2008) that more irrigation is required for some improved maize varieties compared to the local/traditional varieties; and farmers who depend on rains for maize production or engaged in upland maize farming as it is for the majority of Nigerian farmers might be reluctant to adopt IMV. This is possible especially in the emerging issues relating to climate change and weather variability in the country and other nations of the world. As noted by Kandji et al (2006), one of the reasons why farmers in Africa are unwilling to adopt improved (high-yielding) crop varieties and other complementary technologies such as chemical fertilisers is that they do not want to commit their scarce resources without knowing whether the rain will be adequate or not. Nevertheless, an examination of the magnitudes of the marginal effects suggests that the probability of adoption would be marginally higher among farmers in the south-south, north-east and north-central than those in the remaining zones.

Table 3. Factors Influencing Adoption of Improved Maize Varieties

Variables	**Model A** (Model with Neighbourhood Effect)			**Model B** (Model without Neighbourhood Effect)		
	β	t-values	Marginal effect	β	t-values	Marginal effect
Sector	0.22	1.42	0.06	0.14	0.94	0.04
Marital Status	0.19	0.77	0.05	0.27	1.09	0.07
Sex of Household Head	-0.26	-0.94	-0.06	-0.4	-1.5	-0.11
Education Status of HH	0.02	5.63*	0.01	0.02	5.73*	0.01
Farm Size	0.04	2.52**	0.01	0.02	1.61	0.01
Use Herbicide	0.15	1.19	0.04	0.04	0.37	0.01
Use Fertilizer	0.16	1.54	0.04	0.19	1.92***	0.05
Membership of Association	-0.04	-0.4	-0.01	-0.01	-0.06	0.001
Access Extension Visits	1.76	11.45*	0.47	1.75	11.61*	0.48
Non-farm Employment	-0.09	-0.94	-0.02	-0.08	-0.86	-0.02
Household Labour	-0.01	-0.61	0.001	-0.01	-0.73	0.001
Total Livestock Unit	-0.11	-0.78	-0.03	-0.11	-0.74	-0.03
Own Land	0.01	0.05	0.001	-0.04	-0.4	-0.01
South-South	-1.17	-4.11*	-0.32			
South-East	-1.89	-6.07*	-0.51			
South-West	-1.64	-5.17*	-0.44			
North-Central	-1.19	-4.23*	-0.32			
North-East	-1.23	-4.23*	-0.33			
North-West	-1.68	-5.05*	-0.46			
Constant	-	-	-	-1.26	-4.71*	-0.35
Pseudo R-Square	0.47			0.45		
Log likelihood	-487.25			-498.93		
Log marginal likelihood	-600.69			-599.54		

Source: Computed from GHS Survey Data, 2011(www.worldbank.org/lsms-isa). *Note: ***variables significant at 10%, **variables significant at 5% and *variables significant at 1% level of significant. β=vector of estimated coefficients. HH=Household Head.*

5. Conclusion

Emergence of improved maize varieties has been a mammoth step ahead in the development of suitable technologies for the smallholder farmers in Africa. Although several adoption studies have continued to indicate a number of socioeconomic and institutional/organizational variables as important factors influencing adoption of improved maize (crop) varieties in many parts of Africa (and Nigeria), whether these factors are the main issues of concern, and whether the inclusion of regional/agro-ecological variables in adoption model are also important in explaining what could drive farmers' adoption behaviour in the Nigeria's context are the motivations for this study. Consequently, this

study examined factors influencing adoption of improved maize varieties among farmers in Nigeria.

The results suggests in line with some previous studies that higher educational attainment and farm size, as well as access to fertilizer and extension cervices are socioeconomic and institutional factors that would increase the probability of adopting IMV among farmers. Policies that would enable farmers gain access to more farmland, fertilizer, and promote formal education and extension services should be promoted or strengthened. This would entail, among others, revisiting and reforming the Land Use Act to enable farmers to have more access to land for arable crop production; proper monitoring and strengthening of the on-going fertilizer subsidy intervention in order to block leakages and ensure timely disbursement to farmers; and renewed efforts to project the critical roles of agricultural innovation through the various arms of the educational institutions- as a long-term strategy to ensure high and sustained level of adoption of agricultural technologies. The agricultural extension arm of the Agricultural Development Programme (ADP) should be encouraged to take advantage of emerging technologies, such as Information Communication Technology (ICT) in delivering a more effective and efficient services.

The results also show that all the regional/ecological variables in the adoption model had negative influence on the probability of adoption, indicating that farmers across the entire country share some negative sentiments regarding adoption of improved maize varieties. While we might be unable to adduce a comprehensive list of reasons for our findings in this paper, we opine in line with some previous studies that such findings could be attributed to farmers' expectation/experience about unpredictable rainfall patterns (climate change issues). An attempt to incorporate variables that capture farmers' perception/experience on climate change might help decision makers gain better understand of what drives farmer's adoption decision especially in the light of the emerging climate change issues and its implication on food security.

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