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RESEARCH ARTICLE

The financial implications of specialization, diversification, or alternative enterprises on small farms: Evidence from Tennessee

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Abstract
In response to survival challenges, small farms in the United States undertake decisions to minimize downside risk or maximize gross revenue. Using primary survey data of small farms in Tennessee, we examined farmers' strategic decisions on specialization or other forms of diversification and estimated the impacts of these decisions on farm financial performance. We found that farmer's age, farmland holdings, use of a smartphone in farm-related activities, and off-farm work significantly influenced these strategic decisions. Our multinomial endogenous switching regression estimates suggested that small farms could attain significantly higher performance, around 45% higher gross farm income and a 30% higher return on assets, by adding alternative on-farm enterprises.

Keywords: alternative agricultural enterprises; average treatment effect on treated; diversification; multinomial endogenous switching regression; small US farms; survival strategy

Introduction

Small farms[1] constitute around 89% of the total number of farms in the US (ERS/USDA 2023) and play a key role in strengthening the rural economy. As agricultural production is concentrated on fewer specialized farms who benefit from economies of scale, small farms are declining (ERS/USDA 2023). In general, small farms are likely to face fluctuating incomes, which may be resolved by expanding their operations by increasing the scale of production or specialization. However, specialization and expanding their size is not an option for most of the small farms, given their land and capital constraints. Thus, many

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[1]The United States Department of Agriculture considers small farms as those having annual gross cash farm income (GCFI) of less than or equal to $350, 000 (USDA, ERS 2019). We have used this definition in this study.

small farms exit their farming businesses as they struggle to survive (Libbin et al. 2004). Small farms should adopt ways to stabilize their economic returns or incomes to maintain their sustainability by identifying the potential ways or strategies of doing so.

Small farms are one of the inevitable components of US agriculture. Contributing around 21.5% of total farm production (USDA 2019), small farms are the major producers of agricultural commodities like beef, grains, soybeans, poultry, fruits, vegetables, and dairy products. Additionally, small farms contribute significantly to the rural landscape, local economies, and the national food supply (Hoppe et al. 2010). As compared to larger farms, small farms are less able to insure against price risks and access capital (Hazell et al. 2010). They face various other challenges like small land holdings, limited capital and managerial ability, shortage of skilled labor, and lower access to technology. Due to these challenges, they have unique difficulties in tackling risks and uncertainties. Therefore, seeking alternative sources of income such as off-farm work, on-farm diversification, and adoption of alternative enterprises are some of the options available to small farms (Khanal and Mishra 2014; McNamara and Weiss 2005). Past studies have noted that farm diversification can be a lucrative option for small farms as it helps to optimize their revenues while managing risk and uncertainty (Barbieri 2006; Turner et al. 2003; Nilsson 2002; Sharpley 2002; Ventura and Milone 2000; Barbieri and Mahoney 2009). Farm diversification exposes farmers to more diversified markets (Clark 2004). Concisely, literature shows that crop/livestock diversification supports small farm households to withstand price, market, and weather breakdowns and favors economies of scope (Gliessman 2006; Russelle et al. 2007; Hendrickson et al. 2008; Ryschawy et al. 2012; Wilkins 2008). However, none of these studies have explicitly estimated the impacts of different forms of diversification on the farm financial performance for US small farms.

Past studies have found the association of different farm- and farmer-related characteristics associated with farm diversification decisions such as growing or raising multiple crops and livestock enterprises on the farm. For example, Meraner et al. (2018) found that younger farmers are more likely to adopt on-farm diversification strategies. In a study in Texas, Barbieri and Mahoney (2009) found a negative association between the age of the farmers and their decision to adopt nonagricultural diversification strategies. However, Barbieri and Mahoney's study does not particularly deal with on-farm diversification strategies. In addition, Amanor-Boadu (2013) examined Kansas farmers and found a positive association between education level and the decision to diversify income sources. Here, diversifying income sources does not necessarily confer diversifying farm incomes. In addition to education, some studies found that factors such as farming experience, capital availability, and size of the operation significantly influence farmer's diversification decisions (Hung et al. 2016; Bernardo et al. 2004). Similarly, Brown and Reeder (2007) found that wealthier farmers, those having fewer off-farm hours, and farms with natural amenities and located far from city centers were more likely to incline towards diversification activities related to farm-based recreation.

We considered agritourism as one of the alternatives on-farm business enterprises in this study. Several studies (for example, Palkechova and Kozakova 2015; Veeck et al. 2006; Viglia and Abrate 2017) have explained agritourism as an important income diversification tool. Although the adoption of recreational farm activities and agritourism has been discussed in the literature, there have been limited studies on their impact on farm welfare. Moreover, their contributions to farm income are ambiguous. For example, some studies reported a decrease in total farm revenues or little to no contribution of agritourism to farm income (Jamshidi et al. 2017; Tchetchik et al. 2006; Schilling et al. 2012; Sharpley and Vass 2006; Tew and Barbieri 2012). These studies imply that farmers choose to incorporate agritourism enterprises for nonmonetary reasons such as family lifestyle, family members involved in farming, social interaction, and rural lifestyle preservation (McGehee et al. 2007; Mitchell and Turner 2010). On the other hand, more recent studies have found that the adoption of agritourism is an important feasible diversification strategy with the potential to maximize farm revenue or stabilize household income (Khanal and Mishra 2014; Bagi and Reeder 2012; Joo et al. 2013; McGehee and Kim 2004; and Schilling et al. 2006). Few other past studies suggest that there have been difficulties in designing adequate support policies for small farms with agritourism (Addinsall et al. 2017; Barbieri and Mshenga 2008) but having so to support knowledge and innovation could enhance further growth in agritourism (Hjalager et al. 2018).

Our empirical study is based on a sample of small farms in Tennessee. Tennessee is an important study site for this study because small farms are an indispensable component of Tennessee agriculture—around 41% of the total land in Tennessee is farmland, and 95% of the total farms in Tennessee are small farms (Farm Bureau Tennessee https://tnfarmbureau.org/tnfarmfacts). Despite having greater potential for agriculture enterprises, including alternative farm enterprises, the evaluation of the scope of these remains underexplored in Tennessee. Therefore, our study addresses these limitations and contributes to the literature in at least two ways. First, using a multinomial logit regression model (MNL), we explicitly analyze the factors influencing small farmers' strategic choice of specialization, crop/livestock diversification, or on-farm alternative enterprises. Second, we estimate the impact of such strategic choices on the financial performance of farms using multinomial endogenous switching regression (MESR) models. The use of MESR appropriately estimates impacts in terms of average treatment effects on treated (ATT), accounting for selection bias and unobserved heterogeneity.

Data

We conducted a primary survey in 2020 in Tennessee, using a survey link sent through email to 1,139 sampled farm households. We maintained online survey in Qualtrics—a software that enables to create online surveys. Under different sections, the survey maintains questions to collect information regarding farm household's agricultural and business activities, demographic and household-related information, resources availability, annual farm incomes, assets, and related financials. We sent an email to the sample farmers in January 2020 requesting their participation in the survey. The email also included an informed consent document and Institutional Review Board approval letter along with a link to an online survey. We used the farm household database by *Pick Tennessee Product* and *Tennessee Agritourism Association,* maintained in collaboration with Tennessee Department of Agriculture. Our sampled farm households were drawn from the various categories of farm types maintained in four separate lists. Not repeating the farm households across the list, this included 380 farmers under agritourism and fun farms category, 393 farmers under various farms of cash grains and field crops category, 13 farmers under organic farm category, and 353 farmers under animal and specialty crop or vegetables farms category. The stratified random sampling method was used for sampling. To ensure a good response rate, we sent two reminders. The first reminder was sent 2 weeks after the initial survey email, and the second reminder was sent 10 days (about 1 and a half weeks) after the first. We received 126 responses (11% response rate) from the survey and used 121 complete observations corresponding to small farm size appropriate for empirical analysis. Our sampled farmers include agricultural farm producers ranging from crop growers, vegetables and fruit growers, nursery farm operations, livestock or poultry farmers, beef cattle or animal farms, dairy farms, and agritourism farms from east, west, and central regions of Tennessee.

Methodology

Conceptual framework

Portfolio theory suggests that investment in diverse enterprises allows risk management through an exposure to diverse market conditions by minimizing the variability in return without reducing the expected level of return. Following Markowitz (1959), we assumed that farmers who want to stabilize their farm income would opt in for farm diversification and alternative on-farm business enterprise but opt-out for specialization. Diversification can be defined as spreading risk among various assets to balance overall farm income fluctuations (Libbin et al. 2004). Typically, diversification is based on the premise that investing in enterprises that have low or noncorrelated returns will stabilize the total farm returns (Barry et al. 2012).

The expected rate of return $\bar{r}_t$ and variance of the portfolio can be represented by equations 1 and 2, respectively.

$$\bar{r}_t = \sum\nolimits_{n=1}^{N} r_n P_n \tag{1}$$

$$\sigma_T^2 = \sum_{n=1}^{N} P_i^2 \sigma_i^2 + \sum_i \sum_j P_i P_j \sigma_{ij} \tag{2}$$

where $\bar{r}_t$ represents the total return of the portfolio with N enterprises, r_n represents the return of enterprise n, and P_n represents resources allocated corresponding to a n enterprise. σ_T^2 represents the total variance of the portfolio and σ_{ij} represents the covariance between enterprises that may include various agricultural (crop and livestock) and alternative on-farm enterprises.

Consistent with equations (1) and (2), let us evaluate the return and variance on three choices: specialized farm, diversified farm with crops and/or livestock, and diversified farms with the addition of alternative on-farm business enterprise. Suppose the investments in these separate strategic choices as X_1, X_2, and X_3, rates of returns as r_1, r_2, and r_3, and resource allocations as P_2, and P_3, respectively. A specialized farmer will have all resources on X_1, implies $P_1 = 1.0$, $P_2 = 0.0$, and $P_3 = 0.0$. Therefore, for a specialized farm, the total variance is $\sigma_t^2 = \sigma_1^2$. However, for diversified farms with crops and/or livestock or those with alternative on-farm business enterprises, portfolio return is the added return from the enterprises. In this case, total risk is a mix of variance and covariance spread across enterprises. For instance, for N=3, portfolio return is given by $\bar{r}_t = r_1 p_1 + r_2 p_2 + r_3 p_3$ and total variance is influenced by the covariance (correlation) between enterprises. For correlation c, such that $-1 \leq c \leq 1$, we have following total variance in extremes (Barry et al. 2012):

$$c = -1: \quad \sigma_T^2 = \sigma_1^2 p_1^2 + \sigma_2^2 p_2^2 + \sigma_3^2 p_3^2 - 2\sigma_1 p_1 \sigma_2 p_2 - 2\sigma_2 p_2 \sigma_3 p_3 - 2\sigma_1 p_1 \sigma_3 p_3 \tag{3}$$

$$c = 0: \quad \sigma_T^2 = \sigma_1^2 p_1^2 + \sigma_2^2 p_2^2 + \sigma_3^2 p_3^2 \tag{4}$$

$$c = 1: \quad \sigma_T^2 = \sigma_1^2 p_1^2 + \sigma_2^2 p_2^2 + \sigma_3^2 p_3^2 + 2\sigma_1 p_1 \sigma_2 p_2 + 2\sigma_2 p_2 \sigma_3 p_3 + 2\sigma_1 p_1 \sigma_3 \tag{5}$$

From equations 3, 4, and 5, we can see that portfolio risk depends on the relative proportion of the investments, their variances, and the correlation of their returns. Specifically, this shows that: a) the higher the correlation for positively correlated enterprises, the higher would be the total risk, and b) the higher in magnitude but negatively correlated enterprises, higher would be the risk reduction. Hence, the lower the correlation or negative correlation, the greater the risk reduction associated with diversification resulting in a more stable economic return. This derivation of portfolio

Table 1. Strategy choice adopted by farmers operating small farms in Tennessee

Strategy set	Crop/animal diversification (> 3 crops or animals raised for business)	Alternative on-farm enterprise developed or adopted (like agritourism, on-farm recreational, or educational ventures) as business
D_0E_0	0	0
D_1E_0	√	0
D_0E_1	0	√

Notes: '0' denotes no or strategy not chosen, while '√' denotes yes or strategy chosen. Each element in the combination is a binary variable for strategy choice: with diversification condition (D) or with alternative on-farm enterprise (E) Subscript 1 = participation, and 0 = otherwise.

theory suggests better outcomes by integrating the uncorrelated assets and enterprises with dissimilar risk situations. Portfolio diversification includes the addition of returns but diversification of risks (Figge 2004; Pennington and Fisher 2009). From this theoretical perspective, we argue two propositions: 1) higher stable returns for small farms are likely to be achieved from diversified small farms with the addition of alternative on-farm enterprises than diversified small farms adopting multiple crop and livestock enterprises, 2) Any of these strategic diversification choices (diversification by adding of alternative on-farm business enterprises or by adopting multiple crops and livestock enterprises) provide higher stable returns for small farms than specialization.

Empirical framework

The empirical framework includes a two-stage approach. In the first stage, MNL is used to estimate the factors affecting farmer's decisions regarding strategic choice. Table 1 shows these choice alternatives: (1) specialization, (2) diversification with multiple crops and/or livestock enterprises, and (3) the addition of alternative on-farm enterprises. Following McFadden's Random Utility model (McFadden 1986), the latent model describing the i^{th} farmer's behavior in making a strategic choice is given by

$$y_{ji} = \beta_j X_{ji} + \varepsilon_{ji} \qquad j = 1,\ 2,\ 3 \tag{6}$$

In which, X is a vector representing the set of exogenous variables such as the farmer's perceived risk, household income, age, gender, education level, off-farm labor supply decisions, insurance participation, farm location, etc. ε includes unobserved characteristics that influence the choice decisions. Here, we assume that farmers make their choices that maximize their utility. Utility is not observed but the choice made by the farmer can be observed (Bourguignon et al. 2007; Kassie et al. 2015). The choice variable has three categories and is unordered i.e., j = 1, 2, 3 does not imply that 1 is higher than 2 and 3.

A farmer's decision to choose strategy j among other alternatives k is given by

$$I = \begin{cases} 1 \ if \ I_{ji} \ > max_{k \neq 1}(I_{ki}) or \ \eta_{1i} \ < 0 \\ \quad \cdot \\ \quad \vdots \qquad for \ all \ k \neq j \\ J \ if \ I_{ji} > max_{k \neq j}\,(I_{ki}) or \ \eta_{ji} \ < 0 \end{cases} \tag{7}$$

In which, $n_{ji} = max_{k \neq j}\left(I_{ki} - I_{ji}\right) < 0$ (Kassie et al. 2015 and Bourguignon et al. 2007). The individual farmer i with a set of characteristics X chooses a strategic choice j with the following probability (McFadden 1973),

$$P_{ji} = \frac{\exp(\beta_j X_{ji})}{\Sigma_j \exp(\beta_k X_{ij})}. \tag{8}$$

The regression coefficient indicates the direction of association between the dependent (choice) variable and independent variables. The marginal effects $\frac{dy}{dx}$ are then calculated representing the magnitude of the association between choice variable and the explanatory variables.

In the second stage, the impact of the farmer's choice on the farm's financial performance is measured using MESR. MESR uses separate impact equations for each given choice. In this study, three financial performance variables: gross cash farm income (GCFI), gross return on assets (ROA), and debt to assets ratio (DTA) are used as dependent variables. These indicators have been discussed as financial performance indicators. For example, ROA allows to measure the financial performance by evaluating assets and incomes (Gloy et al. 2002; Khanal et al. 2019); DTA provides farm financial position by hinting on how farm is financed by debt (Husna and Satria 2019).

To ensure that the impact is solely due to strategic choice, correction for sample selection is essential. We did so by using selectivity-corrected multinomial logit (Bourguignon et al. 2007). This approach has an advantage over others because it exempts the assumption of independence of irrelevant alternatives (IIA), which guarantees the consistency and the efficiency of the estimated parameters (Bourguignon et al. 2007). The use and suitability of this approach is inconsistent with recent empirical impact studies in agricultural and applied economics (Di Falco et al. 2011; Teklewold et al. 2013; Abdulai and Huffman 2014; Di Falco and Veronesi 2013; and Kassie et al. 2018; Khanal, Mishra et al. 2020). The impact on farm financial performance corresponding to each strategic choice represents each regime as

$$\{ \textit{Regime } 1: R_{1i} = \delta_1 \mathbf{Z}_{1i} + u_{1i} \textit{ if } j = 1$$

$$\{ \textit{Regime } J: R_{ji} = \delta_j \mathbf{Z}_{ji} + u_{ji} \textit{ if } i = j, \mathrm{J} = 2, 3 \tag{9}$$

Where $j = 1$ is a base category that represents the choice for the specialized farm. R is a farm holder i's farm financial performance in regime j; $\mathbf{Z}$ is a set of explanatory variables influencing impacts and u represents an error term. u in equation (9) and ε in equation (6) are not independent because of the possibility of unobserved correlation between first and second-stage regression which demands the use of additional selection correction terms of alternative choices λ to appropriately estimate δ (Bourguignon et al. 2007). The equation can now be written as

$$\{ \textit{Regime } 1: R_{1i} = \delta_1 \mathbf{Z}_{1i} + \sigma_1 \lambda_{1i} + u_{1i} \textit{ if } i = 1$$

$$\{ \textit{Regime } J: R_{Ji} = \delta_j \mathbf{Z}_{Ji} + \sigma_{\mathrm{J}} \lambda_{Ji} + u_{Ji} \textit{ if } i = j, \ J = 2, 3 \tag{10}$$

In which λ is the inverse mills ratio predicted and computed from the probability estimates of equation (6). u is the error term with an expected value of 0. Equations represented in equation 10 yield estimates due to treatment effects and counterfactual (a situation that describes if A had not occurred then B would not have occurred) and which allow us to compute individual impact due to a particular strategic choice. Farmers adopting diversification strategies may characteristically differ from those adopting specialization in terms of unobserved characteristics (such as managerial ability, risk preference, strength etc.) and observed characteristics (such as education level, resource availability, access to market, access to Internet etc.) affecting decisions and outcomes (Midingoyi et al. 2019). MESR method is advantageous over propensity score matching because it corrects selection bias due to both observable and unobservable heterogeneity (Khanal, Mishra et al. 2020; Kassie et al. 2018; Lokshin and Sajaia 2004).

We estimated average treatment effects in terms of ATT, which are computed based on conditional expectations (Kassie et al. 2015). Treatment effects are outcomes caused by the farmer's specific choice of that strategy and therefore can be solely attributable to its effect or impact. Equation 11 to 14 shows the calculation for the expected financial performance.

Financial Performance of farmers adopting diversification strategy (actual)

$$E\left[R_{ji}\middle|I=j,\ \mathbf{z}_{ji},\ \ \lambda_{ji}\right]=\delta_i\mathbf{z}_{ji,}\ \ +\sigma_{j\varepsilon}\lambda_{ji} \tag{11}$$

Financial performance of farmers not adopting diversification strategy (actual):

$$E\left[R_{1i}\middle|I=1,\ z_{1i,}\ \ \lambda_{1i}\right]=\delta_1 z_{1i,}\ \ +\sigma_{1\varepsilon}\lambda_{1i} \tag{12}$$

Financial performance of diversified farmers had they decided not to practice any form of diversification (counterfactual):

$$E\left[R_{1i}\middle|I=j,\ \mathbf{z}_{ji,}\ \ \lambda_{ji}\right]=\delta_1 z_{ji,}\ \ +\sigma_{1\varepsilon}\lambda_{ji} \tag{13}$$

Financial performance of farmers not participated in any form of diversification had they decided to participate (counterfactual):

$$E\left[R_{ji}\middle|I=1,\ z_{1i,}\ \ \lambda_{1i}\right]=\delta_1\mathbf{z}_{1i,}\ \ +\sigma_{j\varepsilon}\lambda_{1i} \tag{14}$$

ATT is given by the difference between actual (equation 11) and counterfactual (equation 13) which can be written as

$$\text{ATT}=\ E\left[R_{ji}\middle|I=j,\ \mathbf{z}_{ji,}\ \ \lambda_{ji}\right]-\ E\left[R_{1i}\middle|I=j,\ \mathbf{z}_{ji,}\ \ \lambda_{ji}\right]=\ \mathbf{z}_{ji}\,(\delta_j=\delta_1)+\lambda_{ji}\,(\sigma_j-\sigma_1) \tag{15}$$

Result and discussion

Our data suggests that 40.36% of small Tennessee farmers adopt specialization[2], 24.77% adopt crop/livestock diversification[3], and 34.86% adopt alternative on-farm business enterprises in their farm[4] (Figure 1). Table 2 shows the summary statistics of the variables and means compared among the adopters of these three strategic choices. Through mean comparison tests, we assess the statistical significance of the differences in these variables across adopters of these three strategic choices. The average land acreage of the overall sample is 48 acres. The mean comparison shows that crop/livestock diversified farms hold higher land acreage than specialized or alternative on-farm enterprise adopter farms. Summary statistics shows that the operators of specialized farms aged around 62 years with 15 years of formal education, those in crop/livestock diversified farms aged around 57 years with 15 years of education, and those in on-farm alternative enterprises adopter farms aged around 60 years with 15 years of formal education. However, mean comparison tests of age and education suggest that there are no statistically significant differences in age and education among adopters of these three strategies. Table 2 also shows that the use of family labor significantly differs across the adopter farms of these three strategies. A significantly higher percentage (93%) of crop/livestock diversified farms use family labors while only 73% of specialized farms use so. On the other hand, 84% of the alternative on-farm enterprises adopters use family labors. Additionally, 70% of crop/livestock diversified farms are also engaged in some off-farm jobs, which is significantly higher than the

[2]Specialized farm implies farms adopting a single component of specialized crop or livestock animal.

[3]Crop/livestock diversification in this study implies farm integrating more than three crops and/or livestock.

[4]Diversified farm with alternative on-farm business enterprise implies farms integrating an on-farm business enterprise like agritourism, horse riding, pumpkin patch, educational and recreational activities on the farm generating income.

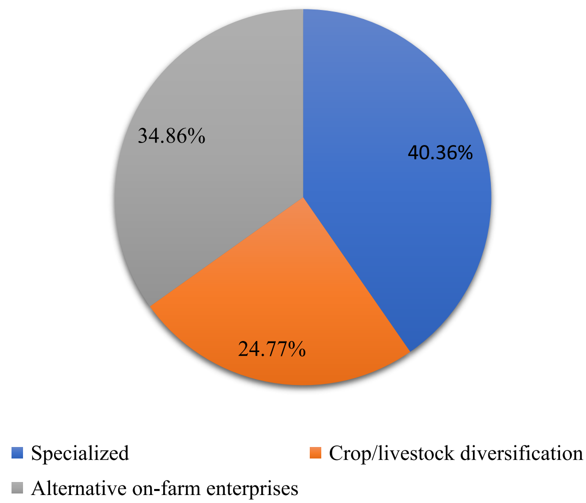

Figure 1. Distribution of small farm households of Tennessee by strategic choices: specialization, crop/livestock diversification, and diversification by adoption of alternative on-farm enterprises. (Source: Primary survey, 2019–2020).

percentage engaged in off-farm jobs by specialized farms (48%) and alternative on-farm enterprises adopter farms (32%). Table 2 also shows that the participation rate in organic farming is not significantly different across specialized and diversified farms: around 39% of specialized farms engage in organic farming practices, followed by crop/livestock diversified farms (30%) and alternative on-farm business enterprise adopter farms (21%).

In the face of digital agriculture and social media use for promotion, and to get and send information quickly, smartphones have been used in farm related businesses. Recent previous studies have included smartphone use in farm management and related decision models (Quandt et al. 2020; Michels et al. 2020; Adhikari and Khanal 2021). We found that a significantly higher number of diversified farms use smartphones in their farm-related activities and businesses as compared to specialized farms—around 85% of crop/livestock diversified farms and 89% of alternative on-farm enterprises adopter farms in our sample used smartphones in farm-related activities as compared to 62% specialized farms.

Our findings show significant differences in insurance participation across adopters of three strategies. Around 87% of alternative on-farm enterprise adopters, the highest among three adopter groups, participate in agricultural or farm-related insurance, while only 66% and 63% of specialized and crop/livestock diversified operations, respectively, participate in farm-related insurance. Finally, female-operated farms across adopters of these three strategies are in similar proportions—21 to 23% of farms in each adopter group are female operated and higher percentage of alternative on-farm enterprises adopter farms are retired Veteran[5] operated (16% as compared 9% specialized farms and 4% crop/livestock diversified farms).

[5]Unlike previous farm diversification decision studies using data from other States or nationwide, we included veteran dummy variable representing (controlling for) veteran/ prior military owned farms in our model specific to Tennessee. Veteran owned farms are in notable numbers in Tennessee, specifically farms with alternative on-farm enterprises like agritourism—our sample shows 16%, which is consistent with Census of Agriculture showing 14,000 veteran/ prior military farmers (around 19% of total farms) in Tennessee; Tennessee Department of Agriculture (2019) writes, “Farmer Veterans Found Throughout Tennessee Agriculture” (https://www.tn.gov/agriculture/news/2019/11/8/farmer-veterans-found-throughout-tennessee-agriculture.html)

Table 2. Variables definition and summary statistics

Variable definitions	Specialization	Crop/ livestock diversification	Alternative on-farm enterprise	Means comparison test&
Log of land own (logarithm)	3.45	4.32	3.65	3.18**
	(1.49)	(0.94)	(1.50)	(0.046)
Age of the farmers (years)	61.86	57.07	60.48	1.25
	(12.98)	(10.79)	(12.97)	(0.290)
Education of the farmers (years)	14.66	14.82	14.74	0.01
	(4.98)	(3.86)	(4.51)	(0.990)
Family labor (dummy, =1 if family members work as farm labors)	0.73	0.93	0.84	2.37*
	(0.45)	(0.27)	(0.37)	(0.098)
Off farm work (dummy, =1 if a farmer works off farm)	0.48	0.70	0.32	5.07**
	(0.51)	(0.47)	(0.47)	(0.007)
Organic (dummy, =1 if farmer practices organic farming practices)	0.39	0.30	0.21	1.50
	(0.49)	(0.47)	(0.41)	(0.228)
Risk perception high (dummy, =1 if farmer risk perception associated with farming is high)	0.21	0.30	0.16	0.91
	(0.41)	(0.47)	(0.37)	(0.403)
Smartphone (dummy, =1 if a farmer use smartphone for farm business purpose)	0.68	0.85	0.89	3.30**
	(0.47)	(0.36)	(0.31)	(0.030)
Insurance (dummy, =1 if a farmer participates in farm insurance	0.66	0.63	0.87	3.15**
	(0.48)	(0.49)	(0.34)	(0.047)
Female (dummy, =1 if a principal farmer is a female)	0.23	0.22	0.211	0.02
	(0.42)	(0.42)	(0.41)	(0.983)
Veteran (dummy, =1 if a farmer was a veteran previously)	0.09	0.04	0.16	1.31
	(0.29)	(0.19)	(0.37)	(0.275)
Number of observations (Total = 121)	44	27	38	

Values in parenthesis, except for the last column, are the standard deviations; &Multivariate mean comparison test, F- statistic reported with p-values in parentheses, **indicates significance at 5% or higher level, *indicates significance at 10%.

Factors influencing strategic choice decisions: Multinomial logit estimates

Table 3 presents the multinomial logit estimates for the factor influencing small farm-holding farmers' choice decision for crop/livestock diversification and alternative on-farm business enterprise against specialization (D_0A_0) as a base category. The result suggests a significant positive association between land acreage holding and the adoption of crop/livestock diversification. A marginal effect of 0.113 infers that the probability of adopting crop/livestock diversification increases by 1% with every 10% increase in land acreage

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Table 3. Multinomial logit estimates for factors influencing strategic choice decisions among small farm households in Tennessee (specialization used as base strategy)

	Crop/livestock Diversification			Alternative on-farm enterprise		
Variables	Coef.	t-stat	ME	Coef.	t-stat	ME
Land acreage owned (in log)	0.807**	2.17	0.113	−0.060	−0.29	−0.058
Age of the farmer	−0.091**	−2.58	−0.008	−0.072**	−2.26	−0.007
Education of the farmer	−0.039	−0.42	−0.008	0.044	0.54	0.010
Family labor use	15.693	0.01	2.137	−0.106	−0.12	−0.946
Off-farm work	0.102	0.14	0.120	−1.789***	−2.71	−0.307
Organic participation	−0.173	−0.23	0.092	−1.949***	−2.64	−0.318
Risk perception high	−0.066	−0.09	0.045	−0.908	−1.25	−0.149
Smartphone	1.120	1.02	0.003	2.013**	1.98	0.273
Insurance participation	−0.640	−0.87	−0.150	1.073	1.30	−0.219
Female farmer	0.685	0.82	0.080	0.222	0.32	−0.003
Veteran owned farm	−0.735	−0.55	−0.088	−0.106	0.12	0.060
Constant	−13.666	−0.01	–	2.933	1.12	
Psuedo-R^2						0.251
LR test (Chi^2, 22)						53.79**
Wald test of the complete set of independent variables (Chi^2 stat, 22)						30.01*

**indicates significance at 5% or higher level, *indicates significance at 10%, ME represent average marginal effects.

holding. The finding is plausible because greater landholdings may provide higher opportunities to use the land for multiple crops and animals in integration—enabling diversification. Producing crops or livestock separately is costlier than producing them together—one can utilize economies of scope with associated inputs, resources, and management required in those together (McNamara and Weiss 2005). Higher land acreage holdings create scope for farmers to integrate various crop and livestock enterprises (Ashfaq et al. 2008). Our results in Table 3 also suggest that relatively younger farmers are more inclined toward diversification strategies than specialization. From marginal effects of age on crop/livestock diversification and alternative on-farm business strategic choice, we found that the probability of adopting crop/livestock diversification strategy decreases by 0.8% while that of adopting alternative on-farm business enterprise decreases by 0.7% with every year increase in age. This result is consistent with findings from Mishra et al. (2004) and Pope and Prescott (1980), who discussed that younger farmers tend to earn more wealth at that phase of life which motivates them to adopt risk-minimizing practices and hence tends to diversify their portfolio. Moreover, one can expect that younger farmers may be optimistic and progressive in technology adoption and plan for a longer payoff period for an investment—which could be a potential reason for younger farmers practicing farm diversification (Bagi and Reeder 2012).

The MNL estimates in Table 3 suggest that farmers who work off-farm for wage and salary are significantly less likely to adopt alternative on-farm business enterprise.

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Our result shows that if a farmer works off-farm, then s/he is 30.7% less likely to adopt alternative on-farm business enterprise than the farmer who does not work off-farm. The result is plausible because farmers who work off-farm may face time constraints to adopt alternative on-farm business enterprises like agritourism as it demands time. Our finding is consistent with Mishra and EL-Osta (2002) and Fernandez–Cornejo et al. (2007) who found that US farm households participating in off-farm works had lower adoption of on-farm enterprises. We also found a significant negative association between organic farming and the adoption of alternative on-farm business enterprises. The marginal effect suggests that organic growers are around 32% less likely to adopt alternative on-farm business enterprises as compared to other conventional farmers. Also, note from summary statistics (Table 2) that the percentage of organic grower farms choosing a specialized strategy is higher than those choosing diversifications and alternative on-farm business enterprises. This MNL finding together with summary statistics suggest that organic growers are likely to specialize and intend to be commodity specific (for example, specific specialty crop). Once chosen to be an organic grower with specific knowledge of a particular commodity, farmers want to focus on specialized production. For organic growers, there may be a high opportunity cost associated with a trade-off between organic farming on the land vs adopting alternative on-farm business enterprise and they choose specialized production over alternative on-farm business enterprise.

Our results show that the use of smartphones in agricultural activities significantly increases the likelihood of the adoption of alternative on-farm business enterprises. The marginal effects in Table 3 show that the probability of adopting alternative on-farm business enterprises is 27.3 % higher for smartphone users in agricultural activities than nonusers. One of the reasons could be that smartphones allow keeping up-to-date information on farm businesses and technologies (McElwee and Bosworth 2010). Smart phones may facilitate the dissemination of information quickly and help to build networking. Farmer may use a smartphone for advertising their business and their services on social media like Facebook, Twitter, Instagram, and Tiktok as a powerful tool to significantly influence buyers or visitors' decisions (Alalwan 2018).

Impacts of the strategic decisions on farm financial performance: MESR model results

We first estimated conditional equations shown in equations 11 to 14 for each financial measure shown in Table 4. Note that the financial measures are the dependent variables in each MESR model, fitted simultaneously in two stages. The selection equation (first stage) defines the likelihood of a particular strategic choice among three strategies in a multinomial logit framework and the impact equation (second stage) estimates the selectivity corrected impact of the choice on financial performance[6]. Based on the predictions of MESR models, we calculated ATT (Equation 15). ATT is a difference between actual and counterfactual outcomes.

Table 5 shows the estimated impact, in terms of ATT, of the strategic choice decision on gross cash farm incomes (GCFI). We compare the expected GCFI under the actual case that the small US farms adopted a particular strategic choice of diversification (i.e., crop/

[6]We used *Female* and *Veteran* dummy variables for exclusion restriction—these variables are used in the first stage multinomial logit selection equations but not in the second stage impact estimations. Note that parameters of the MESR models can be identified through non-linearity (inclusion of Inverse Mills Ratio) but exclusion restriction with additional variables are maintained for robust identification (Manda et al. 2021; Midingoyi et al. 2019). We have presented joint significance of these additional variables in Table 8.

Table 4. Financial variables and their definitions used in this study

Financial variables	Definition
Gross Cash Farm Income (GCFI) ($)	Total annual income before expenses and includes cash receipts, farm-related income, and government farm program payments
Debt-to-Assets (DTA)	$\frac{\textit{Totl Liabilities}}{\textit{Total Assets}}$
Gross return-on-Assets (ROA)	$\frac{\textit{Total Gross Income}}{\textit{Total Assets}}$

Table 5. Average expected Annual Gross Farm Income with diversification decision strategy in terms of ATT

Specialization/diversification decision strategy	Actual outcome (Annual Gross farm income if farm household participates in decision *j*) (1)	Counterfactual outcome (Annual Gross farm income if farm household does not participate in decision *j*) (2)	Average treatment effects on Treated. (ATT) (3)	Percentage (4)
D_1A_0 (diversified with multiple crops or livestock on-farm)	72,150.46	61,764.64	10,385.83	16.82%
	(13602.71)	(9344.75)	(16503.28)	
D_0A_1 (diversified including the adoption of alternative on-farm enterprises)	66,255.73	45,826.72	20,429.01**	44.58%
	(7623.48)	(5381.95)	(9331.82)	

Notes: **indicates significance at 5% or higher level, *indicates significance at 10%, values in parenthesis are standard errors. ATT estimates are computed using predictions of the MESR model.

livestock diversification and addition of alternative on-farm enterprise) and the counterfactual case that they did not (i.e., specialization). Column 2 of Table 5 shows the counterfactual cases. Significant lower GCFI on column 2 for D_0A_1 strategy indicates that small farms who adopted alternative farming enterprises would have had lower GCFI if they had not adopted. Column 3 of Table 5 presents the impact of each strategy on GCFI, which is the ATT, calculated as the difference between column 1 and column 2. Recall that to arrive at these estimates, we controlled for the effects of several covariates and accounted for potential selection bias from observed and unobserved variables affecting GCFI.

We found that farmers choosing alternative farming enterprises adoption strategy over specialization are estimated to gain an additional $20,429 annual GCFI, which is around 45% higher performance as compared to specialization. The positive impact results are in-line with findings from Joo et al. (2013), who used nationwide US data and propensity score matching methods and found a significant positive impact of the adoption of agritourism on small farm's financial performance.

Similarly, Table 6 shows the impacts of strategic decisions on gross returns on assets (ROA). Column 1 and column 2 in Table 6 show the expected Return on Assets calculated based on MESR for actual and counterfactual groups corresponding to the respective strategy choice, respectively. We found a significantly positive effect of D_0A_1 strategy, and

Table 6. Average expected impact on Gross Return on Assets with diversification decision strategy in terms of ATT

Specialization/ diversification decision strategy	Actual outcome (Impact on Return on Assets if farm household participates in decision *j*) (1)	Counterfactual outcome (Return on Assets if farm household does not participate in decision *j*) (2)	Average treatment effects for Treated (ATT) (3)
D_1A_0 (diversified with multiple crops or livestock on the farm)	0.1176	0.0867	0.0308
	(0.0323)	(0.0121)	(0.0345)
D_0A_1 (diversified including the adoption of alternative on-farm enterprises)	0.3741	0.0789	0.2951**
	(0.0943)	(0.011)	(0.0949)

Notes: **indicates significance at 5% or higher level, *indicates significance at 10%, values in parenthesis are standard errors. ATT estimates are computed using predictions of the MESR model.

Table 7. Average expected impact on Debt to Assets with diversification conditions in terms of ATT

Enterprise diversification set	Actual outcome (Impact on Debt to Assets if household participates in decision *j*) (1)	Counterfactual outcome (Impact of Debt to Assets if the household does not participate in decision *j*) (2)	Average treatment effects on Treated (Debt to Assets) (3)
D_1A_0 (adoption of multiple crops or livestock on the farm)	0.418	0.2778314	0.1401686
	(0.1527544)	(0.0441597)	(0.1590094)
D_0A_1 (adoption of the alternative on-farm enterprise)	0.6496191	0.1535993	0.4960198**
	(0.1270927)	(0.0542183)	(0.1381745)

Notes: **indicates significance at 5% or higher level, *indicates significance at 10%, values in parenthesis are standard errors. ATT estimates are computed using predictions of the MESR model.

adoption of the alternative farming enterprise, on Return on Assets. Specifically, the expected Return on Assets of alternative farming enterprise adopters is 37% (Column 2, actual) while this Return on Assets would have been 7.89% had they not adopted alternative farming enterprise (Column 3, counterfactual). Our ATT estimates (Column 4) show a 30% higher Return on Assets—this implies that small farms could achieve around 30% higher Return on Assets by adopting alternative farming enterprises over choosing to be a specialized farm. This finding of around $1.30 of gross returns for every dollar of assets attributable to alternative farming enterprise adoption for a small farm is quite notable. Integration of on-farm alternative enterprise components such as agritourism, recreational, or educational activities on a farm may enable efficient utilization of the farm assets and it can be a lucrative option for the farmer holding a small farm (Joo et al. 2013; Khanal, Honey et al. 2020; Bernardo et al. 2004). Finally, Table 7 shows the impacts of strategic decisions on debt to assets (DTA). We find a significantly higher debt to assets for alternative on-farm enterprise adopter farms than the specialized farms. ATT estimates in

Table 8. Ancillary, selectivity parameters, and test results from estimated MESR impact equations

Variable/ parameters	D_0E_0	D_1E_0	D_0E_1
	MESR estimation equations (dependent variable: Gross Farm Income)		
Coefficient of λ_1		−1.551	1.169
Coefficient of λ_2	−1.884*		−2.805
Coefficient of λ_3	0.752	−0.860	
Joint significance of selectivity parameters	$Chi^2(2) = 4.43$* Prob > Chi^2=0.1	$Chi^2(2) = 9.23$** Prob > Chi^2=0.009	$Chi^2(2) = 5.05$* Prob > Chi^2=0.079
	MESR estimation equations (dependent variable: Return on Assets)		
Coefficient of λ_1		−0.566	−4.233
Coefficient of λ_2	−0.036		1.708
Coefficient of λ_3	0.147	0.179	
Joint significance of selectivity parameters	$Chi^2(2) = 3.41$ Prob > Chi^2=0.18	$Chi^2(2) = 13.87$** Prob > Chi^2=0.001	$Chi^2(2) = 2.83$ Prob > Chi^2=0.24
	MESR estimation equations (dependent variable: Debt to Assets)		
Coefficient of λ_1		4.33	−5.57
Coefficient of λ_2	−0.224		1.99
Coefficient of λ_3	0.511	−3.62	
Joint significance of selectivity parameters	$Chi^2(2) = 1.16$ Prob > Chi^2=0.56	$Chi^2(2) = 1.66$ Prob > Chi^2=0.43	$Chi^2(2) = 2.71$ Prob > Chi^2=0.25
Joint significance of additional variables in the first stage			Chi^2-stat = 0.922 Prob > Chi^2 = 0.91

**indicates significance at 5% or higher level, *indicates significance at 10%.

Table 7 suggest around 49% higher DTA is associated with alternative farming enterprise adopter farms as compared to their counterpart nonadopter farms. Our finding is plausible in that initial investment for the alternative farming enterprise may require higher debt levels through external credit and loans. Higher DTA is not necessarily a problem if it is directed towards prioritized investments in productive activities. Due to limited or no information on how the debt is used by small farms in this data, we could not investigate details of whether the debt is utilized efficiently by small farms—this could be interesting research for future studies. Additionally, individual studies separating crop diversification and livestock diversification farms can result in a distinct analysis which we could not do in this study due to data limitations.

Table 8 provides ancillary parameters and the significance of selectivity parameters corresponding to equation 11 to 14. Selectivity-corrected impact estimations for each financial variable were estimated using simultaneous fit of first and second stages under MESR. Simultaneous fit using maximum likelihood estimation provides consistent estimates. Our ATT estimation are the predictions from these simultaneously fitted MESR models. The coefficient of selectivity terms (coefficient of Inverse Mills Ratio, λs) in each equation are presented in Table 8. Joint significance of selectivity parameters in gross income equations pertaining to all three strategic decisions suggested that our estimates would have been biased had we not corrected for selectivity. This justified our model choice accounting for the selectivity correction on MNL. Similarly, we also found the joint significance of selectivity parameters of diversification decision (D_1E_0) in ROA equation (Table 8).

Though our estimates are based on the sample data from Tennessee, the implications of our findings are broader. For example, with a remarkable and significant impact of alternative enterprises like agritourism, small farms in other states can also adopt these activities to enhance financial performance by evaluating their asset and resources fit for it. States can promote agritourism support programs to enhance the survival of small farms. Additional income generated from farm is likely to be used by farm families in many economic activities that may enhance their well-bring and boost the economic growth in rural communities and farming sector.

Summary and conclusions

In this study, we show how small farms can use farm diversification tools of risk management to enhance financial performance. We investigated the factors influencing farmer's strategic decisions in specialization, crop or livestock diversification, and the addition of alternative on-farm enterprises and then evaluated the effects of these decisions on financial performance. Farm diversification can reduce variability in farm incomes in the face of survival challenges. Using primary survey data collected in 2020 in Tennessee, we estimated decision and impact models using MNL and MESR.

Our MNL results suggest that the farmer's age, use of smartphone in farm-related activities, land acreage holdings, and farmer's off-farm work significantly influence the farmer's strategic decisions on specialization and different forms of diversification. From the MESR model, we found significant positive impacts in terms of gross farm incomes and return on assets that are attributable to the decisions to adopt alternative on-farm enterprises. Specifically, the farms adopting alternative on-farm enterprises could obtain an additional \$20,429 annual gross farm income, 45% higher than their counterfactual nonadopters. Furthermore, our findings indicate that adopters of alternative on-farm enterprises have approximately 30% higher return on assets compared to nonadopters. This difference in return can be attributed to the decision to adopt alternative on-farm enterprises. Finally, our results show a higher debt to assets associated with the adoption of alternative on-farm enterprises. This is likely stemming from the farm's dependence on external credit and loans for the initial investment required to prepare and establish the alternative on-farm enterprises. Though our empirical estimates are based on Tennessee survey data, the essence of our findings are applicable to small farms in other states and nation-wide when it comes to farmer's decision, implications, and policy.

Our study addresses critical issues that have implications for the survival and economic stability of small farm households. We used an adequate impact estimation method, MESR, which considers both observed and unobserved heterogeneity in selectivity. This study provides empirical evidence that the adoption of alternative on-farm enterprises by small farms can improve their financial performance. Adoption of alternative enterprises on the farm can strengthen and stabilize the economic base of the farm. In addition, the results imply that policymakers should prioritize policies that support alternative on-farm enterprises such as integrating agritourism or providing opportunities for recreational or educational pursuits. Supporting these initiatives will enable farmers to augment their farm incomes and simultaneously preserve the value of natural resources. Though we have not estimated the impacts on community and society directly, anecdotal evidence supports that the adoption of alternative on-farm enterprises like agritourism and educational ventures can also help educate younger generations about farming culture, available farm resources, and the beauty of rural landscapes. As a result, these indirect educational efforts can potentially facilitate the transfer of knowledge about the significance of farming and agriculture to younger generations.

Our findings also show that a higher debt-to-assets ratio is associated with the adoption of alternative on-farm enterprises. Higher debt may pose a challenge by inviting higher financial risks for small farms. Therefore, support programs in helping initial investment or mitigating the debt load could encourage small farms to develop alternative farming enterprises. Additionally, small farms could benefit from educational support that enhance financial literacy and balanced capital structure. Finally, we recognize that our study may have some limitations, specifically on the magnitude of our model estimates, due to its dependence on a sample of small farms and the list of farms sourced from the organization featured in the State's Department of Agriculture. Future similar studies could consider utilizing larger sample sizes or nation-wide data from multiple states for more comprehensive insights.

Data availability statement. N/A

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References

Abdulai, A., and W. Huffman. 2014. "The Adoption and Impact of Soil and Water Conservation Technology: An Endogenous Switching Regression Application." *Land Economics* **90**(1): 26–43.

Addinsall, C., P. Scherrer, B. Weiler, and K. Glencross. 2017. "An Ecologically and Socially Inclusive Model of Agritourism to Support Smallholder Livelihoods in the South Pacific." *Asia Pacific Journal of Tourism Research* **22**(3): 301–315.

Adhikari, S., and Khanal, A.R. 2021. "Economic Sustainability and Multiple Risk Management Strategies: Examining Interlinked Decisions of Small American Farms." *Sustainability* **13**(4): 1741.

Alalwan, A.A. 2018. "Investigating the Impact of Social Media Advertising Features on Customer Purchase Intention." *International Journal of Information Management* **42**: 65–77.

Amanor-Boadu, V. 2013. "Diversification Decisions in Agriculture: The Ase of Agritourism in Kansas." *International Food and Agribusiness Management Review* **16**(1030-2016–82820): 57–74.

Ashfaq, M., S. Hassan, M.Z. Naseer, I.A. Baig, and J. Asma. 2008. "Factors Affecting Farm Diversification in Rice–Wheat." *Pakistan Journal of Agricultural Sciences* **45**(3): 91–94.

Bagi, F.S., and R.J. Reeder. 2012. "Factors Affecting Farmer Participation in Agritourism." *Agricultural and Resource Economics Review* **41**(1203-2016–95369): 189–199.

Barbieri, C., and E. Mahoney. 2009. "Why is Diversification an Attractive Farm Adjustment Strategy? Insights from Texas Farmers and Ranchers." *Journal of Rural Studies* **25**(1): 58–66.

Barbieri, C., and P.M. Mshenga. 2008. "The Role of the Firm and Owner Characteristics on the Performance of Agritourism Farms." *Sociologia Ruralis* **48**(2): 166–183.

Barbieri, C. E. 2006. "*Farm and Ranch Diversification: A Strategy for Confronting the Changing Agricultural Context in Texas*." Michigan State University.

Barry, P. J., P.N. Ellinger, J.A. Hopkin, and C.B. Baker. 2012. *Financial Management in Agriculture (7-th edition)*. New Jersey, USA: Pearson Education, Inc.

Bernardo, D., L. Valentin, and J. Leatherman. 2004. "Agritourism: If We Build It, Will They Come." *Risk and Profit Conference, Manhattan, KS*, 19–20.

Bourguignon, F., M. Fournier, and M. Gurgand. 2007. "Selection Bias Corrections Based on the Multinomial Logit Model: Monte Carlo Comparisons." *Journal of Economic Surveys* **21**(1): 174–205.

Brown, D. M., and R.J. Reeder. 2007. *Farm-based recreation: A statistical profile*.

Clark, G. 2004. "The Price History of English Agriculture, 1209–1914," in *Research in Economic History*, vol. 22, 41–123. Bingley, United Kingdom: Emerald Group Publishing Limited.

Di Falco, S., and M. Veronesi. 2013. "How Can African Agriculture Adapt to Climate Change? A Counterfactual Analysis from Ethiopia." *Land Economics* **89**(4): 743–766.

Di Falco, S., M. Veronesi, and M. Yesuf. 2011. "Does Adaptation to Climate Change Provide Food Security? A Micro-perspective from Ethiopia." *American Journal of Agricultural Economics* **93**(3):829–846.

ERS/USDA. 2023. Ag and Food Stattistics: Charting the Essentials–Farming and Farm Income. Economic Research Service, US Department of Agriculture. (Accessed via web, April 18 2023). https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/farming-and-farm-income/

Farm Bureau Tennessee. Tennessee Farm Facts [Fact Sheet]. Farm Bureau Tennessee. Retrieved from Tennessee Farm Facts | Tennessee Farm Bureau (tnfarmbureau.org)

Fernandez-Cornejo, J., R. Nehring, and K. Erickson. 2007. "Off-farm Work and Economic Performance of Crop and Livestock Farms." *American Agricultural Economics Association Annual Meeting*.

Figge, F. 2004. "Bio-folio: Applying Portfolio Theory to Biodiversity." *Biodiversity & Conservation* **13**(4): 827–849.

Gliessman, S.R. 2006. "Chapter 19: Animals in Agroecosystems," in *Agroecology: The Ecology of Sustainable Food Systems*, Second Edition, 269–285. Boca Raton, FL: CRC Press, Taylor & Francis Group.

Gloy, B.A., J. Hyde, and E.L. LaDue. 2002. "Dairy Farm Management and Long-term Farm Financial Performance." *Agricultural and Resource Economics Review* **31**(1203-2016–95074): 233–247.

Hazell, P., C. Poulton, S. Wiggins, and A. Dorward. 2010. "The Future of Small Farms: Trajectories and Policy Priorities." *World Development* **38**(10): 1349–1361.

Hendrickson, J.R., J.D. Hanson, D.L. Tanaka, and G. Sassenrath. 2008. "Principles of Integrated Agricultural Systems: Introduction to Processes and Definition." *Renewable Agriculture and Food Systems* **23**(4): 265–271.

Hjalager, A.-M., G. Kwiatkowski, and M.Ø. Larsen. 2018. "Innovation Gaps in Scandinavian Rural Tourism." *Scandinavian Journal of Hospitality and Tourism* **18**(1): 1–17.

Hoppe, R.A., J.M. MacDonald, and P. Korb. 2010. *Small Farms in the United States: Persistence Under Pressure*. Economic Information Bulletin Number 63 (EIB-63), Economic Research Service, US Department of Agriculture, Washington DC, USA.

Hung, W.T., H.Y. Ding, and S.T. Lin. 2016. "Determinants of Performance for Agritourism Farms: An Alternative Approach." *Current Issues in Tourism* **19**(13): 1281–1287.

Husna, A., and I. Satria. 2019. "Effects of Return on Asset, Debt to Asset Ratio, Current Ratio, Firm Size, and Dividend Payout Ratio on Firm Value." *International Journal of Economics and Financial Issues* **9**(5): 50.

Jamshidi, O., S.M.J. Sobhani, S.D. Hajimirrahimi, and A. Nourozi. 2017. "On the Effects of Tourism Development on Rural Areas (A Case Study of Giayn District, Nahvand County)." *International Journal of Agricultural Management and Development (IJAMAD)* **8**(1047-2019–3436): 287–297.

Joo, H., A.R. Khanal, and A.K. Mishra. 2013. "Farmers' Participation in Agritourism: Does It Affect the Bottom Line?" *Agricultural and Resource Economics Review* **42**(1203-2016–95511): 471–490.

Kassie, M., P. Marenya, Y. Tessema, M. Jaleta, D. Zeng, O. Erenstein, and **Rahut**. 2018. "Measuring Farm and Market Level Economic Impacts of Improved Maize Production Technologies in Ethiopia: Evidence From Panel Data." *Journal of Agricultural Economics* **69**(1): 76–95.

Kassie, M., H. Teklewold, P. Marenya, M. Jaleta, and O. Erenstein. 2015. "Production Risks and Food Security Under Alternative Technology Choices in Malawi: Application of a Multinomial Endogenous Switching Regression." *Journal of Agricultural Economics* **66**(3): 640–659.

Khanal, A.R., U. Honey, and O. Omobitan. 2020. "Diversification Through 'Fun in the Farm': Analyzing Structural Factors Affecting Agritourism in Tennessee." *International Food and Agribusiness Management Review* **23**(1030-2020–240): 105–120.

Khanal, A.R., A. K. Mishra, and O. Omobitan. 2019. "Examining Organic, Agritourism, and Agri-environmental Diversification Decisions of American Farms: Are these Decisions Interlinked?" *Review of Agricultural, Food and Environmental Studies* **100**(1): 27–45.

Khanal, A.R., and A.K. Mishra. 2014. "Agritourism and Off-farm Work: Survival Strategies for Small Farms." *Agricultural Economics* **45**(S1): 65–76.

Khanal, A.R., A.K. Mishra, J. Mayorga, and S. Hirsch 2020. "Choice of Contract Farming Strategies, Productivity, and Profits: Evidence from High-Value Crop Production." *Journal of Agricultural and Resource Economics* **45**(3): 589–604.

Libbin, J.D., J.D. Kohler, and J.M. Hawkes. 2004. "Does Modern Portfolio Theory Apply to Agricultural Land Ownership? Concepts for Farmers and Farm Managers." *Journal of American Society of Farm Managers and Rural Appraisers* 85–96.

Lokshin, M., and Z. Sajaia. 2004. "Maximum Likelihood Estimation of Endogenous Switching Regression Models." *The Stata Journal* **4**(3): 282–289.

Manda, J., C. Azzarri, S. Feleke, B. Kotu, L. Claessens, and M. Bekunda. 2021. "Welfare Impacts of Smallholder Farmers' Participation in Multiple Output Markets: Empirical Evidence from Tanzania." *PloS one* **16**(5): e0250848.

Markowitz, H. 1959. *Portfolio selection*. Yale University Press: New Haven.

McElwee, G., and G. Bosworth. 2010. "Exploring the Strategic Skills of Farmers Across Typology of Farm Diversification Approaches." *Journal of Farm Management* **13**(12): 819–838.

McFadden, D. 1973. "Conditional Logit Analysis of Qualitative Choice Behavior," in *Frontiers in Econometrics*, ed. by P. Zarembka. New York: Academic Press.

McFadden, D. 1986. "The Choice Theory Approach to Market Research." *Marketing Science* **5**(4): 275–297.

McGehee, N.G., and K. Kim. 2004. "Motivation for Agri-tourism Entrepreneurship." *Journal of Travel Research* **43**(2): 161–170.

McGehee, N.G., K. Kim, and G.R. Jennings. 2007. "Gender and Motivation for Agri-tourism Entrepreneurship." *Tourism Management* **28**(1): 280–289.

McNamara, K.T., and C.R. Weiss. 2005. "Farm Household Income and On-and-Off Farm Diversification." *Journal of Agricultural and Applied Economics* **37**(1): 37–48.

Meraner, M., B. Pölling, and R. Finger. 2018. "Diversification in Peri-Urban Agriculture: A Case Study in the Ruhr Metropolitan Region." *Journal of Land Use Science* **13**(3): 284–300

Michels, M., W. Fecke, J.H. Feil, O. Musshoff, J. Pigisch, and S. Krone. 2020. Smartphone Adoption and Use in Agriculture: Empirical Evidence from Germany. *Precision Agriculture* **21**(2): 403–425.

Midingoyi, S.G., M. Kassie, B. Muriithi, G. Diiro, and S. Ekesi. 2019. "Do Farmers and the Environment Benefit From Adopting Integrated Pest Management Practices? Evidence from Kenya." *Journal of Agricultural Economics* **70**(2): 452–470.

Mishra, A.K, and H.S. El-Osta. 2002. "Risk in Agriculture Through Hedging and Crop Insurance: What does a National Survey Reveal?" *Agricultural Finance Review,* **Fall**: 135–148.

Mishra, A.K., H.S. El-Osta, and C.L. Sandre. 2004. "Factors Affecting Farm Enterprise Diversification." *Agricultural Finance Review* **64**(2): 151–166.

Mitchell, M., and G. Turner. 2010. "Agri-tainment: A New Crop for Farmers." *Journal of Food Products Marketing* **16**(4): 373–385.

Nilsson, P.Å. 2002. "Staying on Farms: An Ideological Background." *Annals of Tourism Research* **29**(1): 7–24.

Palkechova, L., and J. Kozakova. 2015. "The Economy of Agritourism Establishments in Selected Agricultural Entities in the Slovak Republic." *Ekonomika Pol'nohospodárstva* **3**: 69–85.

Pennington, J.A.T., and R.A. Fisher. 2009. "Classification of Fruits and Vegetables." *Journal of Food Composition and Analysis* **22**: S23–S31.

Pope, R.D., and R. Prescott. 1980. "Diversification in Relation to Farm Size and Other Socioeconomic Characteristics." *American Journal of Agricultural Economics* **62**(3): 554–559.

Quandt, A., J.D. Salerno, J.C. Neff, T.D. Baird, J.E. Herrick, J.T. McCabe, E. Xu, and J. Hartter 2020. "Mobile Phone Use is Associated with Higher Smallholder Agricultural Productivity in Tanzania, East Africa." *PloS one* **15**(8): e0237337.

Russelle, M.P., M.H. Entz, and A.J. Franzluebbers. 2007. "Reconsidering Integrated Crop–Livestock Systems in North America." *Agronomy Journal* **99**(2): 325–334.

Ryschawy, J., N. Choisis, J.P. Choisis, A. Joannon, and A. Gibon. 2012. "Mixed Crop-Livestock Systems: An Economic and Environmental-Friendly Way of Farming?" *Animal* **6**(10): 1722–1730.

Schilling, B. J., L.J. Marxen, H.H. Heinrich, and F.J.A. Brooks. 2006. "*The Opportunity for Agritourism Development in New Jersey*."

Schilling, B.J., K.P. Sullivan, and S.J. Komar. 2012. "Examining the Economic Benefits of Agritourism: The Case of New Jersey." *Journal of Agriculture, Food Systems, and Community Development* **3**(1): 199–214.

Sharpley, R. 2002. "Rural Tourism and the Challenge of Tourism Diversification: The Case of Cyprus." *Tourism Management* **23**(3): 233–244.

Sharpley, R., and A. Vass. 2006. "Tourism, Farming and Diversification: An Attitudinal Study." *Tourism Management* **27**(5): 1040–1052.

Tchetchik, A., A. Fleischer, and I. Finkelshtain. 2006. *Rural tourism: Development, public intervention and lessons from the Israeli experience*.

Teklewold, H., M. Kassie, and B. Shiferaw. 2013. "Adoption of Multiple Sustainable Agricultural Practices in Rural Ethiopia." *Journal of Agricultural Economics* **64**(3): 597–623.

Tew, C., and C. Barbieri. 2012. "The Perceived Benefits of Agritourism: The Provider's Perspective." *Tourism Management* **33**(1): 215–224.

Turner, M., M. Winter, D. Barr, A. Errington, M. Fogerty, M. Lobley, M. Reed, and I. Whitehead. 2003. *Farm Diversification Activities: Benchmarking Study 2002, Report to DEFRA*. Centre for Rural Policy Research, University of Exeter, Devon, England.

United States Department of Agriculture: Economic Research Service. 2019. *Most Farms are Small, But Most Production is on Large Farms*. USDA: E.R.S. Available at USDA ERS - Farming and Farm Income.

Veeck, G., D. Che, and A. Veeck. 2006. "America's Changing Farmscape: A Study of Agricultural Tourism in Michigan." *The Professional Geographer* **58**(3): 235–248.

Ventura, F., and P. Milone. 2000. "Theory and Practice of Multi-Product Farms: Farm Butcheries in Umbria." *Sociologia Ruralis* **40**(4): 452–465.

Viglia, G., and G. Abrate. 2017. "When Distinction Does Not Pay Off-Investigating The Determinants of European Agritourism Prices." *Journal of Business Research* **80**: 45–52.

Wilkins, R.J. 2008. "Eco-Efficient Approaches to Land Management: A Case for Increased Integration of Crop and Animal Production Systems." *Philosophical Transactions of the Royal Society B: Biological Sciences* **363**(1491): 517–525.

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