A TOBIT ANALYSIS OF PROPENSITY TO DISCONTINUE ADOPTION OF AGRICULTURAL TECHNOLOGY AMONG FARMERS IN SOUTHWESTERN NIGERIA

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ABSTRACT

While much work has been done on the factors determining the adoption of agricultural technologies, little research has been conducted on the factors that predispose farmers to discontinue the adoption of innovation. Following a survey of arable crop farmers in two states of southwestern Nigeria, econometric analysis was conducted in order to identify variables significant in the farmers' discontinuance behaviour. The variables included in the study are Attitude, Extension visit, Feedback provision, Marketability and Input availability. Tobit model was estimated on the data collected during the 2002 growing season. From the estimation, significant variables leading to discontinuance of improved maize and cowpea varieties were identified. Foremost among them is extension visits.

KEYWORDS: Discontinued adoption, agricultural technology, Farmers, Tobit, Nigeria

INTRODUCTION

The importance of farmers' adoption of new agricultural technology has long been of interest to agricultural extensionists and economists. Several parameters have been identified as influencing the adoption behaviour of farmers from qualitative and quantitative models for the exploration of the subject. Social scientists investigating farmers' adoption behaviour have accumulated considerable evidence showing that demographic variables, technology characteristics, information sources, knowledge, awareness, attitude, and group influence affect adoption behaviour.

Adoption of innovations refers to the decision to apply an innovation and to continue to use it [1] . A wide range of economic, social, physical, and technical aspect of farming influences adoption of agricultural production technology. Recent adoption studies in Europe [2] [3] , in Asia [4] [5] and in Africa [6] have identified farm and technology specific factors, institutional, policy variables, and environmental factors to explain the patterns and intensity of adoption. Rao and Rao [7] found a positive and significant association between age, farming experience, training received, socio-economic status, cropping intensity, aspiration, economic motivation, innovativeness, information source utilization, information source, agent credibility and adoption. Also Agbamu [8] found only knowledge of a practice to be significantly related to its adoption. Ikpi et al [9] shows that where farmers have to adopt a new crop technology that shifts time from their farming to the home production activity sector, the probability and rate of adoption of such technology are higher. Also, as family time is shifted away from the farming sector to home production sector, the economic impact index increases. Arene [10] reported a positive and significant relationship between family size and adoption. On the other hand Voh [11] established that household size is not significantly related to adoption. Abdul et al [12] reported a significant relationship between landholdings (farm size) and adoption.

Voh [11] also reported that socio-economic status of farmers is positively and strongly related to adoption. This report implied that the higher the socio-economic status, the higher the tendency to adopt innovation. Igodan, et al [13] reported that farmers who are more exposed to formal extension information have a high propensity towards adoption than those with less exposure. However, [12] did not establish any relationship between education and adoption. Education, size of holdings and cosmopoliteness accounted for significant variation in communication behaviour of farmers. Goswami and Sagar [14] identified some factors associated with knowledge level of an innovation. They found educational level, family educational status, innovation proneness and utilization of mass media to be positively and significantly correlated with knowledge level. Earlier evidences [15] [16] led to the categorization of adoption behavior into innovators, early adopters, early majority, late majority and laggards. This is based on validated studies that the adoption behaviour of any agricultural technology would follow a normal distribution curve in a given social system [17].

However an important component of the innovation decision- making process which has received little recent research attention is the discontinued adoption behaviour which is the decision to reject an innovation after having previously adopted it. Rogers [17] reported two types of discontinuance which can be replacement discontinuance that is rejecting an idea in order to adopt a better one that supersedes it or disenchantment discontinuance when a decision to reject an idea as a result of dissatisfaction with its performance. Alexander et al [18]and Darr and Chern [19] described discontinuance among farmers who previously adopted Genetically Modified crops by Ohio farmers as disadopters. Leuthold [20] concluded that the rate of discontinuance was as important as the rate of adoption in determining the level of adoption of an innovation at any particular time. Bishop and Coughnor [21] reported that the percentage of discontinuance among Ohio farmers ranged from 14 percent for innovators and early adopters, to 27 percent for early majority, to 34 percent for late majority, to 40 percent for laggards; while Leuthold [20] reported 18 percent, 24 percent 26 percent and 37 percent respectively for Canadian Farmers. Greeve [22] reported the discontinuance of the easy listening format by radio stations in USA and also Rogers [17] noted the discontinuance of chemical innovation and the rise of organic farming.

Ogunfiditimi [23] used the term "abandoned adoption" to describe discontinued use of previously adopted innovation and identified 14 reasons among maize& cassava and cocoa farmers in Nigeria. Similarly Kolawole et al [24] reported the varying degrees of discontinuance among farmers in Ekiti state Nigeria to be immediate, gradual and rapid based on the nature of innovation and farmers situation. In the extensive reviews of studies on discontinuance of adoption behaviour, in developing countries, no study was found to have analyzed the factors that predisposes farmers to discontinuance adoption behaviour of agricultural technology. Adesina and Baidu-Forson [25] found that farmers perceptions affect the adoption of improved varieties of sorghum and mangrove rice in Burkina Faso and Guinea respectively. The paucity of empirical evidences on the concept justifies further investigation. The objective of this paper is to determine the propensity of farmers to discontinue adoption of agricultural technology using evidences from two arable crops technology in Nigeria (improved varieties of cowpea and maize).

The following sections give the description of the technologies examined in this paper. Maize and cowpea occupy a very crucial position in the farming system of Nigeria based on their role in attaining food security of the nation's teeming population. NAERLS [26] reported the various combinations of crop mixture by which these crops are grown, as represented in Table 1.

Maize has emerged as the most important cereal crop in Nigeria following sustained

expansion in cultivated area into marginal zones. Maize is currently produced in all

five agro-ecological zones of the country. An increase of about 10.6% in total area put

under its cultivation was estimated compared with 2000 growing season. Much of the increase in area has been made possible following the introduction of improved varieties that are resistant to Downy-Mildew Infection. The package include the use of improved varieties, planting distance, seed dressing, fertilizer application, split fertilizer application, weeding, and storage.

Cowpea is the first and most important major legume crops in Nigeria and a very important crop in the food habit of most Nigerians. It is cultivated across the country, though large-scale production occurs only in the savanna region of the country. The cowpea technology as disseminated by the extension service in the country consist of improved varieties, planting distance, seed dressing, spraying on the 35^{th} day after planting, spraying with Cypermethrin, spraying 3 times and storage.

MODEL SPECIFICATION

The decision to discontinue the adoption of agricultural technology embodies the endogenous (the characteristics

Table 1: Maize and cowpea in Nigeria's farming system

Crop mixtures	Agro-ecological zones				
	North West	North east	Central	South west	South east
Yam/Maize			X	X	X
Maize/Rice	X	X	X	X	X
Cassava/Maize			X	X	
Sorghum/ cowpea	X	X	X		
Maize/ cowpea	X	X	X		
Maize/ cocoyam				X	
Maize/Sorghum	X	X	X		
Maize/ Groundnut	X	X	X		
Sorghum/millet/Cowpea	X	X			
Maize/Yam/Cassava			X	X	X
Maize/sorghum/ Groundnut	X	X			
Maize/yam/Vegetables			X	X	X
Maize/Yam/Cassava/Melon			X	X	X
Millet /Cowpea	X	X			
Millet/sorghum/cowpea	X	X			
Maize/Cassava/Vegetables				X	X
Maize/Sorghum/cowpea	X	X	X		
Millet/Maize	X				
Maize/Soyabeans	X	X			
Maize/cocoyam/cassava				X	X
Maize/melon/cassava			X	X	
Maize/cassava/cocoyam/vegetable			X	X	
Maize/Yam/Cassava/ cocoyam			X	X	
Maize/Irish potatoes			X		
Maize/cotton	X				

and benefits of the technology itself) and exogenous (institutional characteristics of the technology) such that the observed discontinuance of an agricultural technology is hypothesized to be an end result of these exogenous and endogenous variables at different points on the time and innovativeness continuum. Conventional variables in the studies of adoption behaviour might have to be eliminated because adoption has already taken place.

In order to accomplish the objectives of this paper, the Tobit model was used to estimate the propensity of farmers to exhibit discontinued adoption behaviour . The Tobit model, originally developed by Tobin [27], may be expressed in the following way:

$Y^* = X\beta + \varepsilon$

where β is a vector of unknown coefficients, X is a vector of independent variables, and ε is an error term that is assumed to be independently distributed with mean zero and a variance of s^2. Y^* is a latent variable that is unobservable. If data for the dependent variable is above the limiting factor, zero in this case, Y is observed as a continuous variable. If Y is at the limiting factor, it is held at zero. This relationship is presented mathematically in the following two equations:

$Y = Y^*$ if $Y^* > Y_{0}$; $Y = 0$ if $Y^* \leq Y_0$

where Y_0 is the limiting factor. These two equations represent a censored distribution of the data. The Tobit model can be used to estimate the expected value of Y_i as a function of a set of explanatory variables (X) weighted by the probability that $Y_i > 0$ [27]. Maddala [28] shows that the expected intensity of adoption, E(Y), is:

$E(Y) = X\beta F(z) + \sigma f(z)$ and $z = X\beta / \sigma$

where F(z) is the cumulative normal distribution of z, f(z) is the value of the derivative of the normal curve at a given point (unit normal density), z is the Z-score for the area under the normal curve, and s is the standard error of the error term. The coefficients for variables in the model, β, do not represent marginal effects directly, but the sign of the coefficient will give the researcher information as to the direction of the effect.

Data for the study were collected in 2002 growing season from farmers who are in the adopter category for the technologies examined in this paper. Sixty farmers (60) each were selected through a multi-stage random sampling process from Osun state in case of maize and Oyo state for cowpea. The two states are in southwestern Nigeria with Osun being an endemic state to Downy Mildew infestation hence the consequences if farmers discontinue the adoption of improved varieties of maize and downy- mildew resistant varieties. There is high production of cowpea in the derived savannah of Oyo state- , a potential that was to be maximized through the dissemination and exploration of the improved cowpea varieties in order to attain self-sufficiency in the area. Table 2 shows the definition of variables used in the estimated Tobit model.

RESULTS

The results for the model of farmers' propensity to discontinued adoption improved maize varieties are presented in Table 3. From the variables that are included in the model, only three are significant, with extension

Table 2: Definition of variables

Variables	Description	Dummy description
Dependent variables		
Discontinued adoption	Farmers propensity to discontinued adoption	0 low, 1 medium, 2 high
Explanatory variables		
Attitude	Change in attitude after adoption	1 for yes 0 otherwise
Extension visit	Extension visit to reinforce the technology	1 for yes, 0 otherwise
Feedback provision	Opportunity for expression of reactions to the technology	1 for yes, 0 otherwise
Marketability	Opportunity to market surplus yields	1 for yes, 0 otherwise
Input availability	Availability of required input to sustain adoption	1 for yes, 0 otherwise

visits indicating a very strong significance. This implies that the lack of extension visits to farmers who have adopted the improved varieties of maize would lead to discontinuance. Extension visits will help to reinforce the message and enhance the accuracy of implementation of the technology packages. The provision of feedback on the adopted technology is significant at 10%. This may be due to the fact that when farmers are unable to express their reaction to researchers and extension agents on the innovation they have adopted, withdrawal from such innovation will follow. Similarly, availability of input is also significantly related to the discontinuance of adoption. This may be attributed to the fact that the lack of input required for the implementation of the technology package may lead to the rejection of such innovation. Oladele and Kareem [29] reported that 60% of arable farmers in Oyo state, Nigeria had stopped using fertilizer due to the unavailability, and the untimely and high cost of the input. Marketability of maize arising from the increased yield due to the adoption of the technology is not significant because there exist a high local and international market demand for maize as a major raw material for the brewing and livestock industry.

Results for farmers' propensity to discontinued adoption of improved varieties of cowpea is presented in the last column of Table 3 show that only two of the variables included in the model are significant, namely attitude and marketability. The significance of attitude may be due to the change in attitude. Attitude is readily affected by transient situation such as group influence and family considerations. The resulting increase in yield through the adoption of improved varieties of cowpea leads to a need for market among farmers that are predominantly subsistence farmers. Their inability to generate income from the surplus production lead to discontinuance of the technology.

CONCLUSIONS

This study adds to the literature on adoption behaviour by showing the factors that predisposes discontinued adoption. It has been able to empirically provide insights in to the problems that are likely to occur after the dissemination and acceptance of innovation by farmers. The study has also paved ways into different perspectives by which the explanation of farmers' tendencies to withdraw from the adoption of innovation could be examined. From the model applied in this paper, the result has shown that important variables that stimulate adoption could turn around to cause farmers to discontinue such innovation. It is therefore important that extension visits should be sustained after a seemingly success of technology adoption. Similarly the issue of input and market availability should not be allowed to impact negatively on the adoption behaviour through changes that likely result from the macro-economic policies.

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Table 3: Estimated Tobit model of farmers propensity to discontinuance adoption of improved technology

Variables	Improved Maize varieties	Improved cowpea varieties
Intercept	1.065 (15.492**)	1.095(10.862**)
Attitude	0.289 (1.130)	0.816(1.826*)
Extension visit	0.538(2.978**)	0.356(1.616)
Feedback provision	-0.326(-1.796*)	-0.284(-1.154)
Marketability	-0.131(-0.432)	-0.797(-1.677*)
Input availability	0.471(1.810*)	0.339(1.291)
Nos of observation	60	60
Log likelihood	-177.94	-89.094
S.E. of regression	1.092	1.152

Figures in brackets represent the Z- statistics. Asterisks indicate significance at *: 10% , ** :1%

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