Evaluating the Effectiveness of Extension Methods used by National Agricultural Extension and Research Liaison Services (NAERLS) in Kaduna State, Nigeria

S. Usman
National Agricultural Extension and Research Liaison Services, ABU Zaria, Nigeria

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Abstract

Using cross-sectional data of 164 crop farmers from two NAERLS adopted villages in Kaduna State, a binary response model was employed to evaluate the effectiveness of NAERLS extension methods in influencing crop farmers' decision to adopt improved crop production technologies. Among all the seven extension methods commonly used by NAERLS in disseminating improved crop production technologies, only the extension agent visit method ($p<0.01$), on farm demonstration plot method ($p<0.05$), management of training plot method ($p<0.05$) and farmer to farmer extension method ($p<0.10$) were found positive and statistically significant in influencing farmers' adoption decision. Hence, in an effort to increase high crop productivity through increased adoption rates, it is recommended that extension policy to adequately fund extension agent visit to farmers, as well as technology result demonstration and training should be framed by the government and other stakeholders for effective extension delivery and enhanced productivity. Other complementary adoption determinants, like making credit available to more experienced crop farmers and encouraging farmers' cooperative, are also indispensable in influencing adoption decision.

Keywords: Effectiveness, extension methods, improved technologies, adoption

Introduction

The agricultural sector in sub-Saharan Africa countries is known to be an essential instrument for stimulating growth, reducing both relative and absolute poverty, and decreasing food insecurity. However, the sector in Nigeria is characterized by pre-dominance of small-scale farmers, with low use of improved technology which results in low productivity (Manyong et al., 2005). Improving the farm productivity and income of small-scale farmers who formed the majority (90%) in the Nigerian agricultural sector through the adoption of improved technologies has been recognized a way out of food insecurity and poverty (Cadoni and Angelucci, 2013). Achieving increased farm productivity to curtail food shortfall and escape the circle of poverty will not be feasible unless productivity-enhancing technologies are developed, disseminated and adopted by farmers. World Bank (2008) posited that the use of effective extension methods to disseminate improved technologies to resource-poor farmers could significantly lead to high adoption rate at the farm level and facilitate the transition from subsistence agriculture to high productivity agro-based industrial economy.

In this regard, Nigerian research institutes have been developing and disseminating improved crop production technologies to farmers in order to stimulate increases in productivity level with aim of achieving self-sufficiency in some strategic mandate crops. The National Agricultural Extension and Research Liaison Service (NAERLS) is one of these research institutes saddled with a unique national mandate of agricultural extension and research and its mission is to disseminate proven and relevant agricultural technologies to farmers and to conduct research in agricultural extension methodologies and policy.

Since its inception in 1975 as a national research institute in agricultural extension, NAERLS has been using various extension methods to disseminate improved technologies to the target population. However, there is little or no research carried out to evaluate the effectiveness of the extension methods used in disseminating improved crop production technologies to the benefiting population. Conducting an evaluation on the effectiveness of extension methods used to disseminate improved technologies is particularly important because in Nigeria, public extension sections receive limited funding and support (Izuogu and Atasie, 2015). So, identifying and maintaining effective extension methods are imperative for the sustainability of improved technology development and extension programmes. Besides, Simpson *et al.* (2012) asserted that the pluralistic natures of too many extension methods used by many extension service providers may sometimes be conflicting and confusing to farmers and farmers' valuable and limited time resource are not occasionally taken into consideration when it comes to designing and packaging extension services. It is against this background that this study evaluated the effectiveness of the various extension methods used to disseminate improved crop production technologies to crop farmers in the NAERLS adopted villages in Kaduna State.

Three criteria used to evaluate the effectiveness of an extension method (WHO, 2003) includes: its ability to reach the greatest number of farmers with a given budget, its capability of reaching farmers quickly, and its ability to influence adoption of improved technologies. Since the ultimate aim of any agricultural extension process is to influence farmers' decision to accept and finally adopt the technologies brought to them; therefore, this study evaluated the effectiveness of these extension methods on the ability to influence the probability of farmers' decision to adopt improved crop technologies.

Methodology

Kaduna State falls within the North West Agro Ecological Zone of Nigeria, occupying a land area of about 48,473.2km^2 (NAERLS, 2013). The state is located between latitude 9^0 10" and 11^0 30" N longitude 6^0 10" and 9^0 E. Based on NPC (2006), the State has a projected population of 7,287,295 as at 2013 with an annual growth rate of 3.2%. Majority (61%) of the population are engaged in farming and related activities as a means of livelihood. The mean annual rainfall is 1,524mm. The annual temperature ranges between 14.6^{0}C and 36^{0}C. The major crops grown in the State include maize, rice, yam, cowpea, cotton, ginger, cassava, sorghum, and groundnut (NAERLS, 2013). At the time of the survey, the most common improved crop production technologies disseminated by NAERLS to the study area are shown in Table 1.

At the time of this survey, the major extension methods used by NAERLS for disseminating improved production technologies to farmers in the study area were:

i. On-farm demonstration managed by farmers (OFD)
ii. Management training plot (MTP)
iii. Extension agent visit
iv. Radio programmes
v. Farmers field day (FFD)
vi. Farmer to farmer (FTF)
vii. Farmers exchange visit (FEV)

NAERLS has implemented an Adopted Village Project in 3 local government areas (LGAs) of Kaduna State. These 3 LGAs are Sabon Gari, Giwa and Zaria. A sample size of 164 crop farmers was used for the study which was selected using a multi stage sampling technique. In the first stage 2 LGAs, namely Sabon Gari and Giwa LGAs, were purposively selected out of the 3 LGAs. The purposive selection of these 2 LGAs is because they are among the first set of LGAs chosen for NAERLS's adopted village project implementation in Nigeria. Secondly, one project village in each LGA was purposively identified and chosen for data collection. The two adopted villages selected were Nasarawan Buhari and Sakadadi adopted villages from Giwa and

Sabon Gari LGAs respectively. Thirdly, 82 crop farmers were randomly selected from each village sampling frame obtained at the survey using a random number method in excel worksheet. Thus, a total of 164 respondents constituted the sample for the study.

Descriptive statistics such as the mean, maximum, minimum, standard deviations, frequency distribution and percentages were used to describe the social, economic, demographic and institutional variables of the sampled crop farmers. Moreover, since an effective extension method is the one that plays a significant role in influencing the probability of adopting improved crop technologies (Izuogu and Atasie, 2015), binary logistic regression model was therefore used to evaluate the effectiveness of the NAERLS extension methods used in disseminating improved crop production technologies to target farmers. Binary logistic regression analysis extends the techniques of multiple regression analysis to research situations in which the dependent variable is binary. The most common types of binary response model are logit and probit models. According to Hosmer and Lemeshow (1989) logit model is the standard method of analysis when the outcome variable is dichotomous. Also, Shariff et al. (2009) posited that a logit regression seems to be the most robust and preferred approach to the probit regression. Hence, this study adopted logistic regression to evaluate the effectiveness of extension methods to influence the probability to adopt improved crop production technologies, in part and other determinants hypothesized to influence the adoption among the sampled crop farmers. Based on the cumulative logistic distribution function expressed by Green (2003), the logit model is given as:

$$P(y_i = 1|x) = \frac{e^Z}{1 + e^Z} = \wedge(Z) \ldots\ldots\ldots\ldots\ldots (1)$$

Where P is the proportion of occurrences, $\wedge(Z)$ is the logistic cumulative distribution function. The inverse relation of equation (1) is expressed as:

$$Z = ln\left(\frac{P}{1 - P}\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

That is, the natural logarithm of the odds ratio, known as the logit. It transforms P which is restricted to the range [0, 1] to a range [−∞,∞]. Empirically, the study model is defined as:

$$Z = \alpha_0 + \alpha_i \sum_{j=i}^{14} x_i + e_i \ldots\ldots\ldots\ldots\ldots (3)$$

Where, $x_1, x_2 \ldots\ldots x_{14}$ are the explanatory variables defined in Table 2, α_0 is the intercept, $\alpha_1, \ldots \alpha_{14}$ are the parameters to be estimated. Z is the explained adoption binary variable in which 1 is scored for adopters and 0 scored otherwise. A farmer is an adopter only if he adopts at least one improved technology extended to him through any one of the NAERLS extension methods and non-adopter otherwise.

Table 2 shows the socio economic features of the crop farmers that were included in the study model. These characteristics are indispensable to the understanding of the crop farmers as those characteristics have direct effects on the farmers' decision making process and adoption of improved crop production technologies extended to them.

Results and Discussion

Descriptive statistics of the variables

A summary of statistics of the variables used in the analysis is presented in Table 3. The averages of farm sizes (ha), years of farming experience and years spent as member in farmers' cooperative were 3.6 hectares, 13.2 years and 6.6 years respectively. This indicates that the crop production is mainly done by smallholders in the study area with a mean land area of less than 4 hectares with several years of experience in crop production. The means of age of farmers and years of schooling were 41.2 and 6.4 years respectively, probably these variables can influence adoption of improved crop production technologies especially when an effective extension method is used. The dispersion around the mean of the amount of credit used was slightly high as shown by a standard deviation of about ₦50,000. The highest and lowest means recorded for the extension methods in the study area were 0.46 and 0.02 for extension agent visit and farmer field day methods respectively.

Effective extension methods in influencing adoption

The maximum likelihood estimates of the binary logistic model (equation 3) for evaluating the effects of extension methods on adoption decision of improved crop production technologies and alongside with other hypothesized determinants of adoption were presented in Table 4. The model accounted (Cox & Snell R^2 $_{Logistic}$.) for about 51% of the variation between improved crop technologies adopters and non-adopters. Among all the improved crop production technologies extension methods included in the regression as exogenous variables explaining the probability of adoption decision only the extension agent visit, on-farm demonstration, management training plot and farmer to farmer variables have positive and significant effects on influencing farmers' decision to adopt improved crop production technologies.

Extension agent visit and farmer to farmer methods were significant at 1% and 10% level of probability respectively. The extension agent visit and other farmers' influence methods are known to be very effective in convincing farmers to accept, try and finally adopt an innovation (Khatam et al., 2013). These methods provide opportunity for person-to-person contact on individual basis between the farmer and the extension agent or other progressive farmers. The estimates of on-farm demonstration and management training plot were statistically significant (P<0.05) and positively related to the decision to adopt improved crop production technologies. This implies that farmers tend to get merely convinced person-to-person and on seeing physically the immediate outcome from using a particular technology on their own farms. Some studies (Arshed *et al.,* 2012; Yusuf *et al.*, 2013) have reported similarly findings. Also, Khatam *et al.* (2013) reported that demonstration extension method was perceived to be the most effective method for dissemination of agricultural technologies among the farming community of Khyber Pakhtunkhwa in Pakistan.

The likelihood of adoption increases with increase in the years of farming experience, amount of credit used and years in cooperative variables. The years of farming experience and years spent as member in farmers' cooperative variables show the expected signs and are statistically significant (p<0.01). The increased probabilities of the decision to adopt improved crop production technologies with more years of farming experience and years spent as member in cooperative were most probably due in large part to awareness of the economic benefits obtain by accepting and adopting an innovation through learning by doing and group influence. Ideally, more exposed members of farmers' cooperative with more years of experience are likely to understand the benefits of adopting new innovation brought to them through an extension method. The odds ratio of years of farming experience variable was 1.198 implying that one year increase in farming experience increases the odds of adopting improved crop production technologies by about 20%, *ceteris paribus.*

Conclusion and Recommendations

Based on the findings of the study, it is concluded that the most effective improved crop production technologies extension methods are extension agent visit (p<0.01), on-farm demonstration (p<0.05), management training plot (p<0.05) and farmer to farmer extension contact (p<0.10) methods. Other significant adoption determinants were years of crop farming experience, amount of credit and years spent as member of farmers' cooperatives. It is recommended that viable policy instrument to effectively improve these four extension methods should be designed by the government and other relevant stakeholders in order to record high adoption rates of improved crop technologies which may ultimately result to increased productivity and attained food security. NAERLS should focus on using these four extension methods especially in disseminating crop production related improved technologies. Although other complementary adoption determinants like making credit available to more experienced crop farmers and encouraging farmers' cooperative are needed to influence adoption.

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Table 1: Crop production technologies disseminated to the farmers in the study area

S/No	Improved crop production technologies
1	Maximum planting density (cowpea)
2	Zero weeding
3	Double row planting (maize)
4	Rice drill planting
5	IAR 48 cowpea variety
6	DTMA (maize)
7	Strip cropping (soybeans & sorghum)
8	Quality Protein Maize (QPM) (SAMMAZ 14)
9	FARO 44 (improved rice variety)
10	Broadcasting method of rice planting
11	Irish potato production

Table 2. Definition of the variables used in the analyses

Variable	Type	Description
Dependent (z)	Binary	1 for adopters, 0 otherwise
Farming experience (x_1)	Continuous	Years of experience in farming
Amount of Credit (x_2)	Continuous	Total (N) amount of credit used in crop production
Farm Size (x_3)	Continuous	Total size of farmland owned in hectares
Household size (x_4)	Continuous	Total household size in person
Age of farmers (x_5)	Continuous	Age of farmers in years
Years of schooling (x_6)	Continuous	Years of formal schooling
Years in Cooperative (x_7)	Continuous	Years spent in farmers' cooperative as member
Radio (x_8)	Dummy	1 if farmer received technology via radio, 0 otherwise
Extension agent visit (x_9)	Dummy	1 if farmer received technology via EAV, 0 otherwise
Farmers Exchange Visit (x_{10})	Dummy	1 if farmer received technology via FEV, 0 otherwise
Farmer to farmer (x_{11})	Dummy	1 if farmer received technology via FTF, 0 otherwise
On-farm demonstration (x_{12})	Dummy	1 if farmer received technology via OFD, 0 otherwise
MTP (x_{13})	Dummy	1 if farmer received technology via MTP, 0 otherwise
Farmers Field Day (x_{14})	Dummy	1 if farmer received technology via FFD, 0 otherwise

Table 3. Descriptive statistics of the variables

Variable	**Mean**	**Maximum**	**Minimum**	**Std dev**
Age of farmers	39.1	70	20	9.6
Years of schooling	6.6	20	0	4.4
Cooperative membership	6.6	30	0	6.0
Amount of credit used	18012	250000	0	49132
Farm size	2.4	13	0.5	3.1
Household size	6.6	46	1	4.1
Farming experience	27.1	60	1	9.9
Radio	0.06	1	0	0.24
Extension Agent visit	0.46	1	0	0.54
Farmers field days	0.02	1	0	0.16
On-farm demonstration	0.21	1	0	0.50
Farmer exchange visit	0.05	1	0	0.18
Management Training Plot	0.17	1	0	0.34
Farmer to farmer	0.31	1	0	0.46

Table 4: Maximum likelihood estimates for the effectiveness of extension methods used

Variables	*β*	*S.E.*	*Wald*	*Sig.*	*Exp(β)*
Years of Farming experience (x_1)	0.181	0.037	23.931	0.000	1.198
Amount of Credit (x_2)	0.092	0.043	4.578	0.046	1.096
Farm Size (x_3)	0.192	0.145	1.753	0.104	1.339
Household size (x_4)	-0.006	0.071	0.008	0.927	0.994
Age of farmers (x_5)	-0.012	0.042	0.085	0.771	0.988
Years in schooling (x_6)	0.045	0.039	1.326	0.249	1.046
Years in cooperative (x_7)	0.121	0.046	6.919	0.004	1.129
Radio (x_8)	0.141	0.843	0.027	0.868	1.152
Extension Agent Visit (x_9)	0.321	0.101	10.101	0.000	1.379
Farmers Exchange Visit (x_{10})	0.435	0.863	0.254	0.615	1.544
Farmer to Farmer (x_{11})	1.352	0.725	3.478	0.061	3.867
On farm Demonstration (x_{12})	1.626	0.761	4.565	0.031	5.085
Management Training Plot (x_{13})	1.013	0.482	4.417	0.041	2.754
Farmers Field Day (x_{14})	0.906	0.954	0.902	0.342	2.474
Constant	-2.525	1.364	3.426	0.064	0.081

*Note***:** -2loglikelihood = 185.975; Cox & Snell R^2= 0.506