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RESEARCH ARTICLE

Examining organic, agritourism, and agri-environmental diversification decisions of American farms: are these decisions interlinked?

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Abstract

Farm households adopt various diversification strategies to enhance their stable income. This study analyzes the factors affecting farm household's decision to adopt organic, agritourism, and agri-environmental strategies. Using a nation-wide farm household data collected through the Agricultural Resource Management Survey, our results show the interlinkages between these on-farm diversification decisions. We found complementarity between agritourism and organic farming decisions, and between agri-environmental conservation and agritourism. Additionally, farm's financial position, insurance participation, land acreage holdings, and farm type and location are likely to influence the diversification decisions of the farm households.

Keywords Agritourism · Agri-environmental programs · American farms · on-farm diversification

JEL Codes Q12 · Q15 · Q26

Introduction

The agricultural landscape in the US has been characterized by large and small farms with different degrees of specialization and diversification. The current overall trend in the last

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four decades show that the number of farms are declining, larger farms occupy the higher share in commodity production while the small farms' share in production is declining (Hoppe et al. 2010). As a result of technological developments and increased competition in new market structures, farmers face constant pressure to adopt new technologies and strategies favoring larger farm size. During this challenging time, many farms either increased their size and adopted technology to remain competitive or simply exited from the business—between 1997 and 2002, eighty-six thousand farms were lost in the USA while average farm size increased from 431 acres to 441 acres (Barbieri et al. 2008).

As small and medium sized farms struggle to compete with large farms in specialized commodity production, most of these small farms seek for alternative strategies to enhance farm income. Farms diversify their agricultural bases and undertake structural adjustments on the farm. Vik and McElwee (2011) found that an additional income source is the main motivation for diversification into alternative agricultural enterprises. On-farm diversification involves different types of activities. One of the common practices is an addition of non-traditional crops/livestock production system such as organic agriculture into the farm (Damianos and Skuras 1996). Another on-farm enterprise diversification strategy is to add touristic and recreational component in the farm and ranches (Bowler et al. 1996; McGehee and Kim 2004; Barbieri and Mshenga 2008). Moreover, the US small farm policy also supports for the development, research, and outreach programs that focus on the special needs for developing alternative enterprises and value-added products, conservation, and environmental-friendly production through different programs such as conservation easement, environmental quality incentives, and environmental stewardship promotion programs. Therefore, we focused on three specific on-farm diversification strategies capturing these aspects: organic farming, agritourism, and conservation and agri-environmental decisions. Each of these strategies has been individually discussed in previous literature as feasible on-farm diversifications across American farms nation-wide.

A number of previous studies discuss the adoption of diversification strategies (Bagi and Reeder 2012; Vogel 2012, Joo et al. 2013; Khanal and Mishra 2014). These studies mainly identify factors influencing adoption or decisions on various activities both on and off the farm. However, studies considering each diversification strategy as independent choice of a farm or farm business household fail to account for the simultaneous decision-making. Few studies discussing the adoption of multiple diversification strategies and decision process in diversification include Khanal and Mishra (2014), Meraner et al. (2015), and Dries et al. (2012). Khanal and Mishra (2014) studied single and joint decisions in agritourism and off-farm work using selectivity-corrected multinomial logit model. Meraner et al. (2015) considered diversification activities classified as "broadening" and "deepening" type and analyzed joint decision process in choosing combination of "broadening and deepening" diversification using multinomial probit model. Finally, Dries et al. (2012) studied decisions in agricultural, environmental, structural, and income diversification strategies using multivariate probit model. Taking into account for simultaneous decision-making process and for potential complementarity or competitiveness between different diversification activities can improve the understanding of the decision-making process. Moreover, diversification could be an attractive farm adjustment strategy in agriculture (Barbieri and Mohaney 2009).

We assess the factors influencing diversification decisions accounting for simultaneous decision-making in three strategies: organic, agritourism, and conservation and agri-environmental programs. We used a large nation-wide data of US farm households. This paper contributes to the literature by analyzing farm household's decisions in these strategies, accounting for correlated decision process. Additionally, our study appropriately controls for the farm capital and financial factors such as farm land acreage and farm financial conditions of the farm in addition to the variables capturing farm types, location, insurance participation, and farmer characteristics when analyzing these diversification decisions.

Literature review

Farm diversification is referred to the adoption of different forms of development aimed at generating additional income involving diversion, reallocation, or recombination of the farm resources (Ilbery 1991; Barbieri and Mohaney 2009; Van der Ploeg and Roep 2003; McNamara and Weiss 2005; Mahoney and Barbieri 2004). Barbieri et al. (2008) adopts Mahoney and Barbieri (2004) approach in defining on-farm diversification as "any activity developed on a working farm or ranch by any member of the farm household that generates additional income or adds to the farm/ranch value" (Barbieri et al. 2008). Different forms of on-farm diversification strategies have been discussed in the literature, including those classified as "agricultural" and "structural" (Ilbery 1991) and activities that can be considered under operational classification of "deepening," "broadening," and "regrounding" (Van der Ploeg and Roep 2003). Farm diversification is expressed as multi-faceted contributor of rural development through its role on conservation of environmental values, quality production, direct-marketing, cost savings, and regional development (Barbieri et al. 2008; Ploeg et al. 2000) and also described as risk-avoidance strategy (Kostov and Lingard 2003; Robison and Barry 1987).

Barbieri and Mohaney (2009) pointed out five significant goals that lead to on-farm enterprise diversification. These goals are motivated by retaining and expanding markets, enhancing financial condition of the farm households, individual aspiration and interest/hobbies, additional income sources, and maintaining household labor on the farm. Moreover, Barbieri et al. (2008) conducted an extensive review of the literature about diversification activities among North American farms and found the following broad types of diversification activities: activities involving new crops/livestock and agricultural practices, such as organic production etc., integration of recreational/tourism enterprises, value-added activities on the farm, new marketing, and distribution activities, lease and rental of the farm or farm resources, and contract, services, or consulting offered to others. On-farm diversification through production system, alternative enterprise, and environmental-related practices could be an effective tool to help farmers deal with several types of risks which overall is intended to minimize income risk.

Previous studies have suggested a number of factors associated with the farm household's decision to diversify on-farm enterprise activities. Based on the previous research, diversification decision is influenced by a number of factors which include, but not limited to, location of the farm or distance to regional centers (Lange et al.

2013) and farm and farmer characteristics and household attributes (Mishra et al. 2004; McNamara and Weiss 2005). Dries et al. (2012) classified these factors as "internal" and "external." "External" factors include community and location-related factors while "internal" factors include farm size, farm labor, age of the farm operator, and farm types (Dries et al. 2012). More recently, Bartolini et al. (2014) used similar factors to analyze determinants of on-farm diversification in the Tuscany region of Italy. Moreover, the studies focused on the European context have also suggested that Europe's CAP policy affecting farm structure and type of production somehow supports on-farm diversification activities (Bartolini et al. 2014).

McElwee and Bosworth (2010) found that farm size and farmer's age and education factors likely affect diversification decisions. Additionally, Meraner et al. (2015) found that the factors such as age of the operator, family size, farm size, farm type, and geographical characteristics influence farm diversification decisions. Bowler et al. (1996), empirically analyzing the family labor farms in Northern Pennines of England, highlighted the importance of the dynamics of family labor farm and found the significant roles of characteristics related to farm, farmer, and farm family on the development of alternative agricultural enterprises. In another similar study in Greece, Damianos and Skuras (1996) found the significant effects of farm- and farmer-related factors such as age, education, farm size, farm type, farm debt and profit status, and hired and family labor on the probability of alternative farm enterprise development. Mishra et al. (2004) found that the factors such as off-farm work hours, farm location, a farm's financial condition (measured via its debt-to-asset ratio), government payments, farm size, family size, and farm operator characteristics significantly influence enterprise diversification among US farms. Finally, Mishra and Khanal (2013) found that the financial condition of the farm also significantly influences the farm household's participation in agri-environmental programs.

Methodology

Theoretical concept

Theoretically, portfolio theory highlights the concept and importance of diversification involving interplay of total expected returns and risk associated—methods with lower risk generally have lower expected net return; designing risk management strategies involves the knowledge of risk and return tradeoff (Blank 1990).

Considering a farm business household as an economic agent, portfolio theory suggests that the more agricultural and on-farm enterprises added to the farm portfolio, the better will be the farm household's ability to minimize overall risk through diversification. Therefore, the concept of diverse enterprise as opposed to specialized or sole enterprise provides better risk management. Suppose, portfolio risk is measured using the full covariance model of returns for a number of enterprises. Then, the farm household's risk minimization problem can be represented as (following concept of Markowitz 1959 model; Blank 1990):

$$\text{Minimize } \sigma^2\left(R_p\right) = \sum_{i=1}^{n}\sum_{j=1}^{m} E_i E_j \text{Cov}\left(R_i, R_j\right) \quad (1)$$

where $\sigma^2(R_p)$ is the variance in returns of the portfolio, E_i and E_j are the portfolio proportions of on-farm diversification strategies i and j, $\mathrm{Cov}(R_i, R_j)$ is the covariance between enterprises. This objective function could have a number of constraints related to the expected returns of each enterprise as well as productive, financial, and/or management limitations faced by individual farmers (Blank 1990). Following the concept and discussion about note to general diversification theorem (McMinn 1984), non-positive interdependence (correlation) of risky enterprise returns provides strongest incentives to diversify the portfolio. However, McMinn (1984) also notes that "if two risky assets are characterized by positive interdependence, there will still be an incentive to diversify if the investor can alter his portfolio to preserve the same mean income and reduce the riskiness of his portfolio income" (McMinn 1984, page 541). Blank (1990) applies the concept of the general diversification theorem and related discussion with regard to agricultural enterprise diversification: "one strategy for portfolio creation is to start with the highest returning crop then continue to add crops or other enterprises with returns that have the greatest amount of negative correlation with the first product and/or the portfolio" (Blank 1990, page 205).

With this theoretical concept backed-up by portfolio diversification, the objective of this paper is to analyze the factors influencing the adoption of correlated enterprises. Decision regarding diversification as risk reduction strategy can be influenced by external and internal factors defining motivation, intention, and actions (Deci and Ryan 2000; Amanor-Boadu 2013) assumed to be associated with resource capacities (such as land, labor, financial), economic conditions, and different location and farm types embedded in individual and farm characteristics, managerial ability, family labors, and demographics (McElwee and Bosworth 2010; McGehee and Kim 2004). Based on the previous literature, we assume that decision to adopt each diversification strategy (enterprise) is influenced by a set of variables related to farm operator and demographics, farm managerial and financial characteristics, farm types, and farm location in a system of simultaneous equation. Each equation can be represented by the generic form: $E = f(X, \beta)$ where decision to adopt enterprise E is a function of X which captures a set of factors and corresponding β parameters define the relationship of each factor to the decision. In the estimation framework section below, we have described how we econometrically fit the system of equations representing each diversification decisions.

Estimation framework

Estimation framework design to estimate the likelihood of diversification decision among alternative choices associated with a set of explanatory variables depends on the nature of assumption about alternative choices or strategies (dependent variables). For example, Mishra et al. (2004) used an enterprise diversification index (ranging from 0 to 1) as a dependent variable using weighted least-squares methods with an assumption of a logistically distributed error term; Meraner et al. (2015) used a multinomial probit model to assess the determinants of diversification considering types of alternative diversification strategies; Dries et al. (2012) used multivariate probit in analyzing diversification decisions under agricultural, environmental, structural, and income strategies. One should note that standard logit and multinomial frameworks are suitable when the alternatives are proportional substitutes to each other

because these models require the assumption of independence of irrelevant alternatives, the traditional (IIA) assumption, which is often too restrictive (Train 2009). In the other words, IIA assumption requires that alternative choices are completely independent decisions to each other. By the nature of the decision-making about on-farm diversification: organic farming, agritourism, and agri-environmental conservations, it is highly plausible that these decisions are related, as opposed to independent alternative strategies[1]. A modeling framework accounting for the simultaneous decision assumption instead of independent decision would be a better framework. Therefore, we used an appropriate multivariate probit model to study the joint decision-making between these diversification strategies.

Equation 2 represents a latent utility framework to represent the enterprise diversification decision, in connection with the model described in theoretical concept section above.

$$E_{ij}^{*} = X_i\beta + \varepsilon_i \tag{2}$$

where E_{ij}^{*} denotes the latent variable of net payoffs (or net gains) in the *j*th different diversification activity undertaken by the farm business household *i*. X_i represents a set of explanatory variables that are exogenously determined. ε_i represents the error term. The representative equation for each alternative diversification strategy (activity) for j=1,…,3 can be shown as:

$$E_{i1}^{*} = X_i\beta_1 + \varepsilon_{i1} \quad (organic\ farming\ decision) \tag{3}$$

$$E_{i2}^{*} = X_i\beta_2 + \varepsilon_{i2} \quad (agritourism\ decision) \tag{4}$$

$$E_{i3}^{*} = X_i\beta_3 + \varepsilon_{i3} \quad (agri{-}environmental/conservation\ decision) \tag{5}$$

Let E_i represent a vector of observed binary outcomes for farm business household *i*, E_{i1}, …. E_{i3}, defined by latent variables presented in equations such that $E_{ij} = 1$ if $E_{ij}^{*} > 0$, 0 otherwise; j=1,…,3. Multivariate probit assumes that the error terms (ε_{i1}, ε_{i2}, ε_{i3}) may be correlated. Therefore, instead of independently estimating each equation, all four equations are considered as a multivariate limited dependent variable model and estimated using a simulated maximum likelihood approach using statistical software STATA using *mvprobit* command[2]. The multivariate probit model assumes

[1] A number of individual alternatives as single and mix strategies (combinations) could be possible as shown in Table 2. In that, multivariate model estimates specified may not be free from some biases due to double counting in yes/no type of adoption question. Estimates with all alternative choices (single and mixed combinations) as dependent variable would be an alternative procedure. However, we found at least two empirical problems: (a) there will be very few data points in some alternatives resulting issue in convergence of likelihood function and inconsistent results and (b) considering all alternative choices as dependent variables would be modeled through a multinomial logit type of choice modeling framework which requires IIA assumption (i.e., each choice is independent of other alternative). Having these trade-offs, we decided to use consistent multivariate probit model in this study rather than multinomial logit assuming IIA. Our primary motivation stems from testing correlated decisions and interlinkages.

[2] We want to warn readers that estimates from this framework not necessarily define complete causal relations, rather guided by directional associations and correlations; results should not be interpreted as complete cause and effect.

that error terms follow a multivariate normal distribution with mean zero ($E[\varepsilon_1] = E[\varepsilon_2] = E[\varepsilon_3] = 0$) and a variance-covariance matrix ρ, where:

$$cov[\varepsilon] = \rho = \begin{bmatrix} 1 & \cdots & \rho_{13} \\ \vdots & \ddots & \vdots \\ \rho_{31} & \cdots & 1 \end{bmatrix}. \quad (6)$$

The variance-covariance matrix has diagonal elements all 1, while off-diagonal elements are correlations between respective diversification strategies to be estimated.

Data and descriptive statistics

This study uses, the nation-wide farm household data collected by US Department of Agriculture's Economic Research Service (ERS) and National Agricultural Statistics Service (NASS) through agricultural resource management survey (ARMS) in 2012[3]. ARMS collects data on financial conditions (farm income, expenses, assets, and debts) and operating characteristics of the farm households as well as their production, resources, and governmental program participations. The 2012 ARMS was a special survey effort as the questionnaire was also used to collect the data for the Census of Agriculture as well. This resulted in a larger sample size and a more diversified number of farms. As shown in Fig. 1, 21.59% of the sampled farms are at least engaged in one of the diversification activities among organic[4], agritourism[5], or agri-environmental conservation[6]. Our sample consists of 21,637 farm households. Table 1 shows the adoption of different diversification activities among all farm households and the share of each diversification activity. Table 1 suggests that agri-environmental conservation was adopted by 18.8% of farm households, agritourism was adopted by 1.9% of farm households while organic farming was adopted by 1.7% of farm households.

Table 2 shows the number of sampled farms adopting single and combination of these diversification strategies. In our sample, 359 farms adopted organic farming, 124 adopted agritourism, and 4,066 adopted conservation and environmental programs. Regarding combination of diversification strategies, 8 farms adopted organic and agritourism, 58 farms adopted organic and conservation and environmental programs, 124 farms adopted agritourism and conservation and environmental programs, and 2 farms adopted all three diversification strategies (Table 2).

Figure 2 presents diversification strategies by farm size. Small farms (those generating less than or equal to $350,000 in annual gross farm income) comprise around

[3] We used 2012 ARMS data because this is the only year ARMS cost and return survey asked about organic farming information in a special sub-section.

[4] Following the questions asked in section 31 "organic agriculture" of 2012 ARMS cost and return questionnaire, organic farms are defined in this study as those operations producing organic following national organic production (NOP) standards with acres allocated for organic production or those operations that sold NOP certified or exempt organically produced commodities from their farm operation.

[5] Agritourism farms include those who generated farm income from recreational activities on the farm such as farm tours and education services, hospitality services, petting zoos, hunting, fishing, etc.

[6] Agri-environmental conservation activities include participating in the programs and allocating land for conservation under environmental quality incentive programs, conservation reserve programs, environmental stewardship, and wetland conservation programs.

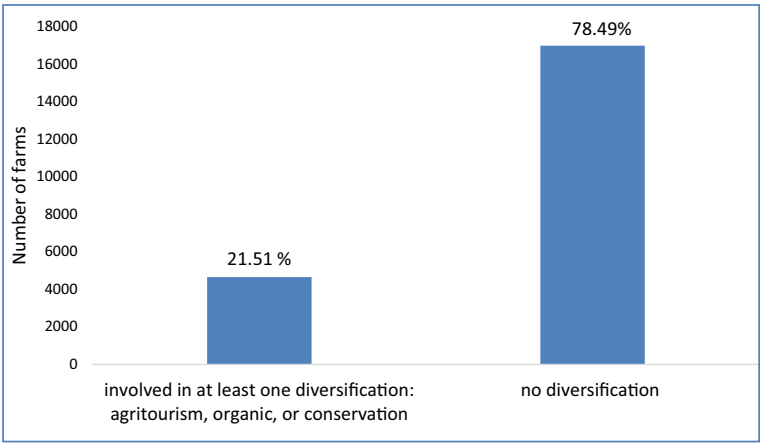

Fig. 1 Farms involved in at least one diversification: agritourism, organic, or conservation

63% of the total farms in our sample. Medium to large farms (those generating greater than $350,000 in annual gross farm income), on the other hand, consist of 37% of the total number of farms. Among the agri-environmental conservation adopting farms, the share of small-sized farms is relatively higher than it is for larger farms (53% small farms, 47% medium to large farms). Similarly, among organic farming adopters, 61% are small farms and 39% are medium to large farms. Among agritourism farms, 62% are small farms and 38% are medium to large farms. This indicates that a higher proportion of small-sized farms tend to undertake these diversification strategies compared to medium and large farms.

Table 3 shows summary statistics of the independent variables used in the study. We include four main types of independent variables in our analysis: (a) variables representing location and county characteristics; (b) operator, spouse, and household characteristics; (c) farm and farm financial characteristics; and (d) farm types.

In our analysis, we included dummy variable to represent whether the farm is located in "farming dependent," "mining dependent," "manufacturing dependent," "government dependent," or "service dependent" county—a county classification defined by USDA's Economic Research Services[7] (ERS) based on the economic dependence of the county (either through income or employment). In this classification, for example, a county is "farming dependent" if: (a) farm earnings account for an annual average of 15% or more of total county earnings or (b) farming accounts for 15% or more in employment of county residents across all occupations. The county-dependency in other sectors (mining, manufacturing, government, service, etc.) was defined similarly. Additionally, a variable is included to represent rural/urban status by a "metro" dummy variable which has value equal to 1, if farm is located in a county classified under metropolitan region, 0 otherwise.

Table 3 suggests that 19% of the farms in our sample are located in farming-dependent counties, followed by 15% in manufacturing-dependent counties. Between metro and non-metro counties, 31% of the farms are located in metro counties. The

[7] Economic Research Services, United States Department of Agriculture. http://www.ers.usda.gov/publications.aspx

Table 1 Organic, Agritourism, and Agri-environmental decisions among sampled farms

Diversification decisions	Percentage of total farms
Organic farming decision	1.7%
Agritourism decision	1.9%
Conservation or Agri-environmental decisions	18.8%

Source: Author's own computation based on ARMS data, 2012

average age of a farm operator is about 58 years and the average schooling of the operator and the spouse is about 13 and 14 years, respectively. The farm operator household consists of three members, on average, and 6% of the households have females as principal farm operators. Around 71% of the farm operators have farming as the main occupation and around 44% of the farms participated in crop or livestock insurance programs. Finally, the sample includes cash grain farms (around 32%), beef farms (23%), high-value crop farms (around 12 %), dairy farms (5%), poultry farms (4%), hogs farm (around 2%), and cotton farms (around 2%), with the remaining consisting of other field crops (around 16%) and other livestock farms (around 5%).

Results and discussion

Results from multivariate probit analysis are presented in Table 4. Multivariate probit model is based on simulated maximum likelihood approach; we used 150 draws (replications)[8] in our model. Results presented in Table 4 show the relationship of explanatory variables on the likelihood of choosing a diversification strategy, while allowing for possible correlation among other diversification strategies. A significant likelihood ratio test result (with p value 0.000) indicates that we reject the null hypothesis of no correlation between diversification strategies. This indicates that a multivariate probit model is an appropriate estimation method compared to using separate probit equations. This also indicates that the estimates would have been biased had we not controlled for simultaneous decision. Additionally, Table 4 presents the correlation between strategies as indicated by different ρ_{ij}.

Our results suggest a positive significant relationship between agritourism and organic diversification strategies, indicating that these strategies are complements. This is plausible because many synergies are possible between agritourism and organic diversifications. For example, the decision regarding organic production is likely linked with the organic farming process, education and outreach about organic, and market of organic produce. These activities are supported by farm tours, recreation, and educational activities involved in agritourism. Specifically, for marketing, agritourism may help to strengthen short supply chains at the local level. These results are consistent with the findings and discussions on previous studies (Dries et al. 2012; Pugliese 2001; Privitera 2010). Pugliese (2001) and Privitera (2010) discuss about integration and

[8] Cappellari and Jenkins (2003) showed that a higher number of draws (R) in simulated maximum likelihood will lead to more accurate coefficients and a more efficient correlation matrix in a multivariate probit model.

Table 2 Number of farms involved in diversification decisions: organic, agritourism, and agri-environmental decisions and combinations

Diversification decisions	Number of farms					
	Organic farming		Agritourism		Conservation or agri-environmental	
	Yes	No	Yes	No	Yes	No
Organic farming (yes)	359	–	8	351	58	301
Agritourism (yes)	8	409	417	–	124	293
Conservation or agri-environmental (yes)	58	4,008	124	3,942	4,066	–
Number of farms adopting all three (organic + agritourism + conservation or environ): 2						

Source: Author's own computation based on ARMS data, 2012

complementarity of agritourism and organic farming in the perspective of sustainable rural development and indicate the potential for rural organic tourism and organic agritourism by the convergence of these two strategies.

Similarly, a positive and significant relationship is observed between agri-environmental conservation and agritourism strategies indicating a complementary relationship. On a diversity activity level, this may suggest that farmers involved in agri-environmental conservation programs are more likely to participate in agritourism in the USA. As conservation and agri-environmental programs need to allocate some land for conservation or environmental-friendly operations, farmers might take that opportunity to share environmental education and demonstrations to visitors involving farm tours and hosting different events—which are activities supporting agritourism. Our finding is consistent with some previous studies: for example, Mastronardi et al. (2015) found that, in the case of Italy, farms with agritourism were more likely to

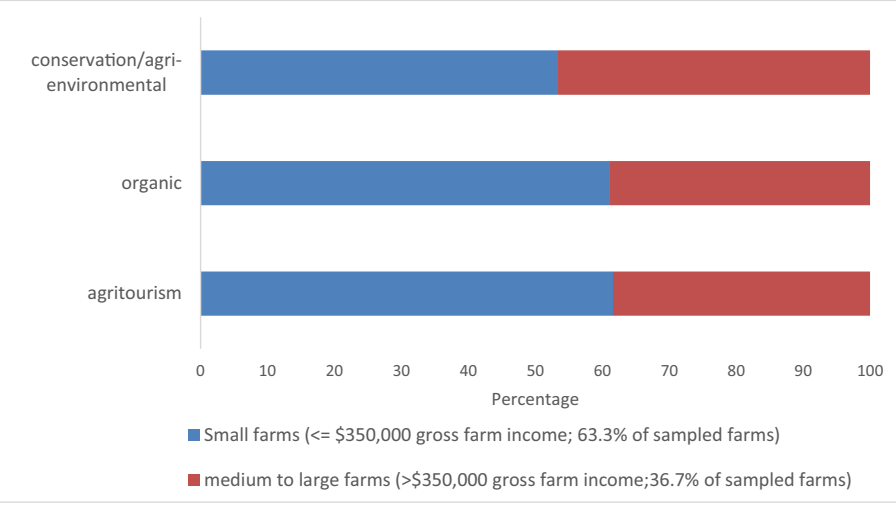

Fig. 2 Share of small and large farms in diversification

Table 3 Variable definition and summary statistics

Variable definition	Mean	Std. Dev.
Location and county characteristics		
Farming dependent (= 1 if farm is located in a farming-dependent county)	0.194	0.395
Mining dependent (= 1 if farm is located in a mining-dependent county)	0.016	0.124
Manufacturing (= 1 if farm is located in a manufacturing-dependent county)	0.152	0.359
Govt. dependent (= 1 if farm is located in a government-dependent county)	0.047	0.211
Service dependent (=1 if farm is located in a services-dependent county)	0.098	0.297
Metro (= 1 if farm is located in metro county)	0.311	0.463
Operator, spouse, and household characteristics		
Age (age of the principal operator)	58.112	12.120
Age squared (age of the principal farm operator, squared)	3523.853	1422.567
Education (years of schooling of the principal farm operator)	13.498	1.800
Spouse's education (years of schooling of the operator's spouse)	14.268	2.342
Household size (size of the farm household, in number)	2.626	1.309
Female (= 1 if principal operator is female)	0.061	0.239
Farming occupation (= 1 if farming is the main occupation of the operator)	0.712	0.453
Farm characteristics		
Log of acres (log of the total acres of the farm)	5.668	1.831
Gov. pay (= 1 if farm received government payments in 2012)	0.548	0.498
Debt to asset (debt-to-asset ratio)	0.099	0.393
Farm hr. Operator (total annual hours of operator worked on the farm)	2045.935	1233.876
Farm hr. Spouse (total annual hours of spouse worked on the farm)	383.743	773.787
Participation in crop or livestock insurance programs	0.441	0.497
Farm types		
High-value crops (= 1 if farm is primarily a high-value crop farm)	0.116	0.320
Beef farm (= 1 if farm is primarily a beef-producing farm)	0.227	0.419
Hogs farm (= 1 if farm is primarily a hog-producing farm)	0.017	0.130
Poultry farm (= 1 if farm is primarily a poultry-producing farm	0.045	0.208
Dairy farm (= 1 if farm is primarily a dairy farm)	0.052	0.222
Other field crops (= 1 if farm is primarily a other field crops farm)	0.158	0.364
Cotton (= 1 if farm is classified as cotton farm)	0.014	0.119
Other livestock (= 1 if farm is classified as livestock farm)	0.051	0.221
Cash Grain crop (= 1 if farm is cash grains-producing farm)	0.320	0.466
Number of observations		21,637

Source: Author's own computation based on ARMS data, 2012

develop environmental sustainable techniques supporting biodiversity, landscape, and natural resources as compared to the farms without agritourism. Brodt et al. (2006), using the case of California, pointed out that the farming practices supporting environmental sustainability and rural communities' socioeconomic viability are often separately dealt in the program thematic areas, however, combine effort addressing explicit linkage of these would enhance support for ecological agriculture.

Table 4 Parameter estimates of factors affecting different types of diversification decision

Variables	Organic farming			Agritourism			Agri-environ./conservation		
	Coeff	*t*-score[a]	ME[b]	Coeff	*t*-score[a]	ME[b]	Coeff	*t*-score[a]	ME[b]
Constant	−3.239***	−6.97		−5.705***	−11.04		−5.180***	−17.09	
Farm location: county characteristics									
Farming dependent	−0.039	−0.45	−0.002	−0.138*	−1.88	−0.006	0.104***	2.80	0.019
Mining dependent	−3.690	−0.02	−0.179	0.232*	1.70	0.007	−0.246**	−2.16	−0.024
Manufacturing	−0.003	−0.04	−0.000	−0.070	−0.85	−0.001	−0.0761*	−1.80	−0.015
Govt. dependent	−0.053	−0.39	−0.001	0.130	1.31	0.002	−0.049	−0.72	−0.008
Service dependent	0.167*	1.82	0.006	0.121	1.5	0.005	0.015	0.32	0.002
Metro	−0.017	−0.22	0.000	−0.112	−1.57	−0.002	−0.206***	−5.21	−0.040
Farm and farm operator characteristics									
Age	−0.015	−1.17	0.000	0.007	0.52	0.000	0.016**	2.13	0.003
Age squared	0.000	1.06	0.000	0.000	0.14	0.000	−0.000*	−1.69	0.000
Education	0.045***	3.22	0.001	0.087***	6.33	0.003	0.056***	7.23	0.011
Spouse's education	0.017	1.45	0.000	0.015	1.32	0.0004	0.002	0.31	0.000
Household size	0.054***	3.00	0.002	0.005	0.22	0.0001	0.004	0.34	0.001
Female	0.025	0.26	0.001	0.221***	2.50	0.008	0.280***	3.92	0.050
Farming occupation	0.141**	2.06	0.005	0.178***	2.64	0.006	−0.124***	−3.21	−0.023
Insurance	−0.127**	−2.05	−0.004	−0.086	−1.43	−0.001	−0.218***	6.68	−0.042
Log of acres	−0.009	−0.48	0.000	0.238***	13.36	0.007	0.135***	10.96	0.026
Gov. pay	0.080	1.22	0.007	0.015	0.25	0.016	3.108***	21.16	0.821
Debt to asset	0.026	0.51	0.001	−0.263*	−1.68	−0.003	−0.176***	−2.43	−0.035
Farm hour, operator	0.000**	1.99	0.000	0.000	0.98	0.000	−0.000***	−9.73	−0.00003
Farm hour, spouse	0.000	0.33	0.000	0.000*	1.86	0.000	0.000***	4.58	0.00002

Table 4 (continued)

Variables	Organic farming			Agritourism			Agri-environ./conservation		
	Coeff	*t*-score[a]	ME[b]	Coeff	*t*-score[a]	ME[b]	Coeff	*t*-score[a]	ME[b]
Farm types (base: cash grain farms)									
High-value crops	0.935***	10.04	0.025	0.590***	6.01	0.018	0.117	1.38	0.025
Beef	0.033	0.33	0.001	0.439***	6.19	0.017	−0.082**	−2.05	−0.017
Hogs	−0.041	−0.16	−0.008	−0.317	−0.94	−0.004	0.134	1.45	0.027
Poultry	0.378***	2.93	0.010	0.574***	4.33	0.018	0.235***	2.34	0.045
Dairy	0.608***	5.98	0.016	−0.013	−0.09	−0.006	−0.210***	−3.50	−0.043
Other field crop	0.435***	5.05	0.012	0.459***	6.04	0.014	0.508***	13.44	0.093
Cotton	−3.436	−0.02	−0.177	−0.310	−1.17	−0.007	−0.260***	−2.91	−0.031
Other Livestock	0.215	1.5	0.004	0.777***	6.77	0.024	−0.083	−0.75	−0.013
Joint-decision parameters	Agritourism and organic (rho21)			Conservation and organic (rho31)			Conservation and agritourism (rho32)		
	Coefficient: 0.072*** *t*-score: 1.98			Coefficient: 0.003 *t*-score: 0.11			Coefficient: 0.081*** *t*-score: 3.47		
Likelihood ratio test rho21 = rho31 = rho32 = 0: chi^2 (3) = 14.6, $p > chi2 = 0.002$***									
Wald-Chi-square statistics of overall fit: 2008.88 (prob > chi-square, 0.0000); log likelihood: −9793.2537									

Parameter estimates are based on multivariate probit model fitted using simulated maximum likelihood method;

[a] *t*-scores are asymptotic *t*-values,

*, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

[b] ME are predicted average marginal effects; decision to remain undiversified is used as a base strategy; though coefficients account for the assumption of correlated decisions, marginal effects are computed considering decisions as independent alternatives (practically using command *margins* after *mlogit* in Stata) with "decision to remain undiversified" as a base category for computational easiness.

Overall, our findings regarding significant correlations of agritourism, organic, and agri-environmental decisions support the theme of the previous studies which describe agritourism as multifunctional integration of social, cultural, and natural/environmental resources of rural areas (Bianchi 2011) and suggest for the combined efforts to address linkages of the sustainable strategies (Brodt et al. 2006).

Factors influencing diversification decisions

Farm location

Table 4 results show that a county's economic condition has a significant influence on the type of farm diversification strategy chosen. Farms located in farming-dependent counties are less likely to adopt agritourism compared to other non-farm-dependent counties. Note that large and more specialized farms usually have higher farm income (in aggregate, collective large farms lead to higher agricultural production and county's agricultural share) and evidence suggests that farms in farming-dependent counties may be dominated by specialized less-diversified farms. Perhaps they are relied on commodity production and are less likely to structurally diversify for agritourism. Table 4 also suggests that farms located in farming-dependent counties are more likely to participate in agri-environmental diversification. This result in conjunction with a positive coefficient of land acreage, may suggest that farms located in farming-dependent counties, perhaps more specialized farms with higher acreage, are also likely to adopt agri-environmental practices (Claassen et al. 2008) as these practices require some land allocation for conservation and fallow. Similarly, our result also suggests that farms located in metro counties are less likely to participate in agri-environmental conservation. This finding is consistent with the fact that most farms located in the metro areas are farms with limited land that likely engage in the production of high-value crops and livestock commodities having high demands from metro area and perhaps care less about conservation.

Farm and farm operator characteristics

Our results suggest that the likelihood of farms choosing agri-environmental strategies increases with the age of the operator, however, it increases in a decreasing rate—as evident by a negative and statistically significant coefficient on the "age squared" term. Older operators are relatively more experienced in farming, have more wealth[9], and could be retired from off-farm jobs and are engaged in farming for recreational purposes (McNally 2001; Ollenburg and Buckley 2007) and perhaps care about conservation programs. Operator's educational attainment has a positive and significant relationship across all types of diversification strategies, suggesting that educated operators are more likely to diversify their farming enterprises, adopting organic farming, agritourism, and agri-environmental practices. This finding is consistent with Mishra et al. (2004). Particularly striking is the highest marginal effect of 0.011, among three strategies, on conservation equation. This suggests that a one-year increase in

[9] Pope and Prescott (1980) point out that older farm operators have more wealth; wealthier farm operators are less risk averse and less diversified.

formal education is associated with an increase in probability of conservation strategy adoption by around 1%.

Results in Table 4 indicate that household size has a positive and significant impact on the likelihood of choosing organic farming. These results are consistent with Meraner et al. (2015) who found that the family (household) size significantly influences farm diversification decisions. This finding is also consistent with the overall diversification literature which emphasizes the role of family labors in diversification and alternative farm enterprises. For example, Bowler et al. (1996) and Damianos and Skuras (1996) are among the authors reporting employment needs of the family members as an important factor motivating farm diversification. This result also supports the findings from some other previous studies which found that households with more members are more likely to be engaged in farming activities requiring intensive care (Benjamin and Kimhi 2006; Nilsson 2002). We found that the operator's primary occupation significantly influences diversification decision regarding organic farming, agritourism, and conservation. Operators identifying farming as their main occupation are more likely to diversify through organic farming and agritourism while less likely to participate in agri-environmental/conservation strategy. Marginal effects suggest that the likelihood of organic farming adoption for farms with farming as a main occupation is 0.5% higher than those with other main occupation. Similarly, the likelihood of agritourism adoption for farms with farming as main occupation is 0.6% higher than those with other main occupations. The likelihood of conservation, on the other hand, is 2.3% lower for farms with farming as a main occupation than those farms with other main occupation. One plausible explanation is that farm operators having farming as a main occupation probably care more about diversification activities providing higher income from the farm resources—organic farming and agritourism likely to provide higher income in comparison to agri-environmental conservation activities. This is further supported by a positive coefficient of operator's on-farm hours in organic equation and a negative coefficient of operator's on-farm hours in conservation equation. Together, this suggests that operators identifying farming as their main occupation are generally full-time farmers devoting more time on the farm and perhaps expect higher income from the farm engaging in diversification activities with higher expected returns. Finally, our results suggest that gender of the farm operator can be an important determinant of farm diversification strategies. Results here suggest that female farm operators are more likely to participate in agritourism and agri-environmental conservation strategies.

We also found that several farm and financial factors significantly influence the likelihood of diversification. Specifically, we found the factors such as farm's participation in crop/livestock insurance and farm's solvency position (debt-to-asset ratio) are significantly associated with different types of diversification decisions. Our results show that farm's participation in crop/livestock insurance program is significantly negatively associated with the decision to participate in organic farming and conservation strategies. The negative relationship is consistent with our expectation because insurance and diversification are considered as risk management strategies. Additionally, we found that farm's higher debt-to-asset ratio is negatively related to agritourism and agri-environmental diversification. While farms aim for the optimum level of solvency depending on their financial structure, our findings suggest that farms with higher debt-to-asset ratios are less likely to participate in agritourism and agri-

environmental diversification activities. Note that relatively higher debt or relatively lower assets could contribute to higher debt-to-asset ratio. Negative marginal effect of 0.003 in agritourism equation and 0.035 in conservation equation suggests that, approximately 0.3% decrease in probability is associated with 1% increase in debt share while around 3.5% decrease in probability of conservation adoption is associated with 1% increase in debt share. This result is consistent, at least in direction, with the findings of Mishra and Khanal (2013) who found that a farm's debt-to-asset ratio was negatively associated with farm decisions to participate in agri-environmental programs in the USA.

Farm types

Finally, results in Table 4 show that farm type is also associated with diversification decisions. Using cash grain farms as base, high-valued crop farms, poultry, dairy, and other field crop farms are more likely to adopt organic farming strategy. A possible explanation is that the increased demand on organic products (fruits, vegetables, milk, and meat) has perhaps led farmers to increase supply of organic products—hence, farm operators are choosing this diversification strategy. Our findings are consistent with Uematsu and Mishra (2012) who found that high-valued crop farms are more likely to participate in organic certifications. Additionally, our findings show that farms specializing in higher-valued crops, other field crops, poultry, and livestock are more likely to adopt agritourism. Farms specializing in poultry and other field crop farms are more likely to adopt agri-environmental diversification strategy, while farms specializing in cotton, beef, and dairy are less likely to adopt agri-environmental diversification.

Finally, we like to provide a cautionary note and warn readers that our estimates do not necessarily define complete causal relations but rather are guided by directional associations and correlations under some assumptions. Nonetheless, findings from our estimates using the large sample of representative dataset contribute towards better understanding and to advance knowledge on diversification literature.

Summary and conclusions

Since the Agricultural Act of 1933, US agriculture has gone through significant dynamic structural change. In an era of globalization, climate variability, and reduced profit margins, it is no surprise that farm business households have to seek ways to reduce risk in production and income to enhance their sustainable farm incomes. Using a large national farm-level database, we examined diversification strategies adopted by US farm households. In particular, we analyzed the factors influencing adoption of three important diversification strategies: organic farming, agritourism, and agri-environmental conservations. Importantly, we accounted for correlations between these decisions to allow simultaneous decision process about diversification. We also found that the estimates would have been biased had we used the class of estimates that do not account for this correlated decisions or had we assumed independence of alternatives. Additionally, we controlled for farm capital and financial factors of the farm in addition to the variables capturing farm types, location, insurance participation, and farmer characteristics in our models.

Our findings indicate the presence of complementarity between diversification strategies. We found a significant complementarity between agritourism and organic farming decisions, and between agri-environmental conservation and agritourism. Model results show that educational attainment and farm operator's main occupation significantly influence the choice of these diversification strategies. Additionally, farm financial, insurance participation, land acreage holdings, and farm type also influence the diversification decision. Finally, results from our study indicate that female farm operators are more likely to participate in agritourism and agri-environmental diversifications strategies.

Overall, we found that farm diversifications to organic farming, agritourism, and conservation decisions are likely to be interlinked and farm households require education skills, endowment of resources, and time allocation strategies in adequate diversification decisions. Farm households likely to choose diversification strategies consider factors such as location, farm types, and asset holdings. Farm households need to develop multiple skills and flexible capacities and perhaps agricultural specific knowledge and experience to tackle farming-related issues, including structural changes and different diversifications. We also found that farm household's solvency problems likely hinder agritourism and conservation diversification decisions. Policies supporting farm household's capacity to capital market and activities supporting the assets acquisition and debt reduction through different means would help farmers to engage in diversification. Additionally, improving employment opportunities for the rural or farming population for supplemental income may enhance their ability to participate in diversification and stimulate structural diversification such as agritourism. Finally, we like to warn readers that our estimates do not necessarily define complete causal relations, more rigorous estimates towards investigating causal inferences could be a research for future studies.

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