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Poultry Farmers' Willingness to Participate in Energy Audits

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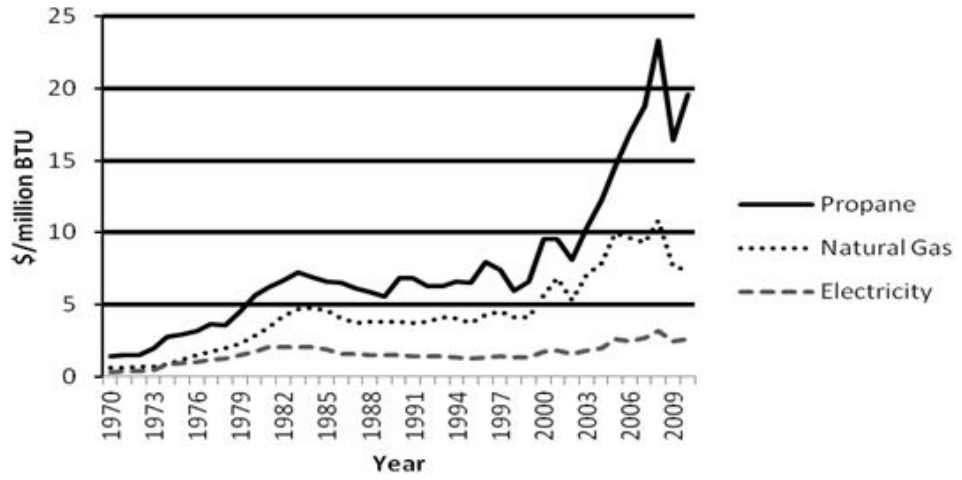
Abstract: *Farmers' willingness to participate in energy audits of their poultry operations is influenced by a variety of farm characteristics and farmer demographics. Data from a 2008 survey of Tennessee poultry farmers were used in a logit regression to investigate factors influencing willingness to participate in energy audits. Size of operation, energy costs, use of propane, farm income, use of energy efficiency measures, and share of acreage in row crops influenced willingness to participate. Farmer demographics, including farming experience, educational attainment and use of Extension services, also influenced willingness to participate.*

Introduction

Poultry and eggs are important to Tennessee's agricultural sales, ranking second in value among all commodities (USDA/NASS, 2007). Energy costs constitute as much as half of poultry farmers' cash expenses (Cunningham, 2008). Rising energy prices (Figure 1) have placed significant cost pressures on poultry producers. As energy prices have risen, so has interest in finding ways to improve energy efficiency on poultry farms in the state.

Figure 1.

U.S. Energy Prices per Million BTU, 1970-2011 (Source: United States Department of Energy, Energy Information Administration [USDOE/EIA], 2012)



The 2008 Farm Bill authorized programs to assist farmers with improving energy efficiency, with an energy audit being the first step. The United States Department of Agriculture, Natural Resources Conservation Service (USDA/NRCS, 2010) cost shares up to 75% of implementing an Agricultural Energy Management Plan. The Rural Energy for America Program (REAP), administered by USDA Rural Development, provides producers loan guarantees and grants to adopt energy efficiency measures (USDA/RD, 2012).

The purpose of the study reported here was to provide Extension and other educators with information about factors that influence poultry farmers' willingness to participate (WTP) in an energy audit. Data from a 2008 survey of Tennessee poultry farmers were used to investigate how farm characteristics and farmer demographics influence WTP in an energy audit. The results have potential for reducing farmers' energy costs and can help in targeting Extension's energy conservation education and energy audit assistance programs to farmers.

Prior Studies

Studies have shown farm size positively affects adoption of environmentally beneficial practices (Chang & Boisvert, 2005; Fernandez-Cornejo, Beach, & Huang, 1994; Hua, Zulauf, & Sohngen, 2004; Ladue, Miller, & Kwiatkowski, 1990; Upadhyay, Young, Wang, & Wandschneider, 2002). Adoption of best management practices (BMP's) on poultry operations is positively influenced by farm income (Paudel & Devkota, 2007). Several researchers concluded that off-farm income positively affects adoption (Chang & Boisvert, 2005; Hua, Zulauf, & Sohngen, 2004; Paudel & Devkota, 2007). However, Gedikoglu and McCann (2007) found off-farm work positively affects adoption of capital-intensive practices, but negatively affects labor-intensive technologies. Ownership positively affects adoption (Drost, Long, & Hale, 1998; Obubuafo, Gillespie, Paudel, & Kim, 2008; Roberts, English, & Larson, 2002), as does higher educational attainment (Chang & Boisvert, 2005; Drost, Long, & Hale, 1998; Ladue, Miller, & Kwiatkowski, 1990; Obubuafo, Gillespie, Paudel, & Kim, 2008; Paudel & Devkota, 2007). Hua, Zulauf, and Sohngen (2004) found farmers 40-50 years old are more likely to adopt conservation programs. Rahelizatovo and Gillespie (2004) found Extension information significantly influences adoption of BMP's in dairy production.

Data and Methods

A mail survey of Tennessee poultry producers was conducted in September 2008. The population of 499 Tennessee poultry producers with at least one poultry house according to the 2002 Census of Agriculture (COA) was drawn by the USDA National Agricultural Statistics Service (USDA/NASS, 2002). USDA/NASS also conducted the mailing. A modified Dillman Tailored Design approach (Dillman, 2007) was used (mailing, reminder postcard, and second mailing to non-respondents). The survey was reviewed by a departmental human subjects committee and deemed to cause participants minimal risk.

Producers were asked whether they had ever participated or would participate in an energy audit. The survey also contained questions about the farm (number and size of poultry houses, annual energy costs, heating systems and fuels, insulation of houses, type of lighting used, and land use). Producer demographic information (age, education, and use of Extension assistance) was also obtained. A copy of the survey is available from the authors upon request.

Willingness to participate in an energy audit (*AUDIT*=1 if participated or willing to participate, 0 if not interested) is modeled on farm operation characteristics and farmer demographics using logit regression. The model of *AUDIT* is expressed as:

Pr(*AUDIT*=1)=f(*TOTSQFT*, PULLETS, *LAYERS*, *BREEDERS*, *ROASTERS*, *EFFIC*, *OFFSET*, ECOSTSQFT, *PROPANE*, *FINCLT10*, *FINC1025*, *FINC2550*, *FINC50100*, *OFI*, *FULLOWN*, *ROWSHR*, *EXPER*, EXPERSQ, HS, COLLEGE, GRAD, *EXTENSION*).

Hypotheses regarding the types of variables to include and their postulated signs were formed based upon prior research and economic theory. The variable names, descriptions, and means for responses included in the model are provided in Table 1. To interpret the magnitudes of the impacts of the variables, the marginal effects (MEs) were calculated. The model was estimated using STATASE 11 (Statacorp, 2011).

Results

A total of 122 producers responded to the survey, for a 24% response rate. However, complete responses to all questions for variables used in the estimation of the logit model are needed. Hence, if a producer did not answer all the questions being used as variables, the response was eliminated from the observations used. The number of observations used for mean comparisons and logit model estimation was reduced to 67 after eliminating responses of producers who did not answer some questions relevant to the analysis (13.4% of producers surveyed) (Table 1). Over 65% of the producers were willing to participate in an energy audit (Table 1).

While characteristics of non-respondents were not available, some characteristics of respondents can be compared with the 2002 COA for Tennessee. According to the 2002 COA, 77% of poultry and egg farmers considered themselves full owners, while in our sample, 73% considered themselves full owners. The average age of the farmers in the sample was 54.99 years, while the average age of all farm operators in Tennessee was 56.00 years in 2002. From the COA, most

farmers had been on their present farm more than 10 years, while the average years of farming experience among the respondents was 14 years. The average farm size in the sample was 177 acres, compared with 133.36 acres across all farm types according to the 2002 COA. Although the average farm size was larger than the COA average, it should be noted that our sample was limited to those with at least one poultry house, which might mean the operations would tend to be larger.

The estimated logit model of *AUDIT* and MEs are shown in Table 2. The Log Likelihood Ratio (LLR) test statistic indicated the overall model was significant at the 99% confidence level ($53.71 > c^2 = 40.29$ with 22 *df* at $\alpha=.01$). The model correctly classified 92.54% of the responses and the Pseudo R^2 is 0.62.

Consistent with prior studies that found larger farm size contributed to adoption of environmentally beneficial practices, the area in poultry houses (*TTOTSQFT*) positively influences WTP in an energy audit. The ME shows that a 1,000 square foot increase in poultry house area increases the probability of participation in an energy audit by an estimated 0.01.

Table 1.

Variable Names, Definitions, and Means

Variable	Definition	Mean (N=67)
Dependent variable		
AUDIT	Willingness to participate in an energy audit (1 if willing or have, 0 otherwise)	0.65
Explanatory variables		
Size of operation		
TOTSQFT	Total square feet of poultry houses (1,000 square feet)	53.66
Type of operation		
BROILERS	Broiler operation (1 if broilers, 0 otherwise, omitted)	0.64
PULLETS	Pullet operation (1 if pullets, 0 otherwise)	0.07
LAYERS	Layer operation (1 if layers, 0 otherwise)	0.13
BREEDERS	Breeder operation (1 if breeders, 0 otherwise)	0.13
ROASTERS	Roaster operation (1 if roasters, 0 otherwise)	0.03
Energy practices		
EFFIC	Use of energy efficient practices: all houses fully insulated, multiple thermostats in most houses,	0.57

	compact fluorescent lighting, radiant tube heating (1 if use at least 2 of four practices, 0 otherwise)	
OFFSET	Energy offset provided by a contractor (1 if receive offset, 0 otherwise)	0.69
ECOSTSQFT	Propane and electricity energy costs/year divided by total sq. ft. feet of housing	0.50
PROPANE	Use of propane as a heating source (1 if use propane, 0 otherwise)	0.93
Farm Characteristics		
FINCLT10	2007 net farm income (nfi) less than $10,000 (1 if nfi<$10,000, 0 otherwise)	0.12
FINC1025	2007 nfi $10,000 to $25,000 (1 if $10,000≤nfi<$25,000, 0 otherwise)	0.13
FINC2550	2007 nfi $25,000 to $50,000 (1 if $25,000≤nfi<$50,000, 0 otherwise)	0.12
FINC50100	2007 nfi $50,000 to $100,000 (1 if $50,000≤nfi<$100,000, 0 otherwise)	0.33
FINC100+	2007 nfi at least $100,000 (1 if nfi≥$100,000, 0 otherwise, omitted)	0.30
OFI	Percent of household net income from off-farm sources in 2007	41.07
FULLOWN	1 if full owner of farm, 0 otherwise,	0.73
ROWSHR	Share of farmland in row crops (ex: soybean, corn, cotton)	0.11
Farmer Demographics		
EXPER	Years of farming experience	14.19
EXPERSQ	Years of farming experience squared	282.97
LHS	Less than high school graduate (1 if <hs, 0 otherwise, omitted)	0.08
HS	High school graduate (1 if high school graduate, 0 otherwise)	0.37
COLLEGE	College graduate (1 if college graduate, 0 otherwise)	0.48
GRAD	Graduate school (1 if graduate school, 0 otherwise)	0.07
EXTENSION	Had received Extension services or assistance for poultry business (1 if have received, 0 otherwise)	0.22

Table 2.

Estimated Logit Model for Poultry Farmers' Willingness to Participate in Energy Audits

Variable	Estimated Coefficient	Z		Marginal Effect	Z	
INTERCEPT	-10.40	-1.58	*			
TOTSQFT	0.11	2.27	***	0.01	2.89	***
LAYERS	-1.17	-0.42		-0.09	-0.43	
PULLETS	9.72	1.48	*	0.76	1.61	*
BREEDERS	3.78	1.01		0.29	1.04	
ROASTERS	6.45	0.95		0.50	0.98	
EFFIC	5.91	2.49	***	0.46	3.38	***
OFFSET	-2.32	-0.91		-0.18	-0.94	
ECOSTSQFT	5.15	1.58	*	0.40	1.72	**
PROPANE	5.36	1.69	**	0.42	1.96	**
FINCLT10	-0.28	-0.11		-0.02	-0.11	
FINC1025	-7.97	-1.82	**	-0.62	-2.08	***
FINC2550	-4.57	-1.96	**	-0.36	-2.37	***
FIN50100	3.69	1.50	*	0.29	1.64	*
OFI	-0.00	-0.02		0.00	-0.02	
FULLOWN	1.78	1.11		0.14	1.17	
ROWSHR	-4.10	-1.82	**	-0.32	-2.13	***
EXPER	-1.00	-2.09	***	-0.08	-2.51	***
EXPERSQ	0.03	2.19	***	0.002	2.70	***
HS	-0.61	-0.28		-0.05	-0.28	
COLLEGE	3.35	1.60	*	0.26	1.78	**
GRADUATE	-5.66	-1.11		-0.44	-1.16	
EXTENSION	4.63	1.92	**	0.36	2.24	***
N=67 LR(22 df)=53.71***						

Pseudo R^2 = 0.62 Percent Correctly Classified=92.54%
* = 0.15 level (15%), ** = 0.10 level (10%), *** = 0.05 level (5%).

The estimated coefficient on pullet production was positive, suggesting pullet producers are more likely to participate than broiler producers. Lower bird stocking densities associated with pullet operations compared with broiler operations may result in less opportunity to use bird heat than in broiler houses (Doye, Freking, Payne, & Ferrell, 2009; Donald, 1999; Tabler, 2001). Light management is critical in pullet houses to orient the birds to longer day lengths in breeder houses (Wineland, 1992).

Use of multiple energy efficiency measures (*EFFIC*) is positively associated with the probability of WTP in an audit. Producers who use multiple energy efficiency measures are 0.46 more likely to be willing to participate in an energy audit. Receiving some type of energy offset from contractors does not have a significant influence, which was unexpected, given that an energy offset reduces producers' energy costs. The coefficient on energy costs per square foot (*ECOSTSQFT*) is positive as expected. A dollar increase in energy costs per square foot increases the probability of participation by 0.40. The coefficient on propane (*PROPANE*), the most commonly used energy source by respondents, is positive as expected. Relative to not using propane, use of propane increases the probability of participation by 0.42. Based upon recent energy prices per British Thermal Unit (BTU), propane has a higher price per BTU than electricity or natural gas (USDOE/EIA, 2012).

As hypothesized from prior studies, lower farm income has a negative influence on participation (FINCLT10, FINC1025, FINC2550). The coefficient on off-farm income (*OFI*) is not significantly different from zero nor is the coefficient on full ownership (*FULLOWN*). The coefficient on share of farmland in row crops (*ROWSHR*) is negative, suggesting that crop farming activities may divert the farmer's time away from labor invested in the poultry operation, including time to participate in and act on audits. For each 0.10 increase in the share of farmland in row crops, probability of WTP in an audit declines by an estimated 0.03.

The coefficient on experience is negative, but the coefficient on *EXPERSQ* is positive. The turning point can be found by the formula (ME of *EXPER*/[2*ME of *EXPERSQ*]. For producers with fewer than 15.9 years experience, each additional year lowers the probability of participation. However, beyond 15.9 years, each year of experience has a positive influence. As postulated, producers whose highest educational attainment is a college degree (*COLLEGE*) are significantly more likely to be willing to participate than those who did not graduate from high school. College education increased the likelihood of WTP by 0.26. Alternatively, the likelihood of WTP in an energy audit for those who graduated from high school or completed a postgraduate degree is no different from those who did not graduate from high school. Producers who had received assistance or services from Extension (*EXTENSION*) are more likely to be willing to participate in an energy audit. Using Extension assistance increases the probability by 0.36.

Conclusions

Results show larger farm size, both in terms of housing facilities and farm income, positively influences WTP. This could reflect larger producers' focused efforts on reducing costs of poultry production, including participation in an audit to reduce energy costs. Assistance programs, such as the Rural Energy for America Program (REAP), administered by USDA Rural Development, are available to help smaller producers with energy efficiency measures through loan guarantees and grants. If those with smaller farms can be made aware of such assistance through Extension programs, the increased awareness may spur interest in participating in an audit.

Cost reduction strategies, such as using multiple energy efficiency measures, positively influence WTP. Thus, educational programs provided by Extension focusing on energy efficiency in poultry houses may spur interest in energy audits. Furthermore, because college education has a positive impact on WTP, college agricultural curricula might include topics regarding energy efficiency in raising poultry or other confined animals.

Not surprisingly, per-square-foot energy cost positively influences interest. During times of higher energy costs, more producers will likely be interested in participating in an audit. The non-linear relationship between likelihood of WTP and years of experience suggests that the least experienced and most experienced poultry farmers may be most receptive to energy audits.

Farmers who use assistance from Extension are more likely to be willing to participate, suggesting farmer education and assistance in the area of energy efficiency of poultry housing can be channeled through Extension services. Not only do opportunities exist to provide Extension educational programs regarding energy efficiency measures, such as appropriate poultry house insulation (R-12 in the ceiling and R-8 in the walls), maintaining timers and thermostats, and using efficient lighting sources, but also information about cost share, loan, and grant programs. These funding programs can provide farmers with the capital to implement energy efficiency measures identified in an audit.

Because the study reported here was limited to Tennessee poultry producers, some caution should be used in extrapolating the results to other products or other regions. Nevertheless, the methods presented in the study can be used by Extension personnel in other regions to identify producers most willing to participate in an energy audit—the first step in improving energy efficiency on their farming operations. As done in the study reported here, an energy survey of producers would be conducted first. Next a logit regression would be estimated to identify the factors influencing WTP in an energy audit. The results would then be used to target Extension programs toward producers who are most likely to participate, increasing the effectiveness of Extension efforts to promote energy efficiency among agricultural producers.

References

Chang, H., & Boisvert, R. (2005). *Are farmers' decisions to work off the farm and participate in the Conservation Reserve Program independent, joint or sequential?* Paper presented at the 2005 annual meetings of the American Agricultural Economics Association, Providence, RI. Retrieved from: http://purl.umn.edu/19474

Cunningham, D. (2008). *2007-2008 broiler production systems in Georgia: Costs and returns analysis*. Department of Poultry Science, University of Georgia. Publication B 1240-3. Retrieved from: http://www.caes.uga.edu/publications/pubDetail.cfm?pk_id=7721

Dillman D. (2007). *Mail and Internet Surveys: The tailored design method*. 2nd ed. New York: Wiley; 2007.

Donald, J. (1999). *Dark-out pullet housing design considerations*. Auburn University Biosystems Engineering Department. Retrieved from: http://www.aces.edu/dept/poultryventilation/documents/DarkoutHse.pdf

Doye, D., Freking, D., Payne, J., & Ferrell, S. (2009). *Broiler production considerations for potential growers.* Oklahoma State University. Oklahoma Cooperative Extension Service Fact Sheet AGEC-202. Retrieved from: http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-3099/AGEC-202web.pdf

Drost, D., Long, G., & Hales, K. (1998). Targeting Extension efforts for the adoption of sustainable farming practices. *Journal of Extension* [On-line], 36 (5) Article 5RIB1. Available at: http://www.joe.org/joe/1998october/rb1.php

Fernandez-Cornejo, J., Beach, D., & Huang, W. (1994). The adoption of IPM techniques by vegetable growers in Florida, Michigan and Texas. *Journal of Agricultural and Applied Economics*, 26, 158-172.

Gedikoglu, H., & McCann, L. (2007). *Impact of off-farm income on adoption of conservation practices*. Paper presented at the 2007 annual meetings of the American Agricultural Economics Association, Portland, OR. Retrieved from: http://purl.umn.edu/9944

Hua, W., Zulauf, C., & Sohngen, B. (2004). *To adopt or not to adopt: Conservation decisions and participation in watershed groups*. Paper presented at the 2004 annual meetings of the American Agricultural Economics Association, Denver, CO. Retrieved from: http://purl.umn.edu/20076

Ladue, E., Miller, L., & Kwiatkowski, J. (1990). Investment behavior and energy conservation. *Northeastern Journal of Agricultural and Resource Economics*, 19, 98-108.

Obubuafo, J., Gillespie, J., Paudel, K., & Kim, S. (2008). Awareness of and application to the environmental quality incentives program by cow-calf producers. *Journal of Agricultural and Applied Economics*, 40, 357-368.

Paudel, K., & Devkota, N. (2007). *Factors affecting the decision to adopt and continue best management practices broiler producers*. Paper presented at the 2007 annual meetings of the American Agricultural Economics Association, Portland, OR. Retrieved from: http://purl.umn.edu/9851

Rahelizatovo N., & Gillespie J. (2004.) The adoption of best-management practices by Louisiana dairy producers. *Journal of Agricultural and Applied Economics* 36(1):229-240.

Roberts, R. K., English, B. C., & Larson, J. A. (2002). Factors affecting the location of precision

farming technology adoption in Tennessee. *Journal of Extension* [On-line], 40 (1) Article 1RIB3. Available at: http://www.joe.org/joe/2002february/rb3.php

Statacorp. (2011). STATASE Data analysis and statistical software. College Station, TX.

Tabler, T. (Winter 2001). Heating the broiler house: Fuel or bird heat? *Avian Advice*, 3, 1-5. University of Arkansas Cooperative Extension Service. Retrieved from: http://www.avianadvice.uark.edu/AA%20PDFs/avian_advice3no4.pdf

United States Department of Agriculture National Agricultural Statistics Service (USDA/NASS). (2002). *2002 Census of Agriculture*. Retrieved from: http://www.agcensus.usda.gov/Publications/2002/index.asp

_____ (2007). 2007 *Census of Agriculture: Tennessee*. Retrieved from: http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Rankings_of_Market_Value/Tennessee/

United States Department of Agriculture Rural Development (USDA/RD). (2012). *Rural Energy for America Program - Renewable Energy System and Energy Efficiency Improvement Guaranteed Loan and Grant Program*. Retrieved from: http://www.rurdev.usda.gov/BCP_ReapResEei.html

United States Department of Agriculture Natural Resources and Conservation Service (USDA/NRCS). (2010). *USDA announces initiative to improve agricultural energy conservation and efficiency: Individual energy audits will help producers reduce energy use*. Retrieved from: http://www.nrcs.usda.gov/news/releases/2010/energy_audits_04.22.10.html

United States Department of Energy, Energy Information Administration (USDOE/EIA). (2012). *Annual Energy Review*. Report No. DOE/EIA-0384(2011), p. 73. Retrieved October 8, 2012, from http://www.eia.gov/totalenergy/data/annual/pdf/aer.pdf

Upadhyay, B., Young, D., Wang, H., & Wandschneider, P. (2002). *How do farmers who adopt multiple conservation practices differ from their neighbors?* Paper presented at the 2002 annual meetings of the American Agricultural Economics Association, Long Beach, CA. Retrieved from: http://purl.umn.edu/36658

Wineland, M. (1992). *Importance of proper blackout housing*. North Carolina State University Cooperative Extension Service. PS FACTS #14. Retrieved from: http://www.ces.ncsu.edu/depts/poulsci/tech_manuals/blackout_housing.html

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