Title

Determinants of farmer adoption of organic production methods in the fresh-market produce sector in California: A logistic regression analysis

Authors

Jamie B. Anderson, Department of Agricultural and Resource Economics, University of California at Davis

Desmond A. Jolly, Cooperative Extension Specialist and Lecturer, Department of Agricultural and Resource Economics, University of California at Davis.

Richard Green, Professor, Department of Agricultural and Resource Economics, University of California at Davis

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Abstract

This research uses binomial and multinomial logistic regression models to identify the factors that influence farmers' adoption of organic technology. Using a sample of 175 farmers growing fresh-market produce in three California counties, the first model examines farmers' choice between conventional-only and organic-only production. The second model compares conventional-only and "dual-method" (combined conventional and organic) production, while the third model employs all three choices in a multinomial model. These results, which indicate that gross sales, direct marketing, number of crops and acres, farmer age, and computer usage are significant determinants, have implications on policies that regulate the organic foods sector.

Contact Information

Jamie Anderson
c/o University of California Small Farm Center, University of California at Davis
One Shields Avenue
Davis, California 95616
Phone: 530-752-8136; Fax: 530-752-7716; Email: jamie.b.anderson@gmail.com

Determinants of farmer adoption of organic production methods in the fresh-market produce sector in California: A logistic regression analysis

Given the rapid expansion of the organic foods sector and the recent implementation of the National Organic Program regulations, questions have emerged about the potential supply response to this growing industry. Such questions call for an examination of the factors that influence farmers in their decision to adopt organic production methods. Using data collected from a mailed survey conducted between October 2003 and January 2004, this research employs both binomial and multinomial logistic regression models to examine the adoption of organic technology, both in lieu of and in addition to conventional production methods, among farmers in Fresno, Imperial, and Monterey Counties, California.

In the first binomial logistic regression model, the two possibilities for the dichotomous dependent variable are conventional-only production and organic-only production. The second binomial model recognizes that some farmers choose to use organic methods on a portion of their acreage, while continuing to use conventional methods elsewhere on the farm. In the second model, therefore, the two possibilities for the dependent variable are conventional-only production and “dual-method” production (as it is called in this paper). Dual-method farmers may be in the process of transitioning from conventional-only production to organic-only production or may simply be diversifying their product lines by venturing into organic production. Finally, the multinomial model captures all three options—conventional-only, organic-only, and dual-method production—in the dependent variable.

Background

Measured in terms of both acreage and sales, the organic foods sector continues to expand rapidly (Buck, Getz and Guthman; Dimitri and Greene, 2002a; Greene and Kremen; Halweil; Tourte and Klonsky; Yussefi and Willer). In the US, certified-organic crop- and pastureland expanded from 935,000 acres in 1992 to 2.3 million acres in 2001, an increase of 146% (Yussefi and Willer). Parallel to this trend, retail sales of organic products have increased at least 20% each year since 1990, while during the same period overall food industry sales have increased at an average of only 2% each year (Dimitri and Greene, 2002a; Dimitri and Greene, 2002b; Klonsky, 2000; Yussefi and Willer).

Since the implementation of the National Organic Program, the adoption of organic production technology and the marketing of organic products in the US now require annual third-party certification. The Organic Food Protection Act, passed by Congress in 1990, initiated a regulatory process that harmonized the varying state standards on organic agricultural production into one uniform body of regulations, the National Organic Program (NOP). Implemented on October 21, 2002, the NOP requires farms or processing facilities that label their products as organic to: 1) Obtain organic certification through an independent, USDA-accredited organic certifier; 2) Not use irradiation, sewage sludge, or genetically-modified organisms; 3) Comply with the maintained list of approved and prohibited substances for organic agricultural production and food handling; and, 4) Renew their organic certification each year if their annual sales exceed $5,000.

Survey data

The results of this research are based on a mailed survey to a random sample of farmers growing fresh-market produce in Fresno, Imperial, and Monterey Counties, California. These counties were chosen for this research because significant amounts of fresh-market fruits and vegetables are produced in each county using both organic and conventional agricultural methods. In addition, as demonstrated in table 1, while the proportion of organic production increased in each county between 1997 and 2002, it was not necessarily at a faster pace than in other California counties. As shown in the right-most column of table 1, the percentage change in organic sales, acreage, and farmers in these counties ranked among the middle of California's 58 total counties, thus indicating that these three counties are representative of statewide trends in the organic sector (Klonsky, 2003).

To select the sample of farmers for this research, we acquired the names and addresses of organic farmers in the target counties from Ray Green, director of the California Organic Program at the California Department of Food and Agriculture. To identify the population of conventional growers, we obtained the names and addresses of growers from the office of the agricultural commissioner in each of the three counties. The complete lists of farms were trimmed, when necessary and possible, to include only those growing fresh-market vegetables, fruits, herbs, and/or nuts; the lists were then cross-referenced to confirm that each grower appeared on only the organic or conventional list. When dual-method farms appeared on both lists, they were kept on the organic list and removed from the conventional list.

Using a random number generator, the organic and conventional samples were independently drawn to ensure an adequate number of responses from the smaller population of organic growers. From the total population of 266 organic growers, a sample of 200 organic farmers was drawn, while from the total population of 2,615 conventional farmers, a sample of 400 conventional farmers was drawn. The surveys were mailed in October 2003, followed by a reminder postcard in November 2003, and finally mailed again to non-respondents in January 2004. Each survey was coded to track responses and precisely target our follow-up efforts to both encourage a high response rate and eliminate self-selection bias.

The survey collected data on the characteristics of the farmer (e.g., age, gender, educational background, use of computers in farm management) and of the farm (e.g., acreage, crops, marketing channels, gross sales). Of the original 600 surveys mailed, 175 (29.2%) useable surveys were returned. Among these respondents, 118 farm using only conventional methods, 28 farm using only organic methods, and 29 farm using both conventional and organic methods. An additional 52 unusable surveys (e.g., wrong address, the recipient had sold the farm) were also returned.

Summary statistics

The descriptive statistics reveal notable differences between the three kinds of agricultural producers, as reported in table 2. Note, for example, how conventional-only, organic-only, and dual-method producers differ in the mean number of:

- Crops per farm (2.0, 12.7, and 7.3 crops, respectively);
- Acres (251.3, 91.5, and 1,101.2 acres, respectively); and,
- Employees during the busy season (34.2, 9.5, and 46.6 employees, respectively).

In addition, differences among primary farm operators include both their:

- Gender (6%, 23%, and 3% are female, respectively); and,
- Age (57.3, 50.1, and 47.8 years, respectively).

In regard to total farm sales in 2002, data indicate that 78.0% of conventional-only farms and 64.0% of organic-only farms earned less than $250,000, while 42.3% of dual-method farms grossed more than $1,000,000, as shown in table 3. Table 4 indicates that while all three groups of growers favor sales to wholesalers and independent packer/shippers, significant proportions of organic-only and dual-method farms also sell their products directly to consumers (e.g., community-supported agriculture subscriptions, direct sales to retail businesses, farm stands, farmers markets). Finally, the use of computers also varies according to production method, as shown in table 5. More than half of dual-method growers use computers regularly for seven of the eight tasks queried. In contrast, unlike their dual-method counterparts, more than half of conventional-only farmers do not regularly use computers for any of these eight management tasks.

Modeling adoption

Based on previous literature analyzing technology adoption in agriculture using binary and multiple choice models (Burton, Rigby and Young; D'Souza, Cyphers and Phipps; Harper, Rister, Mjelde, Drees, et al.), this research examines the influence of a number of exogenous variables (reported in table 6) on the adoption of agricultural production method(s). Given that farmers choose among three methods of farming—conventional-only, organic-only, and dual-method production—this research developed both binomial and multinomial models to analyze the determinants of the adoption of organic technology, using “agricultural production method” as the dependent variable in each model.

Binomial model 1: Conventional-only and organic-only production

The first binomial logistic regression model, which examines farmers' choice between conventional-only and organic-only production, is

$$E[y \mid \boldsymbol{x}] = F(\boldsymbol{\beta}'\boldsymbol{x})$$

$$= \frac{e^{\boldsymbol{\beta}'\mathbf{x}}}{1+e^{\boldsymbol{\beta}'\mathbf{x}}},$$

where the logistic distribution is

$$\text{Prob}(Y=1) = \frac{e^{\boldsymbol{\beta}'\mathbf{x}}}{1+e^{\boldsymbol{\beta}'\mathbf{x}}}.$$

The explanatory variables, presented in table 6, include acres, use of computers, total sales, age, gender, and education. The logistic model can be derived from a theoretical foundation using index functions or random utility models. The producer makes a marginal benefit-marginal cost calculation, for example, based on the utilities achieved by engaging in organic or conventional farming (Greene).

Table 7 reports the results of the conventional-only/organic-only binomial logistic regression model. Three independent variables are significant predictors of the organic-only production choice: 1) Use of direct marketing; 2) Gross sales; and 3) Number of acres farmed. In addition, the number of crops farmed is significant at the α=0.10 level.

Odds ratios ($P_{i,j} / P_{i,k}$, where *i* and *j* represent alternative production choices available to producer *i*, which can be shown to equal $Exp(\beta)$), are interpreted such that if an explanatory variable changes by one unit, the probability of the adoption of organic methods changes by a factor of $Exp(\beta)$. In short, significant variables with an odds ratio greater than (less than) one will increase (decrease) the probability of adoption. The odds ratio of direct marketing (7.59), for example, indicates that the odds of adopting organic methods are more than seven times greater among farmers who use direct marketing strategies. The odds ratio of total sales (8.16) signifies that the odds of choosing organic production are more than eight times greater among farms which report total annual sales above $250,000. The odds ratio of the acres variable (0.99), however, indicates that with each additional acre, the probability that a farmer will adopt organic methods decreases slightly.

Marginal probabilities also indicate how changes in explanatory variables influence the probability of adoption (holding all other variables constant) and are interpreted as typical beta coefficients in a linear regression model. In the logistic model, the marginal probabilities are given by:

$$\frac{\partial E\left[y \mid \boldsymbol{x}\right]}{\partial \boldsymbol{x}} = \frac{e^{\boldsymbol{\beta}'\boldsymbol{x}}}{\left(1+e^{\boldsymbol{\beta}'\boldsymbol{x}}\right)^{2}} \cdot \boldsymbol{\beta}.$$

As the independent variable changes by one unit, the change in the probability of the dependent outcome changes by the value of the marginal probability. In the first binomial model, the marginal probability for the number of acres indicates that as the number of acres increases, there is a slight decrease in the probability (0.99) of producers choosing organic-only relative to conventional-only production.

Each independent variable in the first binomial model demonstrated high levels of tolerance, indicating the absence of any significant levels of multicollinearity. The tolerance of variable *i* is defined as $T_i = 1 - R_i^2$, as R_i^2 equals the multiple correlation coefficient when the *i*th independent variable is predicted from the other independent variables. A small tolerance would indicate that a variable is close to being a linear combination of the other independent variables.

The model was also tested for out-of-sample performance by first selecting ten observations using a random number generator for exclusion from the unrestricted sample. After the model was developed with the remaining observations, we then compared the performance of the partial and full models using the Pagan and Nichols approach (1984). This log-likelihood ratio test compares the unrestricted and restricted models, the null hypothesis being that they are not significantly different. With a χ^2 distribution, the critical value at α=0.05 with 10 degrees of freedom is 18.307.

$$\text{LR} = -2\ln\lambda = -2\left(\ln\hat{\lambda}_{\text{unrestricted}} - \ln\hat{\lambda}_{\text{restricted}}\right) = 71.239 - 54.281 = 16.958$$

This value is less than the critical value, so we cannot reject the null hypothesis that the unrestricted and restricted models are not significantly different, further supporting the model.

Binomial model 2: Conventional-only and dual-method production

The results of the second binomial model, in which conventional-only and dual-method production are the two possible outcomes of the dichotomous dependent variable, are found in table 7. As indicated, the farmer's age and their use of computers in production management (e.g., emailing customers and suppliers, creating harvest lists, researching farm-related information) are significant predictors of the choice to employ dual-method production.

In the second model, the odds ratio for the use of computers in production management (17.17) indicates that farmers who use computers for these tasks are more than 17 times more likely to adopt dual-method rather than conventional-only production. The odds ratio for the age of the primary farm operator (0.91) indicates that with each additional year of age, the probability that a farmer will adopt organic methods decreases. The marginal probability for age in model two (-0.001) also indicates farmers are slightly less likely to employ both conventional and organic methods with each additional year of age.

As in the first model, each independent variable in the second binomial model demonstrated high levels of tolerance, thus indicating the absence of multicollinearity. The results of the Pagan and Nicholls procedure (1984) support the model as well. As above, the null hypothesis states that the unrestricted and restricted models are not significantly different and the critical value at α=0.05 with 10 degrees of freedom is 18.307.

$$\text{LR} = -2\ln\lambda = -2\left(\ln\hat{\lambda}_{\text{unrestricted}} - \ln\hat{\lambda}_{\text{restricted}}\right) = 65.534 - 50.295 = 15.239$$

This value is less than the critical value, so we cannot reject the null hypothesis that the unrestricted and restricted models are not significantly different, further supporting the model.

Multinomial model

The multinomial model, which examines the adoption of organic technology given the choice between conventional-only, organic-only, and dual-method production is:

$$\text{Prob}\left(Y_i = j\right) = \frac{e^{\boldsymbol{\beta}_j' \boldsymbol{x}_i}}{\sum_{k=0}^{2} e^{\boldsymbol{\beta}_k' \boldsymbol{x}_i}}, \text{ as } \; j = 0, 1, 2.$$

The odds ratios associated with the multinomial model are defined as:

$$\ln\left[\frac{P_{ij}}{P_{ik}}\right] = \boldsymbol{x}_i'\left(\boldsymbol{\beta}_j - \boldsymbol{\beta}_k\right) = \boldsymbol{x}_i'\boldsymbol{\beta}_j \text{ if } \; k = 0.$$

The results of the multinomial regression model are presented in table 8. Given these findings, the odds that a farmer will choose organic-only production, rather than conventional-only production, are more than five times as great if direct marketing strategies are employed (5.18). The use of computers in production is also highly significant when comparing dual-method and conventional-only farmers. The odds that a farmer will choose dual-method production rather than conventional-only production are more than nine times as great (9.42) if they use computers in the production management of the farm.

Conclusions

This research indicates that the use of direct marketing strategies, gross sales, and the number of acres farmed are significant predictors of the choice to adopt organic-only instead of conventional-only production. In addition, the age of the primary farm operator and the use of computers in production management are significant predictors of the adoption of dual-method over conventional-only production. The results of the multinomial model indicate that the use of direct marketing, the number of crops, the use of computers in production, and the age of the farmer are significant determinants of the choice to adopt organic methods of production, either in lieu of or in addition to conventional production.

Examining the results of other adoption of technology models, D'Souza, Cyphers, and Phipps (1993) report that among farmers in West Virginia, a farmer's age and level of education and the quality of their ground water were significant determinants in the decision to adopt "sustainable" farming practices. They also conclude, as does this research, that as farmers age, the probability that they will adopt organic or "sustainable" production techniques decreases. In other research, Harper, Rister, Mjelde, and Drees (1990) found that the probability of the adoption of sweep nets and treatment thresholds to manage the rice stink bug [*Oebalus pugnax* (Fabricius)] among Texas rice growers decreases as the farmer's educational level and the proportion of neighboring land in pasture increases. The probability of adoption increases, however, among farmers who plant semi-dwarf rice varieties, are located within the Texas Rice

Belt, and/or attend certain field days. Finally, Burton, Rigby, and Young (1999) examined the determinants of the decision among farmers in Great Britain to adopt organic agricultural production techniques. Their conclusions indicate that the probability of the adoption of organic methods increases the larger the farm household and if the farmer is concerned about environmental issues, participates in an environmental organization, is female, or obtains information primarily from other farmers. In comparison to the Harper, Rister, Mjelde, and Drees and Burton, Rigby, and Young studies, this research either did not examine the variables tested or found them to be insignificant determinants of adoption (e.g., education, gender) in regard to this specific question.

Limitations in the design of this study constrain our ability to make broad, industry-wide conclusions. First, this research focused on California farms that grow fresh-market vegetables, fruits, and tree crops. While these are the most significant crops in the organic sector, they do not represent the entirety of organic production in California or, for example, the types of crops more prevalent in the US Midwest. In addition, our scope is limited to only three counties. Given the broad and expanding application of organic technology, this is but a small portion of the current and potential organic sector. These supply response questions thus merit further study in other areas and with larger samples to develop universally-generalizeable conclusions about which characteristics limit or enable the adoption of organic technology, findings which would suggest directions for effective organic policy and educational efforts. Finally, with the data that we did collect, there are also some limitations in our ability to distinguish between specific crops. The majority of farms in this sample named grapes as their most profitable crop, for example, but the structure of the survey did not permit us to always determine if the farm grew table grapes, raisin grapes, wine grapes, or some combination thereof.

Beyond the geographical scope of such studies, further research on these questions is also necessary over time. The data for this research was collected between October 2003 and January 2004, relatively soon after the NOP was implemented in October 2002. As time passes and the supply response to this policy change stabilizes, additional research could further shed light on the determinants of the adoption of organic production methods under the NOP. This would thus clarify the impact of the new macro regulations on different types of farmers, depending on the constellation of circumstances that constrain or enable their response to adoption.

Despite these limits, we can draw some implications for policy and extension education from our findings. As organic policy continues to evolve in federal legislation, policymakers and researchers should further consider the constraints on the rate of adoption of organic production, as well as possible methods of reducing these barriers to the transition from conventional to organic production. In addition, given that organic-only and dual-method farmers utilize direct marketing avenues to a greater extent than their conventional counterparts, extension education could educate farmers on more effectively utilizing such marketing channels. Finally, targeted policy interventions may also facilitate the expansion of these critical marketing avenues in the rapidly-growing organic food system.

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Table 1. Organic sales, acreage, and farmers in Fresno, Imperial, and Monterey Counties, 1997 and 2002[a.] (Klonsky, 2003)

	1997	2002	Percentage Change: 1997-2002	Rank Among 58 California Counties[b.]
Fresno County				
Organic Sales	$6,612,534	$11,589,471	75.3%	43
Organic Acreage	2,893	11,995	314.6%	30
Organic Farmers	28	86	207.1%	14
Imperial County				
Organic Sales	$1,401,144	$12,420,078	786.4%	17
Organic Acreage	1,089	5,655	419.2%	28
Organic Farmers	10	18	80.0%	33
Monterey County				
Organic Sales	$6,205,359	$27,566,532	344.2%	26
Organic Acreage	2,403	9,050	276.5%	33
Organic Farmers	29	64	120.7%	23

[a.] Sales figures are not adjusted for inflation.

[b.] A ranking of one would indicate that that county had demonstrated the greatest percentage change of all 58 counties in California between 1997 and 2002.

Table 2. Descriptive statistics by agricultural production method, 2003

		N	Min	Max	Mean	SD
Number of Crops	Conventional only	115	1	12	2.03	2.032
	Organic only	27	1	100	12.74	26.267
	Both conventional and organic	28	1	40	7.25	9.898
Employees, busy season	Conventional only	114	0	2,100	34.17	206.319
	Organic only	27	0	60	9.52	13.586
	Both conventional and organic	29	0	200	46.59	62.182
Employees, slow season	Conventional only	112	0	200	3.95	19.521
	Organic only	28	0	15	3.14	4.836
	Both conventional and organic	29	0	40	12.28	13.180
Acreage	Conventional only	118	3	4,700	251.28	649.932
	Organic only	28	1	700	91.50	166.156
	Both conventional and organic	28	10	8,000	1,101.21	2,079.287
Age	Conventional only	116	29	89	57.28	12.975
	Organic only	27	24	74	50.26	11.598
	Both conventional and organic	29	30	63	47.83	8.242
Gender	Conventional only	116	0	1	.06	.239
	Organic only	26	0	1	.23	.430
	Both conventional and organic	29	0	1	.03	.186

Table 3. Total farm sales by agricultural production method in 2002

		Frequency	Percent	Cumulative Percent
Up to $249,000	Conventional only (109)	85	78.0%	78.0%
	Organic only (25)	16	64.0%	64.0%
	Both conventional and organic (26)	8	30.8%	30.8%
$250,000 to $999,999	Conventional only (109)	12	11.0%	89.0%
	Organic only (25)	7	28.0%	92.0%
	Both conventional and organic (26)	7	26.9%	57.7%
More than $1,000,000	Conventional only (109)	12	11.0%	100.0%
	Organic only (25)	2	8.0%	100.0%
	Both conventional and organic (26)	11	42.3%	100.0%

Table 4. Marketing channels by agricultural production method, 2003[a.]

	Conventional-only (118)		Organic-only (28)		Dual-method (29)	
	Mean	SD	Mean	SD	Mean	SD
CSA Subscriptions	.01	.092	.07	.262	.07	.258
Direct Sales to Retail Businesses	.03	.182	.50	.509	.28	.455
Farm Stand	.03	.182	.18	.390	.10	.310
Farmers Market	.03	.182	.43	.504	.24	.435
Internet Sales	.01	.092	.07	.262	.07	.258
Mail Order	.00	.000	.07	.262	.07	.258
U-Pick	.03	.182	.04	.189	.07	.258
Food Processors	.14	.344	.29	.460	.24	.435
Grower-Owned Cooperative	.36	.481	.07	.262	.24	.435
Wholesale/ Independent Packer/Shipper	.66	.475	.82	.390	.83	.384

[a.] Values in this table will not sum to one because respondents could check more than one response to this question.

Table 5. Use of computers for farm management tasks by agricultural production method, 2003[a.]

	Conventional only (118)		Organic only (28)		Both (29)	
	Mean	SD	Mean	SD	Mean	SD
Banking	.32	.469	.54	.508	.62	.494
Bookkeeping	.47	.501	.61	.497	.79	.412
Payroll	.35	.478	.50	.509	.76	.435
Emailing Customers or Suppliers	.14	.344	.46	.508	.55	.506
Harvest Lists	.14	.344	.39	.497	.66	.484
Researching Farming-Related Information	.37	.486	.64	.488	.72	.455
Supply Orders	.09	.292	.39	.497	.52	.509
Website Production or Maintenance	.06	.237	.32	.476	.38	.494

[a.] Values in this table will not sum to one because respondents could check more than one response to this question.

Table 6. Independent variables in the logistic regression models

Crops	Total number of crops grown per farm	Continuous
CropMix	Types of crops grown	0 = Vegetable crops 1 = Fruit, nut, and other crops
Acres	Total cultivated acreage per farm	Continuous
EmpBusy	Number of employees during the busy season	Continuous
EmpSlow	Number of employees during the slow season	Continuous
CompFin	Use of computers in financial management of the farm (e.g., paying bills, creating invoices, banking, bookkeeping, managing payroll)	0 = Use never or yearly 1 = Use monthly, weekly, or daily
CompProd	Use of computers in production management of the farm (e.g., emailing customers and suppliers, creating harvest lists, researching farm-related information)	0 = Use never or yearly 1 = Use monthly, weekly, or daily
DirectMktg	Use of direct marketing (e.g., CSA subscriptions, farmers' markets, direct sales to retail businesses)	0 = Do not use 1 = Do use

(Table 6. continued)

TotalSales	Total farm sales in 2002	0 = Up to $249,999 1 = More than $250,000
Age	Age of primary farm operator	Continuous
Gender	Gender of primary farm operator	0 = Male 1 = Female
GrpEduc	Highest level of education attained	0 = Through vocational or high school 1= College and beyond

Table 7. Results of binomial logistic models

	β	SE	Sig.	$Exp(\beta)$ [a]	MP [b]
Binomial Model 1: Conventional vs. organic production					
DirectMktg	2.027	0.719	0.005 *	7.592	
TotalSales	2.100	0.833	0.012 *	8.163	
Gender	1.520	0.934	0.104	4.574	
Crops	0.221	0.114	0.052	1.247	
Acres	-0.006	0.003	0.021 *	0.994	-0.001
CompFin	0.831	0.667	0.213	2.295	
Age	-0.015	0.030	0.614	0.985	
Education	2.004	1.172	0.087	7.421	
Constant	-4.055	2.176	0.062	0.017	
Binomial Model 2: Conventional vs. Dual method					
DirectMktg	0.218	0.804	0.787	1.243	
TotalSales	0.290	0.771	0.707	1.337	
Gender	-18.119	16677.75	0.999	0.000	
Crops	0.106	0.060	0.078	1.112	
Acres	0.000	0.000	0.889	1.000	
CompProd	2.843	0.828	0.001 *	17.172	
Age	-0.098	0.041	0.017 *	0.906	-0.001
Education	0.216	0.985	0.827	1.241	
Constant	1.759	2.270	0.438	5.809	

(Table 7. continued)

[a] $\boldsymbol{Exp(\beta)}$ is the odds ratio.

[b] MP (marginal probability) was only calculated for significant, continuous independent variables.

* Significant at α=0.05.

Table 8. Results of the multinomial logistic model

	β	SE	Sig.	$Exp(\beta)$ [a]
Organic-only production				
Intercept	-2.557	1.898	0.178	
DirectMktg	1.645	0.616	0.008 *	5.183
TotalSales	0.378	0.633	0.550	1.459
Gender	1.376	0.793	0.083	3.957
Crops	0.073	0.064	0.253	1.076
CompProd	0.587	0.734	0.424	1.798
Age	-0.026	0.026	0.330	0.975
Education	0.342	0.235	0.146	1.407
Dual-method production				
Intercept	0.527	2.070	0.799	
DirectMktg	0.195	0.763	0.798	1.215
TotalSales	1.161	0.662	0.080	3.192
Gender	-1.292	1.496	0.388	0.275
Crops	0.129	0.065	0.048 *	1.138
CompProd	2.242	0.697	0.001 *	9.415
Age	-0.097	0.035	0.005 *	0.907
Education	0.278	0.278	0.317	1.320

Base category: Conventional-only production.

[a] $Exp(\beta)$ is the odds ratio.

* Significant at α=0.05.