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A Discriminant Analysis of Factors Associated with The Adoption Of Certified Organic Farming By Smallholder Farmers in Kwazulu-Natal, South Africa

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Abstract

Discriminant analysis was used to identify the characteristics that distinguish between fully-certified organic, partially-certified organic and non-organic farmers in Umbumbulu district, KwaZulu-Natal (KZN), South Africa (SA) during October- November 2004. 200 farmers interviewed were drawn by purposively selecting the 151 members of the Ezemvelo Farmers' Organisation (EFO), and by random sampling 49 non-organic farmers in wards neighbouring EFO. Results from the two estimated discriminant functions suggested that farmers with higher household sizes, incomes, input costs per hectare and number of chickens owned, locations further from innovators and less risk aversion were more likely to be certified as organic. Household location should be considered in delineating target domains for introducing new technologies especially where resources are limited. There is a need for key stakeholders to increase smallholder's capacity to bear risk by decreasing the perceived risk of adoption of certified organic farming.

Keywords: Adoption, organic, Discriminant Analysis, South Africa

Introduction

High levels of poverty among households in the rural Umbumbulu district of KwaZulu-Natal (KZN), South Africa (SA) have focused attention on whether a shift to certified organic farming by some smallholder farmers can improve household incomes. This shift amongst members of the Ezemvelo Farmers' Organisation (EFO) has been induced by the intervention of key stakeholders and is geared towards commercialization to provide more stable household income and improve access to food. The EFO is the first smallholder group in SA to have been organic accredited. Through group certification, some of the fixed costs of certification and fixed transaction costs to market organic produce are spread over a larger number of growers. Whereas some of the farmers have adopted certified organic farming, some have not, and others are in the process of being organic certified. Adoption of agricultural production technologies is influenced by many economic and social factors and institutional, physical and technical aspects of farming and the risk attitude of farmers (Gardner and Rausser, 2001). Better understanding of these relationships can contribute to the development of appropriate technologies and the design of successful development projects. The certified organic food market is relatively new in SA, and little scientific research has been documented to compare the economics of organic versus non-organic farming. Current research and development endeavours have focused on the agronomic aspects of organic farming and to the authors' knowledge there is no published empirical analysis of adoption of certified organic farming among smallholder farmers in SA. The aim of this study therefore, is to identify the characteristics of smallholder farmers that adopt certified organic farming in Umbumbulu district of KZN.

Organic Agriculture and Sustainable Livelihoods In Sa

In global terms, Africa accounts for only 1% of total certified organic land, but given that most of the organic farms in Africa are very small family smallholdings, the continent accounts for almost 10% of the certified farms (Yuseffi and Willer, 2003). The Organic Agriculture Association of South Africa (OAASA) estimates that there are about 100 non-certified mostly small scale commercial farmers, farming about 1000 hectares, following organic principles, who market informally through local villages or farmers' markets.

Organic farming for many people is associated with sustainable agriculture (Welch and Graham, 1999) and sustainable food security (Althieri, 1998; Piva, 2002). However, for many subsistence farmers in Umbumbulu district, organic farming has been the only method of farming they practice, as they cannot afford chemicals and seeds for conventional farming.

Many farmers in Msinga and Embo wards in KZN associate organic farming with poverty, subsistence farming, perceived low social class and cultural norms (Modi, 2003). Despite the potential for organic farming to improve livelihoods, there is limited research to explain its role in agriculture, rural development and food security in a SA context. The number of organic farms and consultants in SA is increasing but there is limited information on the economics of organic agriculture (Hall, 2002) and factors affecting its adoption, especially among the rural smallholder farmers. This further supports the need for this study.

Methodology

The 200 survey farmers in Umbumbulu district, KZN were stratified into three groups: fully-certified organic farmers (early adopters), partially-certified organic farmers (later adopters) and non-organic farmers (non-adopters). They consisted of 151 organic farmers and members of EFO that were purposively selected (48 fully-certified members and 103 partially-certified farmers), and another sample of 49 non-organic farmers who were not EFO members that was randomly selected within the same region from a sample frame constructed from each of the five neighbouring wards. The farmers' risk aversion was measured using the Arrow-Pratt Absolute Risk Aversion (APARA) coefficient. The utility function is estimated in this study by asking farmers hypothetical questions regarding risk alternatives. The data is adjusted appropriately to account for the sensitivity of the APARA to range and scale of the data and for purposes of standardisation and comparison with other studies (Ferrer, 1999; Nieuwoudt and Hoag, 1993). Standardisation was undertaken by converting the distribution ($x_{min} \leq x \geq x_{max}$) into a distribution ($0 \leq x^* \geq 1$) where X_{min} and X_{max} are the minimum and maximum values on the x-scale. This provides a unit-less expression of the absolute risk aversion function. The proposed empirical model for the Linear Discriminant Function takes the form in equation (1):

$$D_{ikm} = \alpha_1 AGE + \alpha_2 GENDER + \alpha_3 EDUC + \alpha_4 HHSIZE + \alpha_5 LAND + \alpha_6 INCOME + \alpha_7 COSTHA + \alpha_8\ CHICKNO + \alpha_9 LOCATE + \alpha_{10}\ RISK \ldots\ldots\ldots\ldots(1)$$

Equation (1) hypothesizes that the farmer's decision to adopt or not to adopt certified organic farming depends on the ten explanatory variables in Table I which also summarizes the expected sign for the effect that they have on D_{ikm} for each case. Many studies have evaluated the factors affecting adoption of new agricultural technology (Feder *et al*., 1985; Shakaya and Flinn, 1985; Adesina and Baidu-Forson, 1995; Nkonya *et al*., 1997; Hassan *et al.,*1998; and Baidu-Forson, 1999), most focusing on the relation of key variables to the adoption behaviour of farmers. Literature review shows mixed results on the factors that affect technology adoption and diffusion behaviour in agriculture. It does however suggest that the adoption of certified organic farming could vary across the households and that factors such as the farmer's age, gender, education level, household size, proportion of area planted, proportion of income from farming, input cost per hectare, location of households and the farmer's risk attitude should be considered in the local analysis. Chicken ownership was considered because of its significance as a source of manure in the study area. The hypothesized sign of the coefficient of AGE could be positive or negative (Abadi Ghadim and Pannell*,* 1999). Freud *et al.,* (1996) in Cote d'Ivoire found that the farmer's age and adoption of modern varieties of cocoa were not related, while Hossain *et al.,* (1992) revealed that the probability of adoption of new farming practices increased with age among farmers in Bangladesh. GENDER is hypothesized to have a positive sign as male-headed households are likely to have better access to information and services and hence be innovators (Staal *et al.,* 2002). The EDUC variable is hypothesized to be either positively or negatively related to adoption of certified organic farming. Hollaway *et al*., (2002) postulate that education can encourage new technology adoption by lowering learning costs or it may discourage adoption since education provides more profitable off-farm employment opportunities. Large family size implies more labour available for labour intensive activities (Staal *et al.,* 2002) and hence the hypothesized sign for household size (HHSIZE) and adoption is positive. Following Barker and Herdt (1978), Ahmed (1981) and Allaudin and Tisdell (1988) the relationship between farm size (LAND) and adoption of certified organic farming is hypothesized to be negative. Farmers with more income (INCOME) are hypothesized to be innovators because they have more funds to acquire resources and invest in the technology. The number of chicken owned (CHICKNO) is likely to have a positive impact on adoption of certified organic farming as chicken manure is widely used in the study region as a

Table I: Definition of empirical model variables and their and hypothesized relationships with adoptions of certified organic farming, KZN, 2004

Variable	Description	Unit	Hypothesized sign
AGE	Respondents Age	Years	±
GENDER	Gender of household head (F = 0; M= 1)	Dummy	+
EDUC	Years of schooling for household head	Years	±
HHSIZE	Number of people in the household	Number	+
LAND	Proportion of arable area planted	Hectares	-
INCOME	Household income from farming	Rands	+
COSTHA	Input cost per hectare	Rands	+
CHICKNO	Number of chickens	Number	+
LOCATE	Household's location (Sub-ward) Ogagwini /Ezigoleni =0 ;Other =1	Dummy variable	-
RISK	Farmer's risk attitude	APARA coefficient	-

substitute for commercial fertilizers. The variable LOCATE captures the difference's between adopters that are not accounted for by other variables and spatial characteristics. Several authors Rogers (2003), Shideed (1999) and Semgalawe (1998) have found that the further away farmers are from the focal point where the technology was first introduced, the longer technology diffusion takes. In this study the first adopters of the certified organic farming technology were from subwards Ogagwini and Ezigoleni and the 54 fully certified members come from these subwards. Finally the study hypothesizes a negative relationship between RISK and adoption of certified organic farming. Risk-averse farmers are reluctant to invest in innovations of which they have little first-hand experience (Marra and Carlson, 1990).

Discriminant Function Results And Discussion

The first LDF1 (Table II) shows that the most important variables distinguishing the fully-certified organic farmers from the other two strata are LOCATE and RISK. The second LDF2 (Table II) relates to the number of chicken owned and input cost per hectare and discriminates between the fully-certified organic (early adopters) and the partially-certified organic (later adopters) farmers. The Wilk's lambda is statistically significant at the 1 percent level of probability for both the LDFs and significant by the F-test for household size, income, cost per hectare, number of chicken, location of the household and the farmers risk attitude. The LDF1 accounts for 92.3 percent of the variation between the strata. The estimated parameter for AGE is not statistically significant and has a positive sign indicating that older farmers tend to be adopters. The GENDER coefficient estimated is also not statistically significant, implying that female-headed households are not differentially constrained from adopting certified organic farming. These studies support findings by Phiri *et al.,* (2004) who found that adoption of agroforestry technologies in Eastern Zambia by poor households was gender neutral. Though education can play a key role in the adoption decision, the EDUC variable did not have a statistically significant coefficient. Hollaway *et al*., (2002) postulate that education can encourage new technology adoption by lowering learning costs or it may discourage adoption since education provides more profitable off-farm employment opportunities and new technologies may reduce the ability of farm operators to substitute their time inputs away from cultivation.

This may be the case in the study area as the level of education is relatively low with the average year of schooling across the sampled strata at 4.2 years. The HHSIZE coefficient is positive and statistically significant.

A larger family size is more conducive to adoption of certified organic farming which is a labour intensive technology. Hollaway *et al*., (2002) had a similar result interpreted as a confirmation that higher subsistence pressure leads to greater adoption of new agricultural technology aimed at improving food access among households.

Large family sizes are also an indication of availability of labour and provide the opportunity for the farm to develop the technical know-how required for certified organic farming. The potential to meet peak labour

Table II: Standardized discriminant functions distinguishing between fully-certified, partially-certified and non-organic farmers KZN, 2004 (N=140)

DISCRIMINATING VARIABLE	STANDARDIZED COEFFICIENTS ESTIMATES		GROUP MEANS			UNIVARIATE F-VALUE
	Function 1 LDF1	Function 2 LDF2	Fully-certified organic farmers (N=42)	Partially-certified organic farmers (N= 64)	Non-organic farmers (N=34)	
AGE	0.023	-0.176	52.4	49.73	51.82	0.537
GENDER	0.026	0.251	0.83	0.77	0.79	0.348
EDUC	-0.052	0.243	4.81	4.10	3.59	0.761
HHSIZE	0.003	0.011	8.71	8.22	6.85	2.370***
LAND	-0.144	-0.010	0.52	0.62	0.81	0.756
INCOME	0.009	0.376	0.34	0.22	0.14	5.534*
COSTHA	0.064	0.442	4166.52	2010.88	1950.45	4.242**
CHICKNO	0.314	0.580	16.33	9.25	6.67	9.651*
LOCATE	-0.936	0.331	3.67	3.70	8.00	89.882*
RISK	-0.544	-0.095	-24.37	-15.45	9.28	21.880*
Wilk's lambda	0 .325*	0.277*				
Group centroids						
Fully-certified	-1.087	0 .544				
Partially certified	-0.611	-0.412				
Non-organic	2.493	0.103				

Note: *, **, *** denote statistical significance at the 1, 5 and 10 percent level of probability, respectively.

demand also highlights the importance of the availability of family labour. The coefficient of LAND has a negative relation to adoption implying that smaller farms appear to have greater propensity for adoption of certified organic farming. A "subsistence pressure" argument fits well with the finding by Hollaway *et al*., (2002). Shiyani *et al.,* (2002) also found a negative relation between size of land holding to the adoption of Chicken pea varieties among smallholder farmers in India.

This result verifies the hypothesis that smaller farmers in comparison to larger farmers adopt new varieties at a faster rate if additional gains are substantial. In the study area such a pattern was visible on the account that small farmers live on subsistence level that attracts them to adopt innovations which yield better than local varieties and hence promise better incomes from sales *ceteris paribus*. These also results support earlier findings by Allauddin and Tisdell (1998) in Bangladesh. The statistically significant coefficient estimate for INCOME implies that the higher the income the higher the probability of certified organic adoption. Farm income helps to cover implementation costs and also contribute to household income in rural areas. Higher income enables the farmers to acquire and or rent more land for technology adoption, purchase and pay for required inputs timely. The proportion of income from farming is higher for fully-certified farmers than for the other groups. The COSTHA coefficient estimate is positive and statistically significant. Initial costs associated with certification are high and include certification and inspection costs, labour, tractor and draught hiring costs, cost of manure and transaction costs. The statistically significant positive coefficient for CHICKNO is expected as fully-certified organic farmers were facilitated into building chicken houses by stakeholders from the Department of Agriculture and Environmental Affairs, KZN as an incentive for certification and chicken manure is a substitute for commercial fertilizers in the region. The neighbourhood coefficient LOCATE is statistically significant and negatively related to adoption suggesting the presence of local synergies in adoption. This raises the question about the extent to which ignoring these influences biases policy conclusions. The closer a farmer is to the nearest adopter, the higher the frequency of contact, the more likely the farmer will receive valuable information, thus increasing their skill and decreasing their uncertainty (Abadi Ghadim and Pannell*,* 1999). The impact of the degree of risk aversion of farmers is statistically significant and negative for certified organic technology adoption supporting findings by Brink and McCarl (1978), Marra and Carlson (1990) and Abadi Ghadim and Pannell (1999) who found an overall negative influence of risk aversion on adoption of agricultural technology. The average sample farmer in the study area was classified as risk-averse. This is because the overall APARA coefficient was negative for the study farmers. This result shows the need to increase people's capacity to bear risk by decreasing the perceived risk of adoption of certified organic farming These include concerns about the irreversible fixed costs of gaining certification, reduced flexibility in marketing decisions given that the current rules require EFO members to service the pack-house agents requirements first, giving them limited freedom of market choice, uncertainty regarding high rejection rates by the pack-house (increasing income risk compared to the Isipingo (informal) market), lack of information and lack of trust between EFO and its stakeholders. An insight into the above issues has clear implications as to how the perceived riskiness of organic certification may be reduced, thus increasing the likelihood that relatively more risk-averse farmers will adopt certified organic farming.

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