Factors Influencing the Partial versus Complete Adoption of Organic Farming Practices in Saskatchewan, Canada

Abstract

Using a sample of organic producers in Saskatchewan, Canada, this study utilizes two econometric models to determine the factors affecting complete adoption of organic practices. It also investigates the factors influencing the share of total cultivated area under organic management. Specifically, the study evaluates the effect of transaction costs when converting partially or completely[1] from conventional to organic practices. The results highlight the importance of lowering transaction costs in stimulating the complete adoption of organic management practices and indicate that infrastructure and services, satisfaction with marketer and certification body performance, marketing problems, and internet use in marketing organic products, are all important factors influencing the extent to which organic farming technologies are adopted. We infer that farmers with smaller land holdings may be more inclined to undertake complete adoption. While the age and education levels of organic farmers have no significant effect on the probability of complete adoption; younger organic farmers with higher education allocate less of their cultivated area to organic practices.

Key words: organic farming, complete adoption, transaction costs.

INTRODUCTION

Organic farming is a sustainable alternative to conventional farming. It is a production technology that respects the environment's own systems for controlling pests

[1] Complete adoption means that all acreage is under organic management.

and disease in crop and livestock production, and in doing so, avoids the use of synthetic pesticides, herbicides, chemical fertilizers, growth hormones, antibiotics or gene manipulation (European Commission, 2002). Organic farmers must undergo a three-year transition period prior to obtaining organic certification. During this time, they must farm organically but will not receive organic premiums in the marketplace.

Organic food production is one of the highest growth sectors in the global food industry. According to Yuseffi and Willer (2004), more than 24 million hectares are under organic management world-wide. Currently, Australia, with about 10 million hectares, makes up about 40% of this area. The percentages of land under organic management (more than 5.5 million hectares), however, are highest in Europe (Yussefi and Willer, 2004). Organic farming is also one of the fastest growing sectors of North American agriculture. For instance, the growth rate of certified organic farmland for corn, soybean, and livestock production was 100% between 1997 and 2001 in the U.S. (Greene and Kremen, 2003).

Canada has also experienced strong growth in organics over the past decade. Currently, there are approximately 3200 organic producers on 1.16 million acres of cropland, and over 320 organic processors nationwide. Growth in retail sales is estimated to be 20% annually, and in 2000 reached $1 billion (Agriculture and Agri-Food Canada, 2004a). Saskatchewan is the largest producer of organic products in Canada with approximately 1050 farmers on 386,000 acres of farmland. The estimated farm gate value of organic products in Saskatchewan is $92 million (Agriculture and Agri-Food Canada, 2004b).

As expected, increases in organic production have been closely paralleled by increases in consumer demand. The organic food market is among the fastest growing segments in both the North American and EU food industries. Increasing domestic and international demand for organic products, along with environmental interests, has stimulated policymakers and governments to encourage organic production through a variety of farm programs, most notably in the EU, where subsidies have been used to encourage conversion to organic production (Lohr and Salomonson, 2000).

Irrespective of high growth rates in the production and consumption of organic products, organic production makes up only a small fraction of Canadian agriculture, as less than 2% of all farmland is certified organic. Despite this, there is growing evidence that the adoption of organic practices produces numerous environmental, social and financial benefits. MacRae et al (2002) assert that increased adoption of organic farming in Canada can help governments address pollution problems, reduce greenhouse gas emissions, and build consumer confidence by reducing the use of products, practices and processes that are seen to be unsafe by some consumers. They further suggest that organic farming can increase farm incomes and help to revitalize rural communities, thereby decreasing the need for government subsidies.

Investigating potential barriers to the conversion to organic farming is useful because it can provide policymakers with information required to stimulate a conversion to organic farming if so desired. Despite several studies conducted on different aspects of the conversion process, there has not been any research that analyzes why some farmers only partially adopt organic management practices, while others convert all of their acreage to organic management practices. The focus of this research is to identify

transaction costs that can prevent the complete adoption of organic farming and to analyze factors affecting the share of total cultivated area that farmers allocate to organic practices.

The structure of this paper is as follows. The next section provides a review of studies that have been completed in the context of adoption and diffusion of organic farming. Section 3 describes the process of converting to organic farming. Section 4 discusses the econometric models used in the analysis and defines the variables used in each model. Section 5 describes the data analysis as well as the survey data. Empirical results and conclusions are presented in sections 6 and 7, respectively.

BACKGROUND

A great deal of the literature focuses on understanding factors that motivate farmers to adopt organic farming practices. Lampkin (1990) argues that many studies do not adequately isolate the effects of farming systems from the effects of localized factors that are not determined by the choice of farming system. Marshall (1993) identifies several important factors that could impact the adoption of organic farming, including financial competitiveness, management skills, agro-climatic conditions and social considerations. Several studies have compared the economic and financial performance of organic and conventional farms to show the differences between these two alternatives (Lampkin, 1993; Lampkin, 1994; Dabbert, 1994; Fowler et al, 1999; Fowler et al, 2000; Offermann and Nieberg, 2000)

Several empirical studies are available in the scientific literature dealing specifically with the process of the diffusion of organic farming. One of these is the work by Lampkin and Padel (1994), which analyzes, from an international perspective, the

mechanism by which adoption occurs, including both causes of and barriers to converting from conventional to organic production. Their report summarizes financial support programs available to producers from 1987 to 1992 in Denmark, Sweden, Norway, Finland, Switzerland, Austria and Germany. The European experience suggests that conversion subsidies have been a major factor in expanding the organic farming sector. López et al (2005), using a sociological approach, analyze the diffusion of organic agriculture in the south of Spain for olive production, within the framework of the diffusion of innovations theory. Their results indicate that diffusion spreads in an autonomous way among olive growers and is also motivated to a small extent by external factors.

Aker et al (2005) describe adoption decisions as a hierarchical process. They divide the adoption decision into five hierarchal steps including product awareness, information-seeking and processing, evaluation, purchasing, and post-sale evaluations. The importance of information and knowledge are emphasized in several studies that examine the process of converting to organic agriculture. For example, Lockeretz (1989) notes the accumulation of knowledge, as well as the availability of technical support, is important to the expansion of organic farming. In a study on conversion from conventional to organic cereal and livestock farming, Wynen (1993) found that information about organic agriculture is particularly important in technical, regulatory and marketing areas. Padel (2001) highlights the importance of "knowledge networks" to organic farming, referring to it as an "information-based innovation" where participants seek to acquire information from sources beyond those available through conventional agriculture. In a recent study, Wynen (2004), notes that with regard to a farmer's decision

to switch to organic farming, it is extremely important to be well informed about organic farming prior to making the conversion. The importance of information is further highlighted in a case study in Italy, where it was determined that a lack of extension, available information, and general awareness about organic markets constrains the diffusion of organic farming in the area. The authors also note that these information problems were accompanied by some distrust of local agricultural organizations (SIMOCA Project, 2004). Niemeyer and Lombard (2003) using a multi-disciplinary approach, examine in a socio-demographic context, the motivations for and problems related to the conversion to organic farming in South Africa. They recommend that the conversion process should be supported in a variety of ways including improved infrastructure for marketing, networking and information exchange. Similarly, Walz (1999) found that a lack of information and experience in conjunction with an inability to identify organic markets are the most severe barriers to conversion. According to Morgan and Murdoch (2000), networks are the best means of providing information to organic farms, both from within and outside the organic movement.

Social issues are another possible factor affecting the adoption of organic agriculture. Bremiyer (1984) argues that not all farmers undertake organic practices purely for economic reasons and that social factors can influence decisions to convert. Similarly, Lobley et al (2005) suggest that the "social space" of the farmer is an important component in decision-making and innovation with respect to organic farming, particularly as it pertains to soliciting advice or information from others.

Management skills are cited as another factor that can impact the adoption of organic agriculture (Chang et al, 2004). Crosson and Ostrov (1990) argue that organic

farmers need to be intimately familiar with ecological relationships in order to manage crop and livestock production without utilizing synthetic fertilizers and pesticides. According to Schneeberger et al (2002), technical challenges and additional labour requirements are important barriers to adoption. Agro-climatic conditions are another factor to be considered when evaluating the extent to which organic agriculture can be pursued from an economic standpoint (Chang et al, 2004).

Some studies apply econometric models to examine how different factors affect the behavior of organic farmers. Lohr and Salomonson (2000) apply a utility difference model to Swedish data to determine whether a subsidy is required to facilitate organic conversion in that country. The results indicate that access to a range of marketing options and market information are substitutable for payment levels in the farmer's utility function, indicating that services rather than subsidies may be used to encourage conversion to organic agriculture. Pietola and Lansink (2001) combine a numerical dynamic programming routine and the estimation of a Probit-type switching model to explain the decision making process of Finnish farmers switching between organic and conventional farming technologies. The results suggest that decreasing output prices (a price index of standard and organic products) and increasing direct subsidies can encourage the switch to organic farming. In another study, Burton et al (2002) use duration analysis to model the adoption of organic horticultural technology in the UK. The results bring to light the importance of gender, attitudes towards the environment and information networks, as well as systematic effects that influence the adoption decision. Recently, Kuminoff and Wossink (2005), using option value theory, developed a theoretical model to assess the financial compensation that would be required for

widespread conversion from conventional to organic farming. Assuming an interest rate of 10%, they concluded that an annual payment of $228 per acre for ten years would be required to compensate a conventional corn-soybean grower for conversion costs as well as the long run higher production and marketing risks.

The notion that transaction costs keep many rural households from participating in certain agricultural markets has been documented in the economic literature (Goetz, 1992; Key, Sadoulet and de Janvary, 2000). In some cases, researchers have examined the choice between different markets exhibiting different structures of transactions costs to reveal the role of these costs in market choices (Hobbs, 1997; Bailey and Hunnicutt, 2002). Although some researchers try to determine and explain transaction costs in organic markets (Ferguson, 2004; Ferguson et al 2005), little research has been done that considers transaction cost analysis on the production and adoption behavior of organic farmers. Recently, MacInnis (2004) in a survey using cross-sectional farm-level data on U.S. organic producers, derived empirical evidence that existing organic retail and wholesale markets impose substantial barriers to entry for individual organic farmers. He further suggests that the effects of transaction costs are asymmetric between two types of farmers, those who transitioned from conventional farming and those who did not.

From the above discussion it is evident that there are a wide range of factors that need to be considered when investigating organic adoption. It also appears that there is limited research about factors influencing the complete adoption of organic farming. In addition, the specific effect of transaction costs on the process of adopting organic farming practices has not yet been considered.

THE PROCESS OF CONVERSION TO ORGANIC FARMING

Conversion to organic farming is a lengthy process. We depict this process in Figure 1. As shown in this figure, it is necessary to distinguish between diffusion and adoption of organic farming. In general, the adoption and diffusion of innovations are necessary conditions for technological change to occur in any industry. Most studies on technology adoption, model adoption and diffusion separately. While adoption models typically analyze an individual producer's adoption decision, diffusion models analyze aggregate adoption behaviour (Thirtle and Ruttan, 1987).

According to Aker et al (2005), decisions to adopt organic farming practices can be described as a hierarchical process. Based on this approach, the producer first learns about organic farming and then evaluates the alternatives available to him/her before making an optimal choice. At the first stage of this process, referred to as "technology awareness", potential organic farmers become aware of the organic technology through a variety of formal and informal information channels. Technology awareness is very important for stimulating diffusion of the technology among farmers. During the second stage of the process (information-seeking and processing), potential adopters seek out information about the technology by accessing public information or asking people who are knowledgeable about the technology. Potential organic farmers will seek information in a variety of areas, including technology (production), regulations, and marketing. In this stage, it is important for farmers to be well informed about the true nature of organic agriculture, what is involved in a conversion to organic management, the market for organic products, the impact that the technology will have on the farm and the farm family, and in which time period these changes/impacts are required/expected. In the

technology evaluation stage (the third stage), producers compare the costs and benefits of the technology to its alternatives in order to develop preferences over the range of available options. If, after comparing the costs and benefits of two alternatives he/she thinks that organic agriculture ranks higher than the alternative, the producer will begin the conversion to organic management.

In Canada, the transition period usually takes three years and during this time, land that is to be certified must be under organic management and will be inspected annually. After three years, farmers who are granted certification by a certification body will be considered full fledged organic farmers and are able to sell their products in organic markets. During the adoption stage, a producer must decide whether to allocate all of his/her cultivated area to organic practices (as complete adopters), and if not, the share of cultivated area that will be converted to organic farming. After adopting organic practices, the producer evaluates his or her satisfaction with the technology. It is important to keep in mind that the profitability of organic farming is influenced by many factors that can change from year to year or even from day to day, and that producers may be required to periodically modify farm practices and marketing strategies from time to time to accommodate a change in the conditions (Wynen 1993).

ECONOMETRIC MODELS AND DFINITION OF VARIABLES

In this section, we first explain the econometric models and then define the variables used in the models. The first model is used to conduct a micro level analysis of factors that can influence the complete adoption of organic practices. Limited dependent variable models are often used to help researchers simulate farmers' behaviour in decisions to adopt specific technologies. Using a logit model, we examine the probability

that an organic producer will completely convert his/her acreage to organic farming practices (i.e. all of his or her cultivated acreage is in organic production). In this model, it is assumed that the error terms are logistically distributed. The probability of complete adoption by organic farmer (*i*) (P_i), can be expressed as:

$$P_i = F(z_i) = F(\beta x_i) = \frac{1}{1+\exp(-z_i)} = \frac{\exp(z_i)}{1+\exp(z_i)} \qquad \text{Equation (1)}$$

where $F(z_i)$ is the value of the logistic cumulative density function associated with each possible value of the underlying index, and z_i , and x_i are the independent variables that will affect this decision. In equation (1), βx_i is a linear combination of the independent variables such that

$$z_i = \beta_0 + \beta_1 x_{i1} + ... + \beta_k x_{ik} + \varepsilon_i \qquad \text{Equation (2)}$$

where z_i is the unobserved index level or the logarithm of the odds ratio of the ith observation; β are the parameters to be estimated; and ε_i is a random error or disturbance term.

The coefficients in the logit analysis are estimated using maximum likelihood and serve the purpose of indicating a direction of influence on probability. Therefore, the marginal effect of each of the independent variables must be calculated and are indicated by the calculated changes in probabilities (Maddala, 1992). The marginal effect on the probability for an average individual due to a small change in variable x_{ij} under a logistic distribution is:

$$\frac{\partial P_i}{\partial x_{ij}} = \frac{\beta_j \exp(-z_i)}{1+\exp(-z_i)} \qquad \text{Equation (3)}$$

where x_{ij} is the jth element of x_i. The marginal effects can be calculated at the sample means of the data or at each individual observation, and the average of the marginal effects used.

The second model is used to explain the behaviors of organic farmers in allocating different shares of their land to organic and conventional products. Another important decision for organic farmers is the acreage of cultivated land to devote to organic practices. The theoretical models assume that organic farmers are profit maximizers (Kuminoff & Wossink, 2005). Under this assumption we can represent the producer's supply of organic product as follows:

$$Q_i = Q(P_i, Z_i^q) \qquad \text{Equation (4)}$$

where P_i is the decision price for organic farmer i and Z_i^q are exogenous variables that affect production. Transactions costs (TCs) effectively decrease the price received by a seller (Key et al, 2000) and include searching, negotiating, monitoring and enforcement costs, as well as numerous transportation and marketing costs that are unobservable or cannot be easily identified through a survey. We can, however, observe a certain number of factors that explain these transactions costs (Z_i^t). The price effectively received by the ith seller is lower than the market price P_i^M by the unobservable amount TC_i. Including transactions costs, the supply curve for a seller can be written as:

$$Q_i = Q\left(P_i^M - TC(Z_i^t), Z_i^q\right) \qquad \text{Equation (5)}$$

Hence, *TCs* shift the supply curve upwards for sellers[2]. By estimating equation (6), it is possible to investigate the factors affecting the supply of organic products:

$$Q^s{}_i = f\left(Z_i^t, Z_i^q, \varepsilon_i\right) \qquad \text{Equation (6)}$$

where Z_i^t are variables related to transaction costs, Z_i^q are other variables that affect production and ε_i are error terms. In this study we use the share of organic farming relative to total cultivated area as an index for the supply of organic farming. We can then rewrite the equation as follows:

$$Share_i = f\left(Z_i^t, Z_i^q, \varepsilon_i\right) \qquad \text{Equation (7)}$$

where, $Share_i$ is the share of organic farming as a percentage of total cultivated area for the *i*th farmer.

The independent variables with their measurement units and expectations regarding the sign of the coefficients are listed in Table 1. We use the same independent variables for both models. The first five variables represent transaction costs in marketing organic products. In general, it is assumed that lower transaction costs encourage farmers to allocate more of their cultivated land to organic farming and to completely adopt organic practices. There are several studies that confirm that longer distances between farmers and markets result in increased transaction costs that will effect participation in special markets (Goetz, 1992; Staal et al, 1997; Omamo, 1998; Key et al, 2000; Holloway

et al, 2000; Renkow et al, 2002). Distance to cleaning location is an indication of infrastructure services and should therefore be negatively correlated with the adoption of organic farm practices and with the organic share of total production. Most of the marketer and certification body (CB) functions are related to marketing organic products and it is likely that farmers who have more satisfaction with their marketer and CB functions incurred lower transaction costs in marketing their products. The prediction is that farmers who have higher satisfaction with their marketer and CB functions are more likely to be complete adopters and will therefore allocate more acreage to organic farming practices.

Marketing problems can also be potential transaction costs for farmers. Farmers who give a higher ranking for marketing problems are expected to experience higher transaction costs in selling organic products and will therefore have less incentive to manage all of their cultivated acreage organically. Internet usage as a proxy for information technologies is expected to decrease search costs in the process of marketing organic products. The variable is expected to have a positive coefficient in both of the models.

The remaining independent variables are farm and farmer characteristics. We are interested in determining how farm size influences the process of adopting organic practices. The effect of the variable is not predictable. Obviously, complete adoption of organic farming is influenced by the number of years between certification and the present. In both models, a positive coefficient is expected for this variable.

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[2] Here, it is assumed that transaction costs are proportional, i.e. they change positively with the transacted amount for organic producers.

Three independent variables illustrate farmers' perceptions about cost differences between organic and conventional farming. Organic farmers who believe that average marketing and record-keeping costs are higher for organic production than for conventional, are expected to devote less acreage to organic farming and are less likely to completely adopt.

We include a wage that farmers pay to themselves (estimated by each farmer) as an index of opportunity cost. It is predicted that the probability of complete adoption decreases for farmers who have higher opportunity costs. Age and education levels of organic farmers are other important attributes that are considered. The effects of these attributes could not be specified.

DATA ANALYSIS AND SURVEY DATA

The data used in this analysis was obtained from a survey of 57 organic producers in Saskatchewan carried out by the Project on Organic Agriculture at the University of Saskatchewan in 2004. Questionnaires were mailed to 90 organic grain producers randomly selected from across Saskatchewan and included producers from four certification bodies including the Organic Crop Improvement Association (OCIA), Pro-Cert, the Canadian Organic Certification Cooperative (COCC) and the Saskatchewan Organic Certification Association (SOCA). There are two groups of organic farmers in the sample: farmers who allocated all cultivated area to organic practices (complete adopters) and farmers who allocated only part of their cultivated area to organic practices (partial adopters). Descriptive statistics (including mean and standard error) of several explanatory variables in the models, plus some additional important variables are provided in order to illustrate the differences between complete and partial adopters. A t-

test is used to determine whether there is a significant difference between the two group means.

Farm and Farmer Characteristics

Table 2 presents the mean of farm and farmer characteristics for producers who farm organically. The results show that the average organic farmer started the transition process in the middle of 1993 and became certified in the middle of 1996, however, on average, complete adopters started the transition to organic farming sooner than partial adopters. The time between transition and certification (transition period) is about 3.2 years on average. The average cultivated area for all organic farmers is 1242.9 acres but complete adopters have less cultivated area (978.3 acres) than partial adopters (1481.1 acres). The share of transitioned and certified area as a percentage of total cultivated area for all adopters is 88% and 82%, respectively, while 78% and 65% of total cultivated acres were transitioned and certified by partial adopters, respectively. Approximately 50% of organic farmers allocate all of their cultivated area to organic practices (complete adopters).

The results of the survey show that the most of the farmers in the sample are between 41 and 50 years old. Thirty-seven percent of the farmers surveyed have a high school education, while 14% have a university education. The average hourly wage that organic farmers gave to themselves is higher for partial adopters (15.53 $/hour) than for complete adopters ($13.50/hour). Overall, 23% of organic farmers indicated that they use the internet in marketing organic grain; however, complete adopters (33%) were much more active online than were partial adopters (13%). In terms of proximity to cleaning facilities, complete adopters are generally much closer to their cleaning facility (22.85

km) than partial adopters (74.62 km). The average distance from farm to cleaning location for all farmers surveyed is 50.1 km.

The last three rows in Table 2 illustrate farmers' perceptions about cost differences between organic and conventional farming. Organic farmers believe that average marketing and record-keeping costs are higher for organic production than conventional, estimating that average costs per unit of organic production are 12.4% and 18.9% higher than for a unit for conventional production, for marketing and record-keeping, respectively. Thirty percent of farmers believe that farm storage costs for organic production are higher than for conventional production. While 33% of complete adopters think that average storage costs for organic farming are higher, only 27% of partial adopters agree.

Organic Producer Satisfaction with their Marketers

Based on a list of 16 functions that marketers perform, producers were asked to rate the importance of each function to their farm operation, as well as the effectiveness of their marketer in performing that function. Answers were given on a scale of 1 to 5, where 1 was poor effectiveness or low importance and 5 was excellent effectiveness or high importance. If a function receives a low effectiveness rating and a high importance rating, this indicates that marketers need to improve their effectiveness in performing that function. The overall rating of a producer's satisfaction (or a "satisfaction value") can be calculated by multiplying the effectiveness and the importance value together (Ferguson et al, 2005).

Complete adopters reported higher levels of satisfaction for all functions performed by marketers than did partial adopters. The average satisfaction rate of all

organic farmers was calculated to be 7.8, while the average satisfaction rates for complete and partial adopters were 8.9 and 6.8, respectively.

Organic Producer Perceptions of the Role of Certification Bodies

Certification bodies (CBs) are organizations that undertake third-party assessments of conformance with established organic standards. Third-party organic certification allows producers to efficiently communicate the organic quality of their product to other firms in the supply chain (Ferguson et al, 2005).

Producers were asked to rate the importance and effectiveness of CBs, in performing ten functions. Answers were given on a scale of 1 to 5, where 1 was ineffective or of low importance and 5 was very effective or of high importance. In addition, by multiplying the effectiveness and the importance value together the overall rating of producers' satisfaction with their respective CBs is expressed as a single number for each function. Table 4 reports the average satisfaction values for each function for all respondents and for the different groups of adopters.

Complete adopters reported higher levels of satisfaction for all functions performed by CBs than did partial adopters. The average satisfaction rate of all organic farmers was calculated to be 13.3, while the average satisfaction rates for complete and partial adopters were 15.7 and 11.2, respectively.

Marketing problems

To establish an index for marketing problems, the main potential problems in marketing organic products were identified. Then, participants were asked the extent to which each of the potential issues is a problem when selling organic grains. The rank for

each marketing problem is calculated based on the average satisfaction value. The average rank for each marketing problem is contained in Table 5.

The results show that marketing issues are generally minor problems for organic farmers. Of the problems listed, arranging for trucking and lack of information on future prices and market potential for crops are considered important. With the exception of a) providing marketing opportunities shortly after harvest and b) providing agronomic information, partial adopters gave the same or higher rankings than complete adopters, indicating that partial adopters have more problems in marketing organic products than complete adopters.

ECONOMETRICS RESULTS

OLS Estimation Results

Equation (7) was estimated using the Ordinary Least Squares (OLS) method. The results from the organic share estimation are shown in Table 6. The dependent variable in this model is “organic share of total cultivated area”. The model has a relatively good fit, with R-squared values of approximately 51%. Moreover, the F-statistic is statistically significant.

As shown in Table 6, the distance from the farm to the cleaning location (as an index for infrastructure services) has a negative but insignificant effect on the share of organic production. Satisfaction with marketer functions has both positive and significant effects on the model. That is, farmers who are more satisfied with their marketers allocate more of their land to organic practices. Similarly, the relationship between satisfaction with certification bodies and organic share is positive; but the relationship is not significant. There is a negative and significant relationship between marketing problems

and organic share. Thus, problems experienced in marketing organic products result in decreasing organic share. The effect of internet use in the model is positive and significant. Farmers who use the internet to market organic products allocate a higher share of cultivated area to organic agriculture. Most of the estimated coefficients relating to variables that are representative of transaction costs are statistically significant at the 5% level. The results indicate that lowering transaction costs could encourage farmers to allocate more of their cultivated area to organic practices.

There is a significant and negative relationship between the total cultivated area and the dependent variable. It is clear that organic farmers who have larger farms cultivate a lower share of their total acreage using organic practices. The relationship between share of organic farming and the date of certification is positive but is not significant. The hourly wage coefficient as an index of opportunity cost is negative and is insignificant as it pertains to organic share. Labour is identified as an important limitation in organic practices in several studies (Schneeberger et al, 2002; Kirner and Schneeberger, 2000). The rationale is that farmers who have higher opportunity costs allocate less land to organic practices.

Farmers' perceptions about differences in marketing costs, farm storage costs and record-keeping costs are entered as separate variables in the model. There is not a significant relationship for these three variables. That is, marketing, storage and record-keeping costs are not important factors in the share of acreage devoted to organic farming. The farmer characteristics of age and education levels have significant effects on the dependent variable. Younger organic farmers with more education (university and college education) allocate less of their cultivated area to organic practices, while older

farmers with more experience are likely to have a higher share of their land under organic management. Furthermore, as experience with a technology increases, producers may become more comfortable with the technology, and may ultimately find that it reduces their risk.

Logit Model Estimation Results

Complete adoption of organic practices was estimated using the binary logit model [Equation (1)]. Table 7 shows the maximum likelihood estimates of the logit model and the marginal effects associated with each coefficient. The goodness of fit statistics are reported at the end of table. The measures of goodness-of-fit show that the logit model has a relatively good fit, with an R^2 between 16% and 61% and an F-statistic that is statistically significant.

Most of the variables in the logit model have the same sign as in the OLS regression of organic share. This means the factors that affect the complete adoption of organic practices are the same as those that determine the share of organic practices.

The results indicate that all of the coefficients corresponding to transaction costs in the model exhibit the expected signs and most of them are statistically significant at the 10% level or better. The distance to the cleaning location has a negative and statistically significant effect on the complete adoption of organic practices. Those producers who are more satisfied with their certification bodies and marketers are more likely to completely adopt organic practices. The probability of completely adopting organic practices decreases as marketing problems increase. This result highlights the importance of marketing information in encouraging the adoption of organic farming. The coefficient of internet use is positively signed but is insignificant. However, using

the internet as a tool for information collection could still decrease transaction costs and encourage the complete adoption of organic farming.

There is a negative and statistically significant relationship between the total cultivated area and the probability of complete adoption of organic practices. As a producer's total cultivated area increases, he/she is less likely to adopt organic practices completely. As expected, the numbers of years from the date of certification have a positive and statistically significant relationship with the probability of complete adoption. The results show that the effect of wage (as an index of opportunity cost) on the probability of complete adoption is positive and statistically significant. We can infer that labour limits complete adoption of organic practices and that the probability of complete adoption decreases as the wage of the farmer increases. This means that the probability of complete adoption decreases for farmers who have higher opportunity costs for that activity. This result is consistent with the result of several studies that pointed to labour limitations as an important factor in adopting organic farming practices.

Similar to the OLS model, farmers' perceptions about differences in marketing costs, farm storage costs and record-keeping costs do not have a significant relationship with the probability of complete adoption. We conclude that marketing, storage and record-keeping costs are not considered important factors in the complete adoption of organic farming by farmers who are already at least partial adopters. This, however, does not mean that conventional farmers considering converting to organic do not consider these factors important. The coefficients that correspond to farm and farmer's characteristics are insignificant but their signs are as expected. This is in contrast to the

previous model, where the coefficients of farmers' characteristics (age and education levels) did have significant effects on the probability of complete adoption.

CONCLUSIONS

There are several results from this study that can assist in the encouragement of organic production. The results indicate that transaction costs have an important influence on the complete adoption of organic practices, and that they also affect the share of organic farming. Therefore, it may be possible to encourage organic production through:

- Improvement of infrastructure and services for processing and/or cleaning organic products
- Improvement in performance by marketers and certification bodies. Specially, the marketers' and certification bodies' functions related to marketing organic products are important.
- Decreasing problems in the marketing process by providing marketing information
- Encouraging the use of the internet for marketing organic products

Complete adoption of organic farming is correlated to the amount of cultivated land a farmer owns. The more land a farmer owns the less likely he/she will be to adopt organic practices completely and the total share of organic production will be lower. This indicates that smaller land holdings may be more suitable for complete adoption. This result may stem from the fact that managing larger farms under organic practices is more difficult than smaller farms due to high labour requirements. It may also be that larger

conventional farms are typically more profitable than smaller conventional farms and are therefore less likely to consider a switch to organic farming for economic reasons.

The probability of complete adoption decreases as the wage of the farmer increases. This means that the probability of complete adoption decreases for farmers who have higher opportunity costs for that activity. We can infer that labour input is a limitation for complete adoption of organic practices because organic farming is a labour-intensive technology, and constraints on the availability of labour can be expected to influence farmers' decisions to completely adopt organic technology.

Unexpectedly, farmers' perceptions about cost differences between organic and conventional farming practices in marketing, storage and record-keeping are not important factors in determining the probability of complete adoption and the share of organic farming. This is surprising since many studies attempt to compare the costs associated with these two technology types. On the other hand, it is important to remember that the farmers surveyed in this study had already adopted organic farming (either partially or completely) and this may explain why these factors are now perceived as less important to them. For a conventional farmer who does not have any first hand experience in organic farming or has not consulted with an organic farmer about the impact of various factors, these factors may still influence initial adoption decisions and should be considered areas where further information may provide impetus for conversion.

While age and education levels of organic farmers have no significant effects on the probability of complete adoption, it did influence the share of organic acreage devoted to organic farming. A possible reason for this is that these factors may only

influence the initial decision to convert to organic farming but once a farmer is using organic technology in some capacity, it is the experience itself that influences whether complete adoption will occur.

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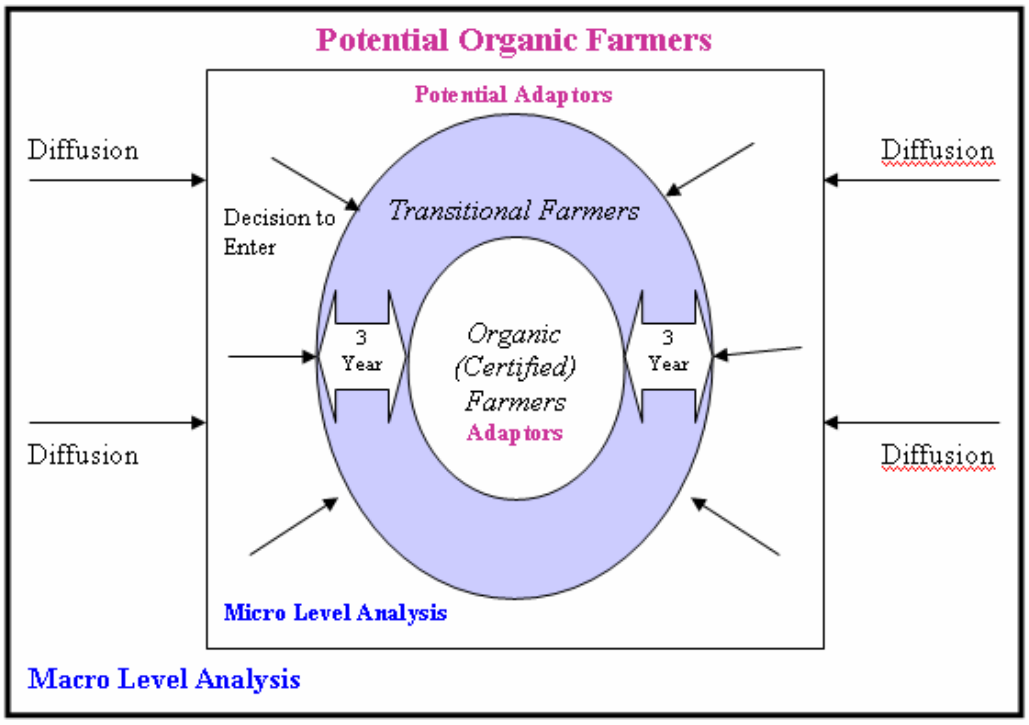

Figure 1: Process of Converting to Organic Farming

Source: Authors

Table 1: Independent Variables for Econometrics Models

Variables Definition	Unit	Expected Sign	
		organic share	Complete Adoption
Distance to cleaning location	Kilometers	-	-
Average satisfaction with certification bodies' functions	Rank* 1-5: lowest rank=1, highest rank=5	+	+
Marketing problems rank	Rank 1-5: not a problem=1, minor problem=2, a problem =3, Relatively significant problem =4, major problem=5	_	_
Average satisfaction with marketer functions	Rank* 1-5: lowest rank=1, highest rank=5	+	+
internet use in marketing organic products	Dummy: yes=1, no=0	+	+
Total cultivated area	Acres	?	?
Years between certification and present	No. of years	+	+
hourly wage	$/hour	-	-
Marketing cost of organic relative to conventional product	Percent	-	-
Storage cost of organic relative to conventional product	Dummy: Higher=1, lower=0	-	-
Record-Keeping cost of organic relative to conventional product	Percent	-	-
Farmer age	Dummy: lower than forty=1, upper than forty =0	?	?
Education level	Dummy: university and college education=1, others=0	?	?

(*) Answers were given on a scale of 1 to 5, where 1 was poor effectiveness or low importance and 5 was excellent effectiveness or high importance.

Table 2: Summary Statistics of Farm and Farmer Characteristics

Characteristics	All Adopters (n=57)		Complete Adopters (n=27)		Partial Adopters (n=30)	
	Mean	St.	Mean	St.	Mean	St.
Date of transition to organic practices	1993.5	6.7	1992.4	7.4	1994.5	6.1
Date of certification as organic producers*	1996.7	5.0	1995.7	5.1	1997.6	4.8
Years between transition and present	9.6	6.7	10.8	7.3	8.5	6.1
Years between certification and present*	6.3	4.9	7.4	5.0	5.4	4.8
Transition period	3.2	3.1	3.3	3.7	3.2	2.6
Total cultivated area (acres)*	1242.9	927.0	978.3	1028.3	1481.1	766.3
Total certificated area (acres)	954.2	821.1	978.3	1028.3	932.6	594.1
Total transition area (acres)*	109.9	331.6	0.0	0.2	208.8	437.0
Total non-certificated area (acres)*	117.3	384.4	0.0	0.2	222.9	510.9
Share of transition to total cultivated area*	0.88	0.21	1.00	0.00	0.78	0.24
Share of certificated to total cultivated area*	0.82	0.26	1.00	0.00	0.65	0.27
Farmer age						
<20	0.00	0.00	0.00	0.00	0.00	0.00
21-30	0.00	0.00	0.00	0.00	0.00	0.00
31-40	0.16	0.37	0.11	0.32	0.20	0.41
41-50	0.42	0.50	0.44	0.51	0.40	0.50
51-60	0.33	0.48	0.37	0.49	0.30	0.47
61-70	0.02	0.13	0.00	0.00	0.03	0.18
>71	0.04	0.19	0.04	0.19	0.03	0.18
Education level						
High School	0.37	0.49	0.44	0.51	0.30	0.47
Technical College or Equivalent	0.23	0.42	0.26	0.45	0.20	0.41
University Bachelors Degree	0.14	0.35	0.11	0.32	0.17	0.38
Others	0.26	0.44	0.19	0.40	0.33	0.48
Hourly wage ($/hour)	14.57	11.53	13.50	10.12	15.53	12.77
Internet use (yes=1, no=0)*	0.23	0.42	0.33	0.48	0.13	0.35
Distance to cleaning location (km)*	50.10	81.36	22.85	30.91	74.62	103.02
Marketing cost of organic relative to conventional product (percent)	12.43	18.04	13.52	20.55	11.46	15.74
Storage cost of organic relative to conventional product (higher=1, lower=0)	0.30	0.46	0.33	0.48	0.27	0.45
Record-Keeping cost of organic relative to conventional product (percent)	18.86	23.68	18.80	26.20	18.93	21.63

* denotes significant differences between the partial and complete adopters at 10% and lower.

Table 3: Satisfaction with Marketer Functions

Marketer Functions	All Adopters (n=57)		Complete Adopters (n=27)		Partial Adopters (n=30)	
	Mean	St.	Mean	St.	Mean	St.
1) Providing marketing opportunities throughout the year	9.1	9.4	10.1	10.0	8.2	8.8
2) Providing marketing opportunities shortly after harvesting	7.4	8.2	8.7	9.1	6.2	7.2
3) Providing the option to contract for sale	7.9	9.1	8.7	9.7	7.3	8.7
4) Provides high prices, given the realities of the market	8.8	9.0	9.0	8.9	8.7	9.2
5) "Fair" marketer fees	9.6	9.9	10.7	10.4	8.7	9.5
6) Provides information on marketing costs, cleaning, transportation, etc.	7.8	9.7	9.5	10.0	6.3	9.2
7) Arranging for trucking from the farm	10.4	10.7	11.5	10.6	9.4	10.8
8) Providing assurance of payment to the farmer	11.8	11.4	12.7	11.9	10.9	11.0
9) Provides prompt payment after delivery	10.9	10.4	12.2	11.2	9.7	9.8
10) Provide information on future prices and market potential for crops	8.0	8.9	8.7	9.7	7.3	8.2
11) Advising on market and price prospects*	7.6	8.9	9.7	10.1	5.6	7.2
12) Providing "target pricing" opportunities	4.3	6.3	4.9	6.9	3.7	5.8
13) Provides advice on "when to sell"	4.9	7.3	5.1	7.3	4.7	7.4
14) Provides advice on "what to plant" in new crop year*	6.3	7.9	8.0	8.9	4.8	6.8
15) Provides advice on "market prospects" based on the quality and quantity that the farmer have grown*	6.7	8.5	8.3	9.0	5.3	7.9
16) Providing agronomic information*	2.9	5.8	4.1	7.4	1.9	3.7
Average Satisfaction *	**7.8**	**7.1**	**8.9**	**7.6**	**6.8**	**6.5**

* denotes significant differences between the partial and complete adopters at 10% and lower.

Table 4: Satisfaction with Certification Bodies' Functions

Certification Bodies' Functions	Total Adopters (n=57)		Complete Adopters (n=27)		Partial Adopters (n=30)	
	Mean	St.	Mean	St.	Mean	St.
1) Providing efficient and timely certification*	16.9	8.3	19.3	7.3	14.7	8.7
2) Providing objective certification*	17.1	9.3	19.3	9.1	15.2	9.2
3) Providing affordable certification*	14.6	8.3	18.0	7.7	11.5	7.6
4) Providing access to the markets	13.6	10.0	14.0	9.8	13.2	10.2
5) Helping seller and buyers to connect with each other*	10.1	9.5	12.5	10.1	8.0	8.4
6) Providing other marketing information (discussion at meetings, pamphlets, etc.)	12.3	9.9	14.0	9.8	10.8	10.0
7) Providing production/agronomic information*	13.0	9.1	15.3	8.7	10.9	9.1
8) Performing research in agronomy and marketing*	9.6	8.6	11.9	8.8	7.5	7.9
9) Distributing research knowledge to members*	12.0	9.6	15.0	9.3	9.4	9.2
10) Participating in the creation of a mandatory national standard*	14.1	10.0	17.6	9.9	10.9	9.2
Average Satisfaction *	**13.3**	**7.2**	**15.7**	**6.8**	**11.2**	**7.1**

* denotes significant differences between the partial and complete adopters at 10% and lower.

Table 5: Marketing Problems

Problems	Total Adopters (n=57)		Complete Adopters (n=27)		Partial Adopters (n=30)	
	Mean	St.	Mean	St.	Mean	St.
1) Processors dispute quality upon delivery	1.1	0.9	1.1	1.0	1.1	0.7
2) Grain companies dispute quality upon delivery	1.2	0.9	1.2	1.0	1.1	0.8
3) Difficult to provide enough high quality grain to meet commitments	1.8	1.1	1.7	1.1	1.8	1.2
4) Buyers do not honour contracts	1.2	0.9	1.1	0.7	1.3	1.1
5) Buyers do not pay on time	1.5	1.2	1.4	1.2	1.6	1.3
6) Prices are volatile	1.9	1.3	1.7	1.3	2.0	1.4
7) Buyers have an "unfair" advantage at knowing what my grain is worth	2.4	1.6	2.1	1.4	2.7	1.7
8) I do not get the best price possible when I sell.	1.9	1.2	1.8	1.3	2.1	1.2
9 Not being able to find a buyer when I want to sell	2.0	1.4	1.8	1.4	2.2	1.5
10) I have a poor understanding of the final market for the products resulting from my crops	1.7	1.1	1.7	1.0	1.7	1.1
11) I have a poor understanding of my buyers' business situation and problems	1.8	1.1	1.7	1.2	1.8	1.1
12) Having problems/disputes with buyers when I try to market "on my own."	1.3	0.9	1.4	0.7	1.2	1.1
Average	**1.7**	**0.8**	**1.6**	**0.8**	**1.7**	**0.8**

1 = Not a problem, 2 = Minor problem, 3 = A problem, 4 = Relatively significant problem , 5 = Major problem.

Table 6: OLS Estimation Results

Variables Definition	*Estimated Coefficient*	*t- static*
Distance to cleaning location (km)	0.00	-0.79
Average satisfaction with certification bodies' functions	0.01	1.20
Marketing problems rank (not a problem=1 , major problem=0)	-0.09	**-2.27
Average satisfaction with marketer functions	0.01	***2.77
internet use in marketing organic products(yes=1, no=0)	0.16	**2.10
Total cultivated area (acres)	0.00	**-1.99
Years between certification and present	0.01	1.40
hourly wage ($/hour)	0.00	-1.24
Marketing cost of organic relative to conventional product (percent)	0.00	1.24
Storage cost of organic relative to conventional product (higher=1, lower=0)	-0.05	-0.76
Record-Keeping cost of organic relative to conventional product (percent)	0.00	-0.76
Farmer age (lower than forty=1, upper than forty =0)	-0.16	**-2.00
Education level (university and college education=1, others=0)	-0.14	**-2.29
Constant	0.96	8.83
Number of observations	57	
R^2	0.51	
Adjusted R^2	0.36	
F statistic	65.88	

***Statistically Significant at 1%, ** Statistically Significant at 5% and *Statistically Significant at 10%.

Table 7: Logit Regression Results and Calculated Marginal Effects

Variables Definition	Estimated Coefficient	t- static	Marginal Effects
Distance to cleaning location (km)	-0.03	**-2.59	-0.01
Average satisfaction with certification bodies' functions	0.13	**2.05	0.03
Marketing problems rank (not a problem=1 , major problem=0)	-1.16	*-1.77	-0.29
Average satisfaction with marketer functions	0.08	1.17	0.02
internet use in marketing organic products(yes=1, no=0)	1.39	1.28	0.34
Total cultivated area (acres)	0.01	**-1.94	0.01
Numbers of years from the date of certification	0.15	*1.66	0.04
hourly wage ($/hour)	-0.08	**-1.99	-0.02
Marketing cost of organic relative to conventional product (percent)	0.02	0.30	0.00
Storage cost of organic relative to conventional product (higher=1, lower=0)	-0.47	-0.51	-0.12
Record-Keeping cost of organic relative to conventional product (percent)	0.04	1.11	0.01
Farmer age (lower than forty=1, upper than forty =0)	-1.02	-0.81	-0.25
Education level (university and college education=1, others=0)	0.28	0.29	0.07
Constant	1.02	0.72	--
R^2 Estrella		**0.55**	
R^2 Maddala		**0.46**	
R^2 Cragg-Uhler		**0.16**	
R^2 Mcfadden		**0.61**	
Likelihood Ratio Test		**34.74**	

***Statistically Significant at 1%, ** Statistically Significant at 5% and *Statistically Significant at 10%.