AN APPLICATION OF PROBIT ANALYSIS TO FACTORS AFFECTING SMALL-SCALE FARMERS' DECISION TO PARTICIPATE IN THE FARMER SUPPORT PROGRAM: A CASE STUDY IN THE EASTERN CAPE PROVINCE OF SOUTH AFRICA

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Undoubtedly, the Farmer Support Program (FSP) has been the most significant initiative at promoting structural change, away from subsistence farming towards commercialisation of agriculture in South Africa. The implementation and effects of the FSP have been exhaustively analysed, and the initiative has been judged to be mostly successful. This paper reports on a different issue related to the FSP : An analysis of the farm and household characteristics that may be used to predict the likely participation of small-scale farmers in the FSP. Probit analysis was used to analyse data obtained from 100 participants and non-participants in the Keiskammahoek FSP in the Eastern Cape Province. The analysis yielded a correct prediction in 78.6% of cases.

'N TOEPASSING VAN "PROBIT"-ANALISE OP FAKTORE WAT KLEINBOERE SE BESLUIT OM AAN DIE BOERDERY-ONDERSTEUNINGSPROGRAM DEEL TE NEEM, BEÏNVLOED : 'N GEVALLESTUDIE IN DIE OOS-KAAPPROVINSIE VAN SUID-AFRIKA

Die boere ondersteuningsprogram (FSP) was sonder twyfel die belangrikste inisiatief om strukturele veranderinge vanaf bestaans- tot kommersiële landbou te bevorder. Die resultate van die FSP is wyd beskryf en meestal as positief bestempel. Hierdie artikel rapporteer 'n ander aspek van die FSP, naamlik die analise van plaas en huishoudingeienskappe van kleinboere wat gebruik kan word om hul deelname aan die FSP te voorspel. Probit analise is gebruik om die data van 100 deelnemers en nie-deelnemers aan die Keiskammahoek FSP in die Oos-Kaap Provinsie te analiseer. Die analise het korrekte voorspellings gemaak in 78,6% van die gevalle.

INTRODUCTION

One of the most significant initiatives in South Africa to cater for the needs of small-scale farmers at large, was the establishment of the FSP in 1987. The main aim of the program was the promotion of structural change, away from subsistence agricultural production towards commercialisation of agriculture, by the provision of comprehensive support services to emerging farmers in

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the so-called "self-governing states" and "independent homelands" in South Africa (DBSA, 1988).

The major concern of the government has always been to expand the existing Farmer Support Programme so that many existing and emerging small-scale farmers could benefit from the multi-faceted services of the programme.

However, before such a program is expanded it is important to be sure of those factors which would lead to adequate demand for its services so that appropriate policies and implementation strategies are built into the design of the programme. Most available studies (Doni, 1997; Kirsten & Sartorius von Bach, 1992; Singini, Sartorius von Bach & Kirsten, 1992; Van Rooyen, Vink & Christodolou, 1987) relate solely to the impact of the FSP on the improvement of farm income and farming structure for those farmers who have participated in the program.

Different analytical techniques have been used to estimate farmers' decision making process as regards adoption of agricultural innovation. Some used regression analysis while others used factor analysis. The most striking feature of studies based on regression techniques is that, because analysis. The most striking feature of studies based on regression techniques is that, because non-participants do not use any level of the innovation, by definition, analysis was based only on information from the participants. The implicit assumption by so doing is that non-participants have a zero demand for the innovation which may not be realistic in all cases. For instance, some non-participants may be planning to adopt it in the near future.

It is, therefore, reasonable to assume that non-participants also display market behaviour by choosing not to participate in the study period. Thus, it is important to include non-participants as well as participants in estimating the parameters of the innovation adoption function. Besides, selecting participants alone may be regarded as a problem of selectivity bias, which may be looked at as an omitted variable problem. An application of ordinary least square (OLS) regression to such data on participants alone may therefore cause a serious bias in estimates because non-zero conditional means are ignored. Hence there is a need to use appropriate analytical techniques that incorporate observations on both participants and non-participants to overcome these selectivity bias problems. The objective of this paper, therefore, is to analyse farmer and household characteristics that may influence small-scale farmers' decision whether or not to participate in the FSP. This is done using *probit analysis,* which incorporates both participants and non-participants in the dependent variable.

ANALYTICAL MODEL

Economic, social, physical, technical and educational considerations are generally thought of as influencing the adoption behaviour of farmers. The theoretical propositions and hypotheses from studies in the fields of agricultural economics, rural sociology, and extension education have been used here. Some selected socio-economic variables are used to develop the concept of threshold level of adoption and to develop a predictive model to determine the probability that a farmer in a given situational-function setting would adopt the use of FSP.

The appropriate model to analyse such types of decision problems is the qualitative response model, which is also known as the binary or discrete or dichotomous model. For this study the multivariable *probit* model is used. The main advantage of the *probit* model is that it is bounded between 0 and 1, hence the problem of predicted values being outside the probability range is overcome. Furthermore, it compels the disturbance term to be homoscedastic because the form of the probability function depends only on the distribution of the difference between the error terms associated with one particular choice and another (Amemiya, 1981; Domenlich & McFadden, 1975 and Hill & Kau, 1973).

It was hypothesised that the variables of farm size, regular labour force, age, education, sex, employment status, vocational and skills training, tenure status, and membership of farmers' associations were significant variables in an explanatory model of farmers' decisions to participate in the FSP.

The *probit* model specified in this study to analyse farmers' decisions about whether or not to use the FSP cam be expressed as:

$$\begin{aligned} Y_i &= 1 = X^1{}_i\beta + V_i \quad \text{if } X'_i\beta + V_i > T \\ &= 0 \quad \text{if } X'_i\beta + V_i \leq T \\ &\quad \text{for } i = 1, 2 \ldots N \end{aligned}$$

where:

Y_i = farmers' decision variable which takes on the value of 1 if he/she participates in the FSP and 0 otherwise
X'_i = vector of socio-cultural and economic factors
β = vector of unknown parameter
V_i = an independently distributed error term assumed to be distributed – $N(0\sigma^2)$

T = the threshold point

Factors affecting participation in the FSP are presented in Table 1.

Table 1: Factors affecting participation in FSP

Variables		Variable definition and measurement
Y_1	=	The farmer's decision to participate (the dependent variable) which takes the value of 1 of the farmer used FSP in 1997, 0 otherwise
X_1	=	Size of arable land in hectares
X_2	=	Man-day equivalent of those who worked regularly on the farm (including the farmer himself)
X_3	=	Farmers' age in years
X_4	=	Number of years of formal education completed by the farmer
X_5	=	Sex of the head of household; 1 if farmer operator is male, 0 otherwise
X_6	=	Employment status; 1 if farmer is employed off-farm, 0 otherwise
X_7	=	Vocational and skills training; 1 if farmer has some kind of agricultural training, 0 otherwise
X_8	=	Tenure status; 1 if freehold, 0 otherwise
X_9	=	Membership of farmers' associations; 1 if farmer is a member, 0 otherwise

EMPIRICAL RESULTS

The results of this study, estimated by maximum likelihood methods[1], is based on data collected from a sample of 100 small-scale farmers in the Eastern Cape Province of South Africa, and are presented in Table 2.

The coefficients of X_1, X_4, X_6, X_7, X_8 and X_9 are statistically significant at the 5 per cent level and their signs are as expected. The coefficient of X_5 is significant at 1 percent level. The signs support the *a priori* hypothesis[2]. A likelihood ratio value of 139.67 leads to rejection of the null hypothesis that there is no relationship between the dependent variable and the set of all explanatory variables.

In Table 2, a positive (negative) sign on an explanatory variable's coefficient indicates that higher values of the variable increase (decrease) the likelihood that a small-scale farmer uses the FSP. For example, the positive coefficient on the variable X_1 (farm size), which is statistically significant, indicates that,

other things being the same, as farm size increases, the likelihood that a farmers uses FSP also increases.

Table 2: Probit regression coefficients of factors affecting small-scale farmers' decision to participate in the Keiskammahoek FSP

Variable	Estimated coefficient	Standard error	Asymptotic t-value
X_1	+0.24135**	0.11505	2.0978
X_2	-0.13966	0.09354	-1.4930
X_3	-0.02890	0.01774	-16.290
X_4	0.05929**	0.02985	1.9862
X_5	0.10993*	0.03228	3.3435
X_6	0.26963**	0.13879	1.9427
X_7	0.60729**	0.29868	2.0878
X_8	0.06331**	0.03326	1.9034
X_9	0.22073**	0.10989	2.0086
Constant	1.98020	1.18660	1.6703

* significant at 99% on one-tail test
** significant at 95% on one-tail set

Number of observations	100
Number of observations at one	43
Number of observations at zero	57
Log of likelihood function	-61.348
Likelihood ratio test value	139.67
Cases predicted correctly (%)	78.6

From this study, it is evident that farm size, farmers' education level, sex of the head of household, employment status, vocational skills training, tenure status, and membership of farmers' associations are some of the factors which have a significant positive effect on the decision to use FSP. Conversely, the age and the size of family labour have been fund to have a not-significant negative effect on farmers' decision to use FSP.

CONCLUSION AND IMPLICATIONS

The results of this study have specific implications for the design characteristics, target areas and implementation strategies of support

programmes that are intended to improve conditions for small-scale farmers. A few examples will serve to illustrate this.

The fact that factors such as area of arable land, employment status, level of training and membership of farmers' associations have a significant positive effect on participation, leads to the suggestion that scarce FSP resources should first be used in communities where at least some of these factors are known to be present. Following visibly successful participation in the "first round" of the FSP, it is likely that other communities and areas will display a greater rate of participation.

Factors such as level of vocational training and membership of farmers' associations may even be targeted for improvement *per se*, prior to launching the FSP in a particular area. This can be organisational and administrative skills (which will stimulate the development and successful operation of farmers' organisations). Also, the education of farmers can be improved by way of establishing adult educational and skills development programmes in the villages.

NOTES:

1. The program employed for estimation is SHAZAM.

2. Hypothesis testing coefficient in the *probit* model can be done by a likelihood ratio test.

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