Impact of participation in certified organic production on farm household's economic and agri-environmental performance

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Selected Paper prepared for presentation at the 2017 Agricultural & Applied Economics Association Annual Meeting, Chicago, Illinois, July 30-August 1 2017

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Abstract

This study analyzes the economic and environmental impact of farm household's decision to participate in certified organic production. Specifically, we considered organic and conventional as two different production systems and then analyze the participation decision and their impact using propensity score matching estimators. Our results using nationwide farm survey data in the US suggest that participation in certified organic production could result a significantly higher economic and environmental performance for the growers.

Background

- Over the last decade, there has been an increasing demand for organic foods due to growing demand for healthy foods; Organic products are known for their health-related benefits and are also considered to be eco-friendly when it comes to the environment.
- Many farmers are undergoing the transition from conventional to organic farming. The Economic Research Service (ERS) of United States Department of Agriculture (USDA) reports that between 2005 and 2011, total certified organic cropland in the US expanded by nearly 80 percent, to 3.1 million acres.
- However, the overall adoption level for certified organic cropland and pastureland is about 0.8 and 0.5 percent of the total U.S. cropland and pastureland, respectively.
- Studies related to production side of organic farming are very limited. Studies such as producer's decision and performance due to certified organic farming, switch or no switch decisions, and quantitative studies on economic and environmental outcomes attributable to organic farming are important research questions.
- Additionally, decisions to participate in certified organic farming may be interlinked or vis-à-vis correlated with decisions to participate in agri-environmental programs, farm household's concern about environmental conservation, and structural and agricultural diversification (Khanal and Mishra, 2015; Dries, et al., 2012; Meraner et al., 2015).

Data

This study uses data from 2012 Agricultural Resource Management Survey (ARMS) conducted by National Agricultural Statistics Service (NASS), and ERS, USDA. 2012 ARMS survey is unique and includes a separate section for certified organic farming related questions such as acreage and total farm sales from certified organic production.

Table 1. Characteristics of organic and conventional farmers

Variable	Description	Entire Sample	Organic	Conventional
Age	Age of the farm operator (years)	58.71 (12.68)	55.03 (13.37)	58.76 (12.66)
Education	Education of the farm operator (years)	13.89 (2.92)	14.15 (3.65)	13.88 (2.91)
Acres	Total acres in farm operation	997.02 (3,028.7)	892.75 (4,006.13)	998.36 (3,014.23)
Off-farm income	Farm household has income from off-farm works (=1 if yes, 0 else), %	93	89	93
Direct Sales	Farm had direct to consumer sales (=1 if yes), %	5.4	28	5.1
Marketing contract	Farm had any sales under marketing contract (=1 if yes), %	20.90	24.36	20.86
Distance to Market	Distance to market (in miles)	24.38 (24.19	18.89 (21.29)	24.46
Internet	Have an access to Internet (=1 if yes, 0 else), %	71	73	70
Male	Farm operator is male (=1 if male, %)	87.2	86.4	87.3
Entropy	Entropy index of diversification (=1 if completely diversified, 0 if not at all)	0.161 (0.14)	0.165 (0.155)	0.161 (0.14)

Table 2: Factors influencing participation in certified organic farming (probit estimation, covariates for propensity score matching estimator)

Variables	Coefficient	Standard Error	Z-statistics
Age of the primary operator, years	-0.008**	0.002	-3.06
Formal education of primary operator, years	0.005*	0.003	1.67
Off-farm income	0.002	0.106	0.03
Internet	-0.045	0.077	-0.59
Debt to asset ratio	0.098	0.129	0.76
Direct Sales	0.698**	0.081	8.63
Distance to market	-0.003**	0.001	-2.32
Market contract	0.067*	0.040	1.68
Male household head	-0.169*	0.101	-1.67
Entropy	0.118	0.221	0.53
Acres in farm operation, in log	-0.018	0.019	-0.93
Constant	-1.649	0.258	-6.38
Number of observations	14125		
Pseudo R-square	0.061		
Region of common support	[0.0037, 0.1081]		

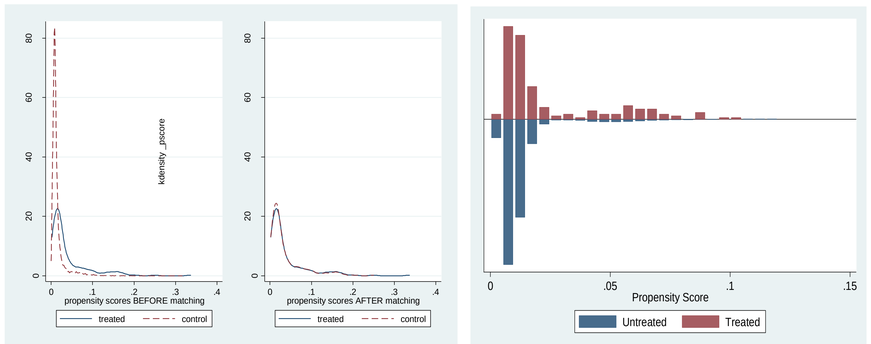

Figure 1: Propensity scores

Table 3: Average Treatment Effects of participation in certified organic production on household's economic and environmental outcomes using matching estimators

	Treatment Effects (ATT)			
	Treated	Controls	Difference	t-stat
Nearest Neighborhood Matching (NNM)				
Value of total production	1,401,555.150	849,958.91	551,596.24	2.44**
Environmental payments/incentives received	4,671.161	2,433.256	2,237.904	2.74**
Cropland idle or used for soil-improvement (acres)	26.950	10.966	15.983	1.64*
Cropland under conservation easement (acres)	23.295	14.65	8.646	0.71
Croplands under cover crops (acres)	53.033	20.720	32.312	1.66*
Radius Based Matching (RBM)				
Value of total production	1,401,555.15	849,958.91	551,596.24	2.44**
Environmental payments/incentives received	4,671.161	2,433.256	2,237.904	2.74**
Cropland idle or used for soil-improvement (acres)	26.95	18.979	7.970	1.56
Cropland under conservation easement (acres)	23.295	20.773	2.522	0.24
Croplands under cover crops (acre)	53.033	28.652	24.380	1.93*
Kernel Based Matching (KBM)				
Value of total production	1,401,555.15	829,751.991	571,803.159	2.44**
Environmental payments/incentives received	4,671.161	2,433.256	2,237.904	2.74**
Cropland idle or used for soil-improvement (acres)	26.950	17.108	9.841	1.68*
Cropland under conservation easement (acres)	23.296	19.581	3.714	0.34
Croplands under cover crops (acre)	53.033	28.652	24.380	1.93*

Methods

This study computes average treatment effects of certified organic production participation using non-parametric propensity score matching (PSM) methods. The empirical procedure is to first estimate a probability model to calculate each farm household's probability to participate in certified organic, i.e., the propensity score, and then calculate the average treatment effect for treated (ATT). Several techniques can be used to match adopters and non-adopters of similar propensity score. We used nearest neighbor matching (NNM), radius based matching (RBM) and kernel based matching (KBM). A common support and balancing condition are required; we identified common support in each case and also tested for balancing property.

Results and Discussion

- Table 1 shows mean comparison between organic and conventional farm households
- Table 2 shows the results of probit specification of the PSM. Relatively younger and educated operators, farms adopting direct-to-consumer sales and market contracts, and those located near to market are more likely to participate in certified organic production.
- Our results show a significant effect of participation in certified organic production on farm household's incomes and environmental outcomes, regardless of matching estimator (NNM, RBM, KBM).
- Our ATT results on matching estimators suggest that certified organic producers generate around $551 to $571 thousands higher in value of total production as compared to conventional producers.
- We found that certified organic farmers receive higher amounts for conservation and environmental quality incentive programs as well as enroll more acres for cover crops and soil improvement programs as compared to conventional producers.
- Results show that organic producers receive $4,600 higher payments related to environmental incentives and quality; they enroll around 16 and 25 additional acreage for soil improvement and cover crops compared to conventional producers.

Acknowledgments

Dr. Khanal's time in this study comes from the TSU Evans-Allen project TENX-1623-GFSHPP, supported from United States Department of Agriculture, National Institute of Food and Agriculture (USDA-NIFA). We acknowledge Dr. Mishra for assistance related to ARMS data.