

OPEN ACCESS



International Food and Agribusiness Management Review
2026; DOI: 10.22434/IFAMR.1152

Received: 24 May 2024 / Accepted: 21 December 2025

Market engagement among US elderberry growers: unpacking influences on market participation and product diversification

RESEARCH ARTICLE

Dikshya Khatiwada^a, Theodoros Skevas^b and Andrew L. Thomas^c

^a*PhD Student, Department of Agricultural and Resource Economics, Colorado State University, Fort Collins, CO, USA*

^b*Associate Professor Division of Applied Social Sciences, University of Missouri, Columbia, MO, USA*

^c*Associate Research Professor, Division of Plant Science and Technology, Southwest Research, Extension, and Education Center, University of Missouri, Mount Vernon, MO, USA*

Abstract

This study examines the marketing practices and attitudes of a sample of US elderberry (*Sambucus* spp.) producers and explores the factors influencing market participation and product diversification. Using data from an online survey, a factor analysis and a double-hurdle econometric model were applied. Factor analysis condensed interrelated attitudinal variables about growers' opinions on challenges in elderberry production into a smaller set of factors to better understand constraints faced by farmers. These factors along with farmers' socioeconomic characteristics were used as determinants in the hurdle model to analyze market engagement and diversification decisions. Results indicate that 40% of the surveyed farmers did not market their elderberries, while the 60% who did primarily sold berries, followed by propagules and other products. On-farm sales were the primary market outlet for two-thirds of marketers. Major challenges included government regulations limiting medicinal promotion, a shortage of specialized equipment for mechanical harvesting, pests and diseases, and limited market access. Larger, more experienced farmers in the Southeast and Northeast were more likely to market elderberries, while regulatory and market concerns reduced participation. Product diversification was more prevalent among experienced, higher income farmers, and those engaged in farmers' markets.

Keywords: double hurdle model, elderberries, market participation decision, marketing breadth, product diversification, *Sambucus*

JEL-code: Q13

^①Corresponding author: dikshya.khatiwada@colostate.edu; dikshyakhatiwada1107@gmail.com

1. Introduction

The American elderberry (*Sambucus nigra* subsp. *canadensis*) is a deciduous fruit-bearing shrub native to eastern and midwestern North America. While its European counterpart (*Sambucus nigra* subsp. *nigra*) has a long history of commercial cultivation in Europe, the American elderberry has historically been less recognized in public and agricultural spheres in the United States (US) (Charlebois *et al.*, 2010). Its commercial production remains relatively small compared to European elderberry (Thomas *et al.*, 2020), but interest in cultivating and marketing American elderberry has grown in recent years. Over the past two decades, elderberries have transitioned into a commercial crop in the US. Historically, Oregon was a major producer of both European and American elderberries (Finn *et al.*, 2008), although production there has since declined. Today, Missouri leads US production, with approximately 607 acres dedicated to elderberry (USDA National Agricultural Statistics Service, 2022).

Recently, elderberry has gained popularity in the US, driven by its perceived health benefits and the growing availability of high-quality processed products (Cai *et al.*, 2024). Studies have highlighted its nutritional value and health-related properties, including antibacterial, antiviral, antidepressant, and antitumor effects (American Botanical Council, 2004; Charlebois, 2007; Lovell *et al.*, 2023; Młynarczyk *et al.*, 2018; Thomas *et al.*, 2020). This increased interest has led to a surge in demand for elderberry supplements, particularly during the COVID-19 pandemic (Ahl, 2023; NatMed, 2021). Industry projections suggest that the elderberry market will grow to USD 267.89 million by 2027, with an anticipated compound annual growth rate of 6.72% (Technavio, 2023). Despite this growth, the US remains a net importer of elderberries (Volza Grow Global, 2023), presenting significant opportunities for domestic production and marketing.

Despite this evident market potential, little research has focused on US farmers' marketing attitudes and strategies for elderberries (Mohebalian *et al.*, 2012). Previous work has examined market barriers, such as economies of scale, high startup costs, and steep learning curves (Cernusca and Gold, 2013). Additional challenges include limited access to technical and market information, financial constraints, existing biases, and low awareness of elderberry and its benefits. This study builds on this foundation by exploring US elderberry producers' marketing practices and attitudes, as well as analyzing the key drivers and barriers to market participation, and product diversification. Studying both aspects provides a comprehensive view of how farmers engage in the market capturing both the decision to participate and the strategies they employ to diversify their product offerings. Product diversification is particularly critical in specialty crop markets, where it can serve as a strategy for managing risks, reaching diverse consumer segments, and enhancing revenue streams (De Roest *et al.*, 2018).

The results of this study provide insights into key factors influencing market participation and marketing breadth among elderberry producers. Understanding these dynamics is essential for realizing the market potential of elderberries, increasing domestic production, and reducing dependence on imports. Moreover, this study contributes to the broader literature on specialty crop marketing by focusing on elderberries, a crop with emerging significance in the US agricultural landscape. It highlights the interplay of market dynamics, producer characteristics, and institutional barriers, offering a foundation for future research on specialty crops with similar market conditions.

The remainder of this study is structured as follows. Section 2 reviews the literature on farmers' market participation, product diversification, and their determinants, while Section 3 presents the data used along with the empirical methodological approach. Section 4 reports and discusses the results, and Section 5 concludes the paper.

2. Literature review

2.1 Understanding agricultural market participation and product diversification: a theoretical perspective

Engaging in agricultural markets entails farmers selling their produce to gain monetary returns (Dlamini and Huang, 2019). This aligns with the concept of commercialization, making the transition from subsistence farming to a more market-oriented approach (Omiti *et al.*, 2009). Often, small-scale farmers adopt a “produce first, find the market later” philosophy, prioritizing production over pre-analysis of market needs and contractual arrangements with buyers (Blandon *et al.*, 2009). Market-oriented production requires modernized systems, intensive production processes, and farm mechanization (Omiti *et al.*, 2009).

The theoretical frameworks addressing agricultural market participation have extensively examined barriers such as transaction costs, which can deter farmers from engaging in markets. These costs, categorized as fixed or variable (Key *et al.*, 2000), significantly influence both participation decisions and the intensity of engagement. Fixed costs, such as obtaining market information or negotiating contracts, impact the decision to enter markets, while variable costs directly affect the quantity of goods traded (Holloway *et al.*, 2000). Addressing these barriers requires fostering technological progress and investing in private and public resources to improve market access and reduce costs (Barrett, 2008).

Market participation is closely linked to strategies for product diversification, which entails adding new products to existing offerings, either through related or unrelated diversification (Nouteya-Jackson, 2022). In related diversification, synergies between existing and new products often enable better alignment with market demands, improving overall performance (Arte and Larimo, 2022; Nouteya-Jackson, 2022). This strategy helps farmers manage risks by broadening their product range, catering to niche markets, and reducing reliance on single crops or markets (Hamlin *et al.*, 2016; De Roest *et al.*, 2018; Nouteya-Jackson, 2022). Studies show that diversification allows farmers to reduce their reliance on a single crop or livestock product, thus mitigating risks from price volatility and climate uncertainties (Arte and Larimo, 2022; Barbieri and Mahoney, 2009; Bradshaw, 2004; De Roest *et al.*, 2018; Kurdyś-Kujawska *et al.*, 2021). Research in agricultural economics has shown that farmers engaging in product diversification can achieve greater financial stability and access high-value markets with higher profit margins (Lancaster and Torres, 2019; Torres *et al.*, 2021). For elderberry farmers in this study, as detailed in subsequent sections, diversification typically aligns with a related strategy, leveraging existing expertise and market connections to broaden product offerings.

2.2 Determinants of market participation and product diversification

Shifting from theoretical foundations to empirical analysis, researchers globally have extensively explored the determinants of market participation. In the US crop marketing context, studies have predominantly centered on factors influencing marketing strategies (e.g. marketing contracts) and outlets, such as direct-to-consumer or intermediary channels (Detre *et al.* 2011; Dong *et al.* 2019; Hoque *et al.*, 2015; Katchova *et al.* 2004; Kim, 2016; Low and Vogel, 2011; Plakias *et al.* 2020). However, relatively few have concentrated on specialty crop marketing (Monson *et al.*, 2008; Popp *et al.*, 2023). Some research in this area has explored opportunities and challenges related to introducing specialty crops, including marketing barriers faced by farmers (Kim, 2016; Stafne *et al.*, 2023).

By contrast, studies analyzing market participation are more common in African agriculture (Adenegan *et al.*, 2012; Belayneh *et al.*, 2019; Burke *et al.*, 2015; Dlamini and Huang, 2019; Haile *et al.*, 2022; Hlatshwayo *et al.*, 2021; Makhura *et al.*, 2001; Mignouna *et al.*, 2015; Mpombo *et al.*, 2022; Musah *et al.*, 2014; Olwande *et al.*, 2001; Omiti *et al.*, 2009; Ouma *et al.*, 2010; Sigei *et al.*, 2014). These studies highlight that socioeconomic characteristics such as education, farm size, farming experience, gender, household income, age, and farm location, and market-related factors are critical determinants of market participation decisions.

Education has shown mixed effects on market participation, with some studies suggesting a positive influence (Dalmini and Huang, 2019; Paul *et al.*, 2021) and others showing a negative association (Haile *et al.*, 2022; Ouma *et al.*, 2010; Hlatshwayo *et al.*, 2021). Farm size, on the other hand, consistently shows a positive relationship (Adanacioglu, 2017; Haile *et al.*, 2022; Hoque *et al.*, 2015; Musah *et al.*, 2014; Osmani and Hossain, 2015). Gender and household income also play significant roles, with male-headed households and higher-income farmers more likely to participate in markets (Haile *et al.*, 2022; Hlatshwayo *et al.*, 2021; Musah *et al.*, 2014; Ouma *et al.*, 2010). However, the effects of age and farming experience are mixed, with both positive and negative findings reported across studies (Adenegan *et al.*, 2012; Belayneh *et al.*, 2019; Haile *et al.*, 2022; Hlatshwayo *et al.*, 2021; Hoque *et al.*, 2015; Paul *et al.*, 2021). Finally, farm location has been identified as a factor influencing market engagement, with Ouma *et al.* (2010) showcasing it as an important determinant of market participation. Market-related factors, such as marketing outlets and access to transportation and information, also significantly influence participation levels (Dalmini and Huang, 2019; Low and Vogel, 2011).

Product diversification is closely tied to market participation. Studies categorize the drivers of diversification into external and internal variables. External variables include factors beyond the farmer's control, such as market and information access through extension services and networking (Anosike and Coughenour, 1990; Torres *et al.*, 2021). Internal variables, on the other hand, pertain to farm characteristics, farmer's demographics, and perceptions (Torres *et al.*, 2021; Lancaster and Torres, 2019).

Market access itself has been identified as a key driver of diversification among specialty crop farmers. Torres *et al.* (2019) found that the number of markets accessed, and the use of value-added technologies significantly influenced diversification strategies. Transforming specialty crops into value-added products like jams, sauces, or dried goods enables farmers to access additional markets, generate off-season income, and secure price premiums (Izaba, 2021; Torres *et al.*, 2019). Socioeconomic factors, including age, farming experience, gender and education, also shape diversification strategies (Ibrahim *et al.*, 2009; Mishra *et al.*, 2004). For example, women are often more likely to adopt innovative practices (Seuneke and Bock, 2015; Torres *et al.*, 2021), while education enhances the adoption of value-added practices (Mishra *et al.*, 2009). Farm location plays a crucial role, as areas with better market access support the adoption of value-added technologies or products (Dimitri and Oberholtzer, 2009; Torres and Marshall, 2018).

Farm size and income also play significant roles in diversification. Larger, higher income farms benefit from economies of scale, enabling them to diversify into high-value niche markets (De Roest *et al.*, 2018; Lancaster and Torres, 2019). By contrast, medium-sized farms often face challenges accessing both wholesale and direct-to-consumer markets (Kirschenmann *et al.*, 2008; Stevenson *et al.*, 2014). For these farms, diversification becomes a critical strategy for capturing different market segments, managing risk and maintaining profitability. Direct-to-consumer sales also promote diversification, as they allow farmers to leverage customer relationships and direct feedback to tailor and differentiate their offerings (Lancaster and Torres, 2019).

Despite extensive research on market participation and product diversification no studies have specifically addressed the determinants of market participation and product diversification among elderberry farmers. This is a critical gap, given the unique opportunities and challenges elderberry farming presents, including its potential for value-added products and access to niche markets.

3. Data and empirical methods

3.1 Farmer sampling and survey method

The data for this research were collected through an online survey conducted in 2023, targeting elderberry farmers across the US. To ensure ethical standards were met, the survey instrument was reviewed and approved

by the University of Missouri Institutional Review Board (IRB), with approval number 2095266. The IRB approval process ensured that the study met all the requirements for informed consent, confidentiality, and voluntary participation.

The survey was hosted on Qualtrics (Provo, UT, USA), a widely used online survey platform, and distributed via a single anonymous link. No personally identifiable information was collected, ensuring respondent anonymity. Participation was entirely voluntary, and respondents who completed the survey were entered into a raffle for a chance to win one of ten \$100 Amazon gift cards. To maintain anonymity, participants wishing to be entered into the raffle were asked to provide their email addresses through a separate link, ensuring that their contact information was not linked to their survey responses.

Due to the lack of comprehensive lists of US elderberry farmers, probability sampling was not feasible. As such, a multi-faceted outreach strategy was employed to engage participants. The survey link was distributed via several channels, including email invitations sent to a limited number of farmers whose contact information was obtained from the Midwest Elderberry Cooperative and other networks, posting survey invitation in social media groups dedicated to elderberry growers, and engaging extension educators to share the survey with their contacts. Additionally, participants were encouraged to share the survey with other elderberry farmers they knew, a method known as snowball sampling.

To mitigate the risk of fraudulent or duplicate responses, several security measures were implemented. These included using Qualtrics's built-in tools for bot detection and duplicate response prevention. The platform's features such as reCAPTCHA and the RelevantID tool, helped detect and filter out responses likely generated by bots or submitted multiple times by the same individual. Additionally, measures were taken to prevent email scanning software from inadvertently opening the survey link, and search engines were blocked from indexing the survey to avoid unintended exposure.

The survey was active from January to March 2023 and was designed to capture responses exclusively from individuals who had grown elderberries in 2022. To ensure eligibility, the first question of the survey asked respondents whether they had grown elderberries in 2022. Only those who answered "yes" were allowed to proceed with the survey, while individuals who answered "no" were automatically exited from the survey. This approach ensured that only eligible respondents, specifically those with experience in elderberry production and marketing, completed the survey. Qualtrics was set to mark as "complete" responses that did not meet the eligibility criterion, as well as those submitted fully or partially after the survey end date. A total of 119 complete responses were received, but 36 were deemed unusable due to partial completion or non-compliance with the eligibility criterion, resulting in 83 valid responses for analysis.

3.2 Survey design

The questionnaire used to investigate elderberry marketing practices and market participation was part of a comprehensive survey instrument that also examined elderberry farmers' production and management practices. The survey instrument was pretested with two horticulture specialists from the University of Missouri, each with 25 years of experience in elderberry research and production, as well as an agroforestry specialist from the same university and one from the University of Minnesota, all of whom are involved in a collaborative elderberry grant. Their feedback was instrumental in refining the survey, ensuring that it accurately addressed the research objectives. Following this, the questionnaire was pretested with three elderberry farmers to ensure clarity and relevance. Based on feedback from both the experts and the farmers, several revisions were made to improve the questionnaire's clarity and ensure its relevance to the study.

For the purposes of this paper, we focus exclusively on the components relevant to our research objectives, namely: (a) elderberry marketing practices, (b) opinions on challenges for investing in elderberry production, and (c) socioeconomic characteristics.

The section on elderberry marketing strategies first asked respondents whether they marketed elderberry products in 2022. If they did, the survey then sought details on the specific products marketed and the marketing outlets utilized. The survey also gathered opinions on challenges related to investing in elderberry production. This was done through a series of 13 statements, where respondents rated the extent to which each challenge affected their operations on a scale from 1 (very low) to 5 (very high). To ensure the relevance and accuracy of the challenges, a thorough review of the relevant literature on elderberry production and marketing, as well as on other specialty crops, was conducted. This review helped identify common challenges faced by elderberry producers and growers of similar crops. These challenges were then formulated into statements, which were further refined based on feedback from both the experts and the pretested farmers. This process ensured that the statements accurately reflected the key challenges faced by respondents, allowing them to rate each challenge according to its perceived impact.

The questionnaire also gathered data on respondents' socioeconomic characteristics including education, age, gender, cooperative membership, household income, elderberry acreage, years of experience in elderberry cultivation, farm location, and availability of successor.

Table 1 highlights key socioeconomic features of the sample. The largest age group consists of farmers aged between 45 and 64 years, making up 40% of the respondents. Male farmers represent 58% of the sample. Regarding education, 53% of respondents have a college degree, while 40% hold graduate degrees. In terms of income, 36% of respondents report annual household earnings between \$50 000 and \$99 999. Additionally, 36% of the surveyed farmers are members of cooperatives. On average, the area dedicated to elderberry cultivation is 3.1 acres, with respondents having an average of about 4 years of experience in elderberry farming. Geographically, most respondents (58%) are located in the Midwest region. Finally, 46% of the surveyed farmers have a designated heir to take over their farm.

3.3 Empirical methods

Our empirical analysis comprises three main components. Initially, descriptive statistics and graphical illustrations are used to evaluate the marketing practices of elderberry producers in our sample. Subsequently, factor analysis is utilized to distil key producer perceptions regarding the challenges in investing in elderberry production. Finally, a double hurdle model is employed to explore the factors influencing elderberry producers' market participation decisions and their product diversification. In the following sections, more details are provided regarding the use of factor analysis and the double-hurdle model.

Factor analysis

Factor analysis is used in economics to derive a set of uncorrelated variables, particularly when highly intercorrelated variables may lead to misleading results in regression analysis. It serves as a data reduction tool that examines whether a set of variables is related to a smaller number of hypothetical variables (Kim and Mueller, 1978). In this study, it served as an initial step to condense a group of interrelated attitudinal variables (originally 13 statements about growers' opinion on challenges in investing in elderberry production measured in a five-point Likert scale) into a smaller number of factors. Additionally, it aimed to detect structure in the relationships among these attitudinal variables. By uncovering structural relationships, factor analysis contributes to a better understanding of the constraints faced by the sampled elderberry producers.

The process of factor analysis involves three key steps: (1) extracting factors from a correlation matrix, typically through principal factor analysis, (2) rotating factors, and (3) interpreting factors. For each factor, eigenvalues and factor loadings are computed. Eigenvalues represent the variance captured by a factor, while factor loadings signify the correlation between a variable and a factor. Following Skevas and Kalaitzandonakes (2020) and Hakelius and Hansson (2016), two criteria were utilized to determine a factor solution: ensuring minimum factor eigenvalues of 1.0 and excluding items with factor loadings below 0.60. After identifying and elucidating the factors, Cronbach's alpha statistics were employed to verify their internal consistency.

Table 1. Descriptive statistics of socioeconomic characteristics of sampled elderberry farmers ($n=83$).

Variable name	Definition	Units	Mean	SD
Age	Age of respondent			
<45 (base)		(0/1)	0.34	0.48
45–64		(0/1)	0.40	0.49
≥65		(0/1)	0.27	0.44
Household income	Annual household income			
<\$50 000 (base)		(0/1)	0.17	0.38
\$50 000–\$99 999		(0/1)	0.36	0.48
\$100 000–\$149 999		(0/1)	0.25	0.44
≥\$150 000		(0/1)	0.22	0.41
Gender (base: Female)	Male gender	(0/1)	0.58	0.50
Education	Highest level of education			
Highschool (base)		(0/1)	0.07	0.26
College		(0/1)	0.53	0.50
Graduate		(0/1)	0.40	0.49
Elderberry acreage	Area planted with elderberries	acres	3.10	7.80
Experience	Years of experience producing elderberries	years	4.07	4.02
Location	Region of the respondent’s farm			
Midwest (base)		(0/1)	0.58	0.50
West		(0/1)	0.13	0.34
Southeast		(0/1)	0.14	0.35
Northeast		(0/1)	0.14	0.35
Successor	Has a successor/heir for the farm	(0/1)	0.46	0.50
Cooperative	Member of a cooperative	(0/1)	0.36	0.48

Model estimation for market participation and product diversification

Following other studies that sought to analyze farmers’ market participation decision (Dlamini and Huang, 2019; Hlatshwayo *et. al*, 2021; Olwande and Mathenge, 2011), a modelling approach based on a two-step decision process is used. The first step involves determining whether to participate in the market. The second step, applicable only if the decision to participate is affirmative, entails deciding the number of products to market, which serves as a measure of product diversification. This two-step procedure is modeled using a double hurdle econometric model (Cragg, 1971). This model involves the joint estimation of two equations. Firstly, a binary probability model, functioning as the first hurdle, is utilized to capture the market participation decision. If the initial hurdle is cleared, a truncated count distribution model to capture the degree of product diversification (second hurdle) is estimated. In this study, the binary probability model takes the form of a probit model, while the truncated count distribution model is represented by a zero-truncated count model.

The first hurdle of the double-hurdle model is written as follows:

$$y_i^* = x_i' \alpha + \varepsilon_i \tag{1}$$

$$y_i = 1 \text{ if } y_i^* > 0 \text{ and } 0 \text{ if } y_i^* \leq 0$$

The second hurdle is formulated as follows:

$$s_i^* = z_i' \beta + u_i \tag{2}$$

$$s_i = s_i^* \text{ if } s_i^* > 0 \text{ and } y_i^* > 0$$

$$s_i = 0 \text{ Otherwise}$$

y_i^* is a latent variable that describes elderberry farmers' decision to participate in a market, y_i is the observed market participation decision and takes the value of unity if the respondent markets at least one elderberry product; s_i^* is a latent variable related to product diversification and s_i is the observed product diversification quantified as the number of marketed products; x and z are vectors of explanatory variables for market participation decision and product diversification respectively; α and β are vectors of parameter to be estimated; finally, ε_i and u_i are error terms which are assumed to be normally distributed with zero means and constant variances. Since the parameters α and β lack a direct interpretation, it is common to calculate the marginal effects at the mean of each variable (Greene, 2008; Skevas *et al.*, 2022).

If the error terms in the above two equations are assumed to be uncorrelated (given all covariates), then the standard errors obtained from individual estimations are valid for statistical inference. However, if this assumption is violated, then the coefficient estimates derived from the two separate regressions above may be biased. The testing process for conditionally uncorrelated errors follows the same methodology employed in the Heckman test for selection bias (Heckman, 1979; Woodridge, 2010; as shown in Burke *et al.* (2015) and Skevas *et al.* (2022)). First, the first-stage probit model is estimated and an Inverse Mills Ratio (IMR) around the probability of market participation is predicted. Second, the second stage zero-truncated count model is estimated incorporating the predicted IMR as one of its regressors while assuming conditionally uncorrelated errors.

Although it is not technically necessary for identification, it is a standard practice to impose at least one justifiable exclusion restriction when estimating the second-stage regression. The null hypothesis tested by a standard t -statistic for the coefficient estimate on the IMR is that the first and second-stage errors are conditionally uncorrelated. If the estimate significantly differs from zero, then the null hypothesis is rejected and the model must be re-estimated to conduct valid inference.

The explanatory variables used in the first hurdle of the double hurdle model specification (denoted as x) included factors identified from the factor analysis and socioeconomic characteristics of producer such as age, gender, education level, annual income, cooperative membership, availability of successor, experience in producing elderberries, area under elderberry plantation, and farm location. In the second hurdle model, the marketing outlet (i.e., farmers' market) was added to the vector of explanatory variables. The selection of these variables was informed by past research on factors affecting farmers' market participation (e.g., Burke *et al.*, 2015; Dlamini and Huang, 2019; Haile *et al.*, 2022; Ouma *et al.*, 2010), as well as the specific interests of this study and model performance considerations.

4. Results and discussion

4.1 Elderberry marketing practices and challenges

Figure 1 provides an overview of the sampled farmers' decision to market elderberries. According to the figure, most survey respondents (60%) engaged in marketing elderberries in 2022. Figure 2 shows the types of elderberry products marketed by those farmers who engaged in the market. Berries were the most commonly marketed product, followed by propagules, and other products like juice, jam, and syrup. Figure 3 presents the marketing outlets used by farmers who marketed elderberries. Among these farmers, on-farm sales were the most popular outlet, with 64% of respondents using this channel. The 'Other' outlets category which includes online sales, retail stores, breweries, and other channels, followed as the second most common outlet, with 36% of farmers using these options. Farmers' markets were the third most common outlet, with 32% of farmers selling through them. Wineries and grower cooperatives were used by a smaller portion of

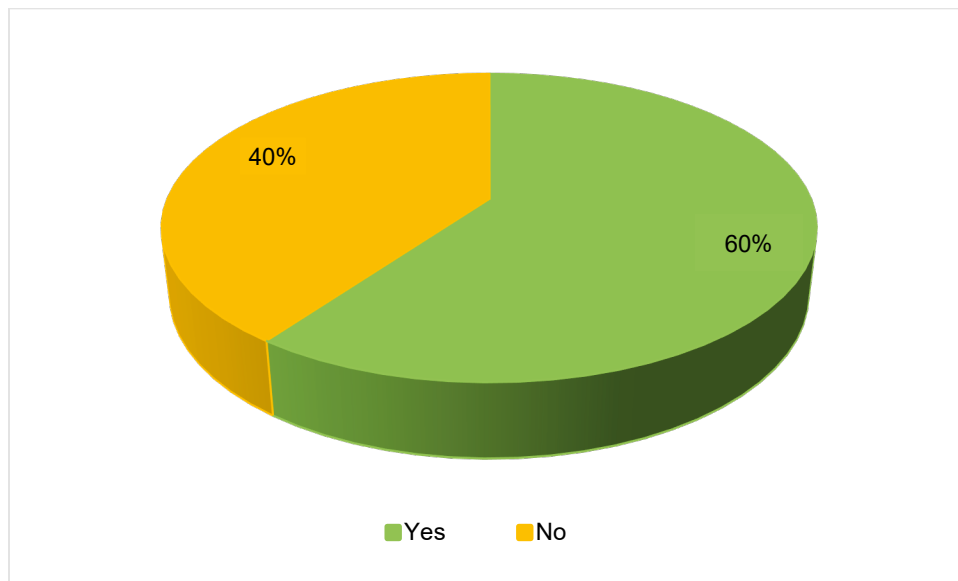


Figure 1. Sampled farmers’ decision to market elderberries, 83 respondents, USA, 2023.

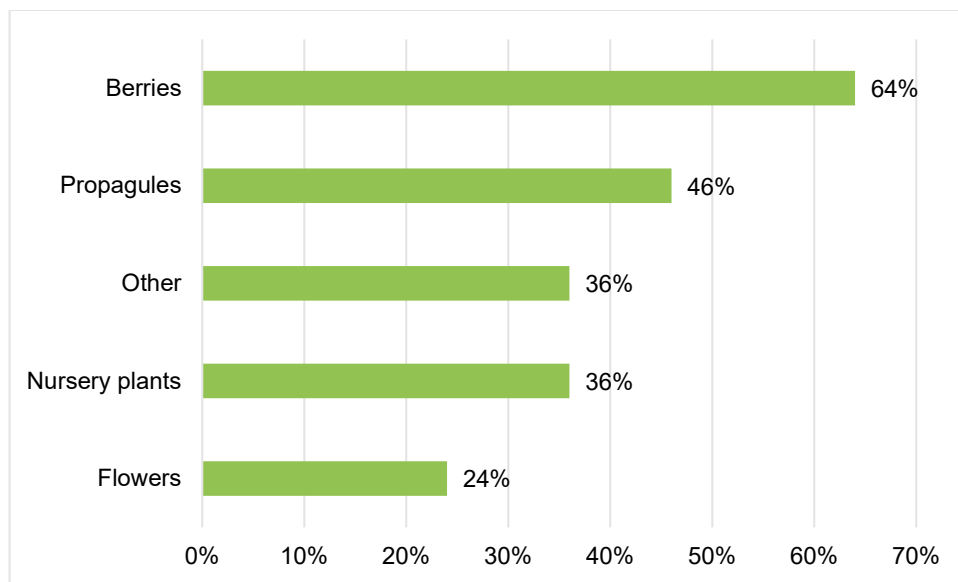


Figure 2. Elderberry products marketed by sampled farmers, 50 respondents, USA, 2023. Farmers could choose multiple products. The “Other” category includes juice, syrup/syrup kits, wine, jam, jelly, smoothies, mead, berry dyed wool, and pulp.

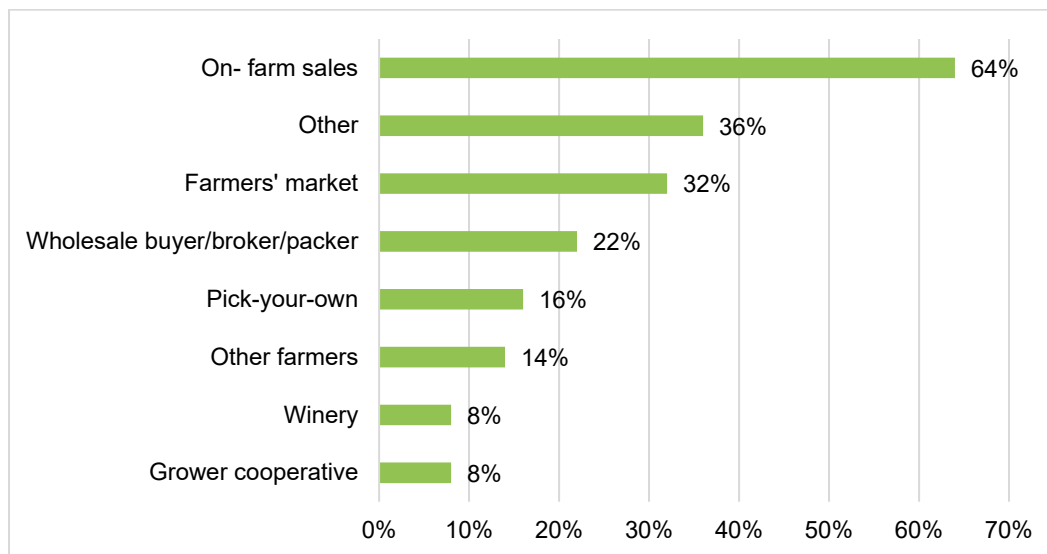


Figure 3. Marketing outlets for elderberry used by sampled farmers, 50 respondents, USA, 2023. Farmers could choose multiple marketing outlets, reflecting diverse strategies. The “Other” category includes online sales (Facebook marketplace/mail orders/Facebook groups/other websites), words of friends and family, retail stores, brewery, fiber festivals, special community events, local processors, herbal tea, Rowley’s red barn, and Craig’s list.

the respondents, with only 8% utilizing these outlets. Since farmers could select multiple marketing outlets, these percentages reflect overlapping choices rather than a single total. Figure 4 illustrates respondents’ perceptions regarding proposed challenges that may impact elderberry operations. The top four challenges rated as having a high or very high impact on elderberry operations were government regulations hindering the promotion of the medicinal value of elderberries (26%), the lack of dedicated equipment for mechanical harvesting (23%), pests and diseases (22%), and lack of market access (18%). This result aligns with the findings of Stanek *et al.* (2019), Kim (2016) and Stafne *et al.* (2023) which shows that potential challenges in establishing horticulture crops include policy and institutional barriers, lack of information on cultivation and marketing, lack of market access, high labor requirements, lack of mechanical harvesting equipment, and pests and diseases.

4.2 Factor analysis of attitudinal variables

Factor analysis was used to extract various overlapping statements into key factors that could individually impact market participation and product diversification. The results show three factors underlying the challenges associated with investing in elderberry production, collectively accounting for 64.85% of the common variance. Factor one contributed 26.38%, factor two 22.20%, and factor three 16.27%, indicating that each factor serves as a crucial indicator of farmers’ opinions on the challenges of investing in elderberry production.

Table 2 presents the factor loadings after oblique oblimin rotation. The first factor exhibits high loadings on statements related to federal regulations restricting elderberry marketing practices, stringent buyers’ requirements, the absence of crop insurance options, and consumer preference for grape over elderberry for winemaking. The second factor is characterized by high loadings on statements emphasizing the need for growers’ support, cooperation with fellow producers, and more technical information on growing elderberries. The third factor showcases high loadings on statements pertaining to pest and disease issues.

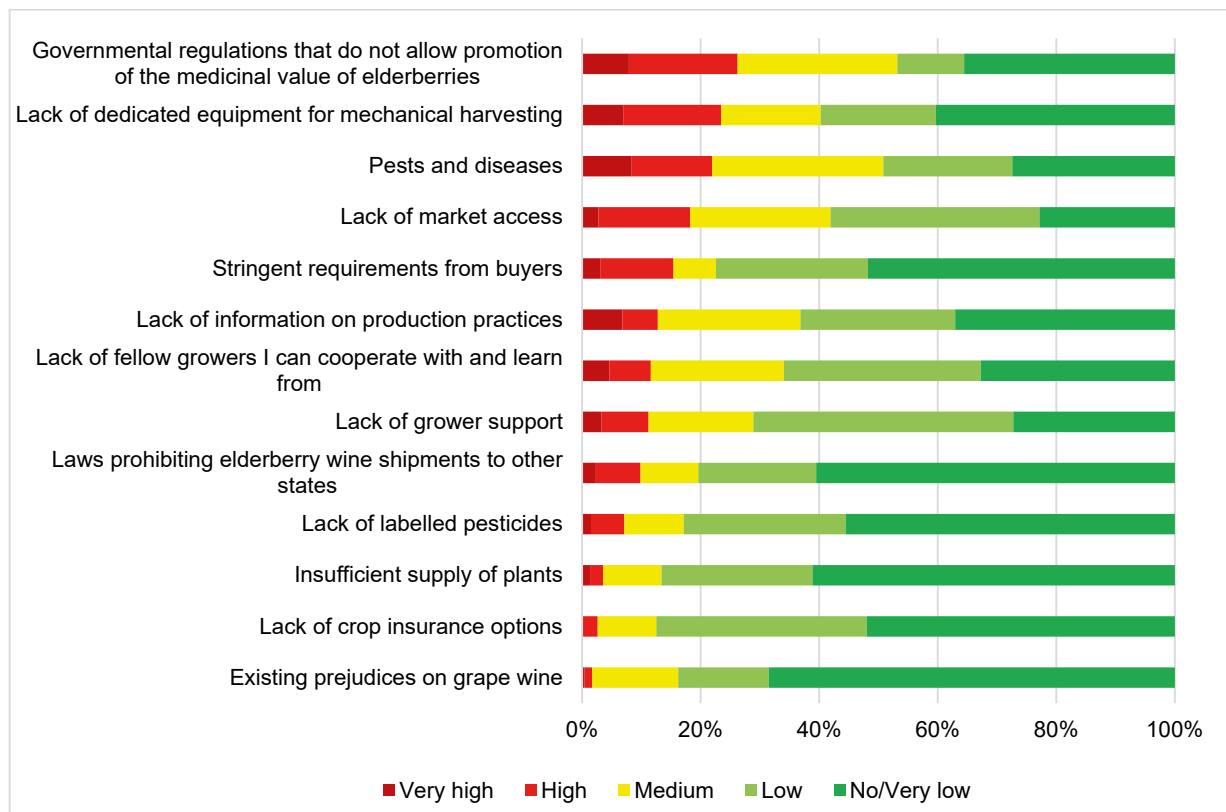


Figure 4. Perceived effect of challenges of elderberry production and marketing on sampled farmer’s operation, 83 respondents, USA, 2023. The exact question in the survey: ‘To what extent do the following potential challenges affect your operation?’

Consequently, these three factors are termed as regulatory and market barriers, information and resource gaps, and challenges in pest and disease control, respectively.

Cronbach’s alpha statistics for factors 1 and 2 exceeded 0.7, indicating strong internal consistency, while the alpha value for factor 3 was 0.51. Therefore, only factors 1 and 2 were used in further analysis, as factor 3 did not pass the internal consistency test.

4.3 Regression results of market participation decision and product diversification

Before examining the estimation outcomes, it is essential to note that different regression models were explored using diverse survey variables (see the Appendix, tables A1–A2). Our focus centers on the results derived from the preferred model, which demonstrated the lowest Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) scores. Additionally, the appropriateness of the employed modeling approach was validated. More specifically, the probability distribution describing respondents’ market participation was assessed. The over-dispersion parameter alpha in Table 3 is positive (2.95e-21) and statistically insignificant. This suggests that the Poisson distribution is more suitable than the Negative Binomial distribution for modeling product diversification (Greene, 2008).

Next, a method similar to Heckman’s test for selection bias was followed to test for conditionally uncorrelated errors between the two regressions in equations 1 and 2. First, a first-stage probit regression was estimated. After that, the IMR around the probability of participating in the elderberry market was calculated by dividing

Table 2. Rotated factor loadings for perceived challenges of elderberry production and marketing.

Variable	Regulatory and market barriers	Information and resource gaps	Challenges in pest and disease control
Lack of information on production practices	0.1501	0.7925*	-0.1459
Insufficient supply of plants	0.0287	0.2241	0.1980
Lack of dedicated equipment for mechanical harvesting	0.2880	-0.0020	0.4562
Lack of labelled pesticides	0.0979	-0.0721	0.8691*
Pests and diseases	-0.2303	0.1868	0.6549*
Lack of grower support	0.1232	0.7230*	0.2704
Lack of fellow growers I can cooperate with and learn from	-0.1173	0.8772*	-0.0299
Lack of market access	0.2201	0.4538	0.0449
Existing prejudices on grape wine	0.6915*	0.1569	0.0851
Governmental regulations that do not allow promotion of the medicinal value of elderberries	0.7234*	-0.2045	-0.1222
Laws prohibiting elderberry wine shipments to other states	0.8093*	0.1486	-0.0624
Stringent requirements from buyers	0.7732*	0.0092	0.0525
Lack of crop insurance options	0.6560*	0.0030	0.2190

* Loading values of 0.6 and above.

Table 3. Estimation of factors influencing market participation and product diversification of sampled elderberry farmers.

Variable	Probit (1 st hurdle) participation		Zero truncated Poisson (2 nd hurdle) product diversification		Negative binomial	
	Coefficient	Marginal effect	Coefficient	Marginal effect	Coefficient	Marginal effect
Regulatory and market barriers	-0.475* (0.276)	-0.088* (0.048)	-0.111 (0.139)	-0.173 (0.216)	0.0004 (0.125)	0.0004 (0.120)
Information and resource gaps	-0.333 (0.214)	-0.062 (0.038)	-0.223 (0.162)	-0.349 (0.249)	-0.143 (0.119)	-0.138 (0.115)
Elderberry acreage	0.133* (0.078)	0.025* (0.013)	0.016 (0.019)	0.025 (0.029)	0.0038 (0.015)	0.0037 (0.014)
Male gender (base: Female)	-1.056* (0.597)	-0.196* (0.105)	0.001 (0.332)	0.002 (0.519)	0.0017 (0.244)	0.0017 (0.235)
Experience	0.548*** (0.164)	0.102*** (0.023)	0.072** (0.035)	0.112** (0.053)	0.046* (0.027)	0.045* (0.026)
Age						
45–64	0.322 (0.534)	0.060 (0.099)	-0.105 (0.412)	-0.145 (0.577)	-0.108 (0.270)	-0.098 (0.246)
≥65	-0.128 (0.618)	-0.024 (0.115)	0.417 (0.480)	0.754 (0.881)	0.204 (0.293)	0.216 (0.314)

Table 3. Continued.

Education						
College	-1.214 (0.961)	-0.201 (0.133)	-0.306 (0.534)	-0.595 (1.178)	-0.185 (0.403)	-0.197 (0.463)
Graduate	-1.211 (0.933)	-0.201 (0.130)	-0.543 (0.634)	-0.946 (1.287)	-0.229 (0.448)	-0.239 (0.502)
Farm location						
West	0.894 (0.636)	0.165 (0.108)	0.760 (0.551)	1.236 (1.115)	0.485 (0.383)	0.518 (0.478)
Southeast	2.271** (0.910)	0.376*** (0.0951)	0.372 (0.528)	0.488 (0.746)	-0.009 (0.375)	-0.007 (0.309)
Northeast	1.744** (0.714)	0.306*** (0.101)	1.113* (0.585)	2.217 (1.490)	0.613* (0.364)	0.702 (0.497)
Annual household income						
\$50,000–\$99 999	-0.951 (0.635)	-0.176 (0.113)	-0.124 (0.542)	-0.156 (0.694)	-0.179 (0.365)	-0.148 (0.312)
\$100 000–\$149 000	-0.987 (0.669)	-0.183 (0.120)	0.842* (0.479)	1.761** (0.898)	0.465 (0.364)	0.533 (0.396)
≥\$150 000	-1.723** (0.689)	-0.321*** (0.110)	0.033 (0.597)	0.044 (0.808)	0.084 (0.402)	0.079 (0.375)
Farmers' market			0.738** (0.363)	1.154** (0.534)	0.811*** (0.258)	0.783*** (0.252)
IMR			0.992** (0.432)	1.551** (0.651)	-0.636** (0.279)	-0.614** (0.249)
Constant	0.314 (1.066)		-0.839 (0.812)		0.072 (0.567)	
No. of observations	83	83	50	50	83	83
Alpha					2.95e-21	
LR χ^2	56.42***		28.77**		61.03***	
Pseudo R^2	0.5058		0.1938		0.2290	

Standard errors are presented in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

the normal probability density function by the normal cumulative distribution and was incorporated into the second stage regression as an additional regressor. The coefficient of IMR proved statistically significant at the 5% significance level (coefficient = 0.992, p -value = 0.022), rejecting the null hypothesis of uncorrelated errors or no selection bias. As Heckman (1979) suggests, IMR was included in the second stage regression to correct selection bias. The IMR captures the significant unobserved characteristics that affect the underlying relationship and generates parameter estimates free of selection bias (Bendig and Hoke, 2022; Certo *et al.*, 2016; Heckman, 1979). Therefore, a double-hurdle procedure with Probit and truncated regression was used separately to address the aforementioned limitation.

The results of the double hurdle model estimation are presented in Table 3. For the probit (first hurdle) and zero-truncated Poisson model (second hurdle), the null hypothesis that the model is statistically insignificant is rejected at the 1% and 5% level, respectively.

Results show that perceived regulatory and market barriers exert a negative and significant impact on elderberry growers' market participation decisions. More specifically, farmers who expressed heightened concerns about regulatory and market restrictions had an 8.8 percentage point lower likelihood of participating in elderberry markets, *ceteris paribus*. This negative relation can be partly explained by previous literature, which reports

that stringent wine laws may restrict the shipment of elderberry wine beyond state borders (Cernusca and Gold, 2013), potentially discouraging elderberry producers from marketing their produce. Additionally, FDA regulations impose market limitations by prohibiting producers from advertising the medicinal benefits of elderberry without clinical trial substantiation (Cernusca and Gold, 2013). Furthermore, prevailing biases towards grape wine and the absence of industry-wide quality standards present challenges for elderberry producers, making it difficult for them to meet buyer requirements (Byers *et al.*, 2022; Cernusca *et al.*, 2012). These factors reflect broader market challenges that are compounded by the economies of scale required to meet stringent buyer demands (Vassalos *et al.*, 2013; MacDonald, 2015). Small-scale producers (like the ones in this sample), who may struggle with the costs associated with scaling up production, are particularly affected by these market pressures. Additionally, while crop insurance options for elderberry farmers are available, some farmers may not be aware of these options (as reflected in the regulatory and market barriers factor), which can deter them from participating in markets due to perceived financial risks associated with crop loss or other uncertainties. This highlights the importance of outreach and education to ensure that growers are informed about available resources, including crop insurance.

Concerning the socioeconomic determinants of market participation, being male exhibits a negative association with the decision to participate in the market. The marginal effect of this variable indicates that the likelihood of males participating in elderberry market is 19.6 percentage points lower than for females. This result contradicts the findings of Haile *et al.* (2022) but aligns with the results reported by Sigei *et al.* (2014).

The coefficient for elderberry acreage is positively signed and statistically significant only in the market participation model. Its marginal effect indicates that an acre increase in the land area dedicated to elderberries increases the probability of participating in elderberry markets by 2.5 percentage points, on average. This result is in line with that of Adanacioglu (2017), Osmani and Hossain (2015), Musah *et al.* (2014) and Hoque *et al.* (2015), indicating that larger farmers are more likely to market their products, possibly due to a higher surplus of farm products. Moreover, larger farms may possess more resources to overcome barriers to market entry (Adanacioglu, 2017).

Experience in elderberry production exhibits a positive and significant effect on both the market participation decision and product diversification. Its marginal effect suggests that an increase in farmer's experience in elderberry farming by one year increases the likelihood of market participation by 10.2 percentage points, on average. Similarly, an additional year of farming experience increases the likelihood of engaging in greater product diversification (i.e., marketing a wider variety of elderberry products) by an average of 11.2 percentage points. This result is in line with the findings of Adenegan *et al.* (2012), Belayneh *et al.* (2019), Hoque *et al.* (2015) and Ouma *et al.* (2010). Makhura (2001) argues that more experienced farmers are better equipped to overcome fixed transaction costs, thus favoring market participation. Farming experience not only reflects the accumulation of expertise in farming but is also linked to repeated transactions, reinforcing trust and building networks necessary for facilitating market information across farmers (Ouma *et al.*, 2010).

Respondents with an annual household income of at least \$150 000 had a 32-percentage point lower likelihood of marketing their elderberries. This result contrasts the findings of Musah *et al.* (2014). One plausible explanation could be that these respondents predominantly derive their income from off-farm employment or the sale of other crops, making them less inclined to compete in a nascent market like that of elderberries. Interestingly, respondents with annual household income between \$100 000 and \$150 000 had a 176-percentage point higher likelihood of engaging in greater product diversification. Higher-income farmers may be more able to reduce the subjective cost of investing in a new market and the associated risks. This result is in accord with Musah *et al.* (2014) and Abu (2015).

Using direct marketing outlets like farmers' market increases the likelihood of engaging in greater product diversification by 115.4 percentage points, on average. One plausible explanation for this phenomenon could be attributed to the predominantly small-scale nature of elderberry farmers, who may encounter challenges in

identifying alternative marketing channels due to their limited production scale. By participating in farmers' market these growers have the flexibility to market a broader range of products, diversifying their offerings and potentially increasing their revenue streams (Lancaster and Torres, 2019), while also mitigating costs related to insurance, advertising, and other marketing aspects (Andreatta and Wickliffe, 2002), making it a preferable market channel for elderberry growers. Additionally, wholesalers often require minimum quantities that smaller farms may struggle to meet, leading them to prefer selling at farmers' markets where they can more easily offer a range of products to smaller, local buyers (Popp *et al.*, 2023).

In terms of regional dummies, the model indicates that elderberry farmers located in the Southeast and Northeast regions had on average, 37.6 and 30.6 percentage points higher likelihood to market their products, respectively, compared to farmers located in the Midwest. One possible reason for this effect could be that the farmers in these regions can tap into larger customer base with high income as this region comprise of major metropolitan areas (Detre *et al.*, 2011).

5. Conclusions

This study explores the marketing practices and attitudes of a sample of US elderberry growers. It further uses a double hurdle model to assess the factors influencing the sampled farmers' decisions to engage in the elderberry market and diversify their product offerings.

Results revealed that a considerable portion of sampled farmers (40%) refrained from marketing their elderberries, highlighting variability in market participation within the sample. Among those who did, berries emerged as the most marketed product, followed by propagules and other products (i.e., juice, wine, jam, syrup, etc.). On-farm sales emerged as the primary marketing outlet for these elderberry growers. The perceived challenges most crucial for elderberry operations were identified as government regulations hindering the promotion of the medical value of elderberries, the lack of dedicated equipment for mechanical harvesting, and pests and diseases.

Regression analysis results revealed that various socioeconomic characteristics and perceptions of challenges influence the market engagement and product diversification among sampled farmers. Larger, more experienced farmers, and those located in the Southeast and Northeast regions of the US, were more likely to engage in marketing their elderberries. Conversely, perceived regulatory and market barriers, along with higher household income acted as deterrents to market participation. More experienced, high-income farmers, and those participating in farmers' markets, were found to engage in greater product diversification, highlighting the importance of diversification in their market strategies.

These findings contribute to a better understanding of the factors associated with market engagement and diversification among sampled elderberry farmers. Additionally, the role of farmers' markets in enabling these producers to diversify their product offerings suggests that such platforms provide both marketing opportunities and flexibility, which may be particularly relevant for smaller-scale producers facing constraints with other sales channels.

While this study provides valuable insights into the marketing practices and attitudes of US elderberry growers, some limitations should be considered when interpreting the findings. The dataset used in this analysis is relatively small and was not drawn through random sampling, which means the sample may not fully represent the broader population of elderberry growers in the US. As a result, caution should be exercised when extrapolating these findings to the entire industry. The results are specific to the sampled farmers and their circumstances, and future research with larger, more representative samples would help validate and expand upon these conclusions.

Acknowledgement

This work was completed while the first author was a master's student in the Division of Applied Social Sciences at the University of Missouri

Conflict of interest

The authors declare that they have no conflict of interest associated with this research.

Data availability

The used data is not publicly available, ensuring the anonymity and confidentiality of the survey participants' responses.

Ethical approval

All the individual participants involved in this study were informed and their responses were confidential.

Funding

This research was supported by United States Department of Agriculture, National Institute of Food and Agriculture, Grant No. 2021-51181-35860.

References

- Abu, B.M. 2015. Groundnut market participation in the Upper West Region of Ghana. *Ghana Journal of Development Studies* 12(1–2): 106–124. <https://doi.org/10.4314/gjds.v12i1-2.7>.
- Adenegan, K.O., A. Adepoju and L.O.E. Nwauwa. 2012. Determinants of market participation of maize farmers in rural Osun State of Nigeria. *International Journal of Agricultural Economics and Rural Development* 5(1): 28–39. Available online at <https://www.researchgate.net/publication/265466598>.
- Adanacioglu, H. 2017. Factors affecting farmers' decisions to participate in direct marketing: A case study of cherry growers in the Kemalpaşa District of Izmir, Turkey. *Renewable Agriculture and Food Systems* 32(4): 291–305. <https://doi.org/10.1017/S1742170516000193>.
- Ahl, J. 2023. *Elderberries are a successful niche crop at a crossroads: go big or stay small*. Available online at <https://www.stlpr.org/economy-business/2023-07-14/elderberries-are-a-successful-niche-crop-at-a-crossroads-go-big-or-stay-small>.
- American Botanical Council 2004. *The ABC clinical guide to elderberry*. Available at: <http://abc.herbalgram.org/site/DocServer/Elderberry-scr.pdf?docID=165>.
- Andreatta, S. and W. Wickliffe. 2002. Managing farmer and consumer expectations: a study of a North Carolina farmers market. *Human Organization* 61(2): 167–176. <https://doi.org/10.17730/humo.61.2.a4g01d6q8dj5lkb>.
- Anosike, N. and C.M. Coughenour. 1990. The socioeconomic basis of farm enterprise diversification decisions 1. *Rural Sociology* 55(1): 1–24. <https://doi.org/10.1111/j.1549-0831.1990.tb00670.x>.
- Arte, P. and J. Larimo. 2022. Moderating influence of product diversification on the international diversification-performance relationship: A meta-analysis. *Journal of Business Research* 139: 1408–1423. <https://doi.org/10.1016/j.jbusres.2021.10.037>.
- 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. <https://doi.org/10.1016/j.jrurstud.2008.06.001>.
- Barrett, C.B. 2008. Smallholder market participation: Concepts and evidence from eastern and southern Africa. *Food Policy* 33(4): 299–317. <https://doi.org/10.1016/j.foodpol.2007.10.005>.

- Bradshaw, B. (2004). Plus c'est la même chose? Questioning crop diversification as a response to agricultural deregulation in Saskatchewan, Canada. *Journal of Rural Studies* 20(1): 35-48.
- Belayneh, N.G., B. Tegegne and A. Ademe. 2019. Determinants of smallholder teff producer farmers market participation in Merhabete District, Amhara Region, Ethiopia. *International Journal of Agricultural Economics* 4(4): 135. <https://doi.org/10.11648/J.IJAE.20190404.11>.
- Bendig, D. and J. Hoke. 2022. *Correcting selection bias in innovation and entrepreneurship research: a practical guide to applying the Heckman two-stage estimation*. Available online at <https://dx.doi.org/10.2139/ssrn.4105207>.
- Blandon, J., S. Henson and T. Islam. 2009. Marketing preferences of small-scale farmers in the context of new agrifood systems: a stated choice model. *Agribusiness: An International Journal* 25(2): 251–267. <https://doi.org/10.1002/agr.20195>.
- Burke, W.J., R.J. Myers and T.S. Jayne. 2015. A triple-hurdle model of production and market participation in Kenya's dairy market. *American Journal of Agricultural Economics* 97(4): 1227–1246. <https://doi.org/10.1093/ajae/aav009>.
- Byers, P., A. Thomas, M. Cernusca, L. Godsey and M. Gold. 2022. *Growing and marketing elderberries in Missouri. Agroforestry in Action*. University of Missouri Center for Agroforestry, Columbia, MO. Available online at <https://extension.missouri.edu/media/wysiwyg/Extensiondata/Pub/pdf/agguides/agroforestry/af1017.pdf>.
- Cai, Z., K. Stubblefield, A.L. Thomas and F.X. Aguilar. 2024. From niche to mainstream: US consumer trends and preferences for elderberry products. *HortScience* 59(12), 1723–1729. <https://doi.org/10.21273/HORTSCI18180-24>.
- Cernusca, M.M., M.A. Gold and L.D. Godsey. 2012. Using the Porter model to analyze the US elderberry industry. *Agroforestry Systems* 86: 365–377. <https://doi.org/10.1007/s10457-012-9546-0>.
- Cernusca, M.M. and M.A. Gold. 2013. Breaking down market barriers for elderberry growers and producers. *In International Symposium on Elderberry 1061, 9 June 2013*, pp. 269–277. <https://doi.org/10.17660/ActaHortic.2015.1061.30>.
- Certo, S.T., J.R. Busenbark, H.S. Woo and M. Semadeni. 2016. Sample selection bias and Heckman models in strategic management research. *Strategic Management Journal* 37(13): 2639–2657. <https://doi.org/10.1002/smj.2475>.
- Charlebois, D. 2007. Elderberry as a medicinal plant. In *Issues in new crops and new uses*. ASHS Press, Alexandria, VA, pp. 284–292.
- Charlebois, D., P.L. Byers, C.E. Finn and A.L. Thomas. 2010. Elderberry: botany, horticulture, potential. *Horticultural Reviews* 37: 213–280.
- Cragg, J.G. 1971. Some statistical models for limited dependent variables with application to the demand for durable goods. *Econometrica* 39: 829–844. <https://doi.org/10.2307/1909582>.
- De Roest, K., P. Ferrari and K. Knickel. 2018. Specialisation and economies of scale or diversification and economies of scope? Assessing different agricultural development pathways. *Journal of Rural Studies* 59: 222–231.
- Detre, J.D., T.B. Mark, A.K. Mishra and A. Adhikari. 2011. Linkage between direct marketing and farm income: a double-hurdle approach. *Agribusiness* 27(1): 19–33. <https://doi.org/10.1002/agr.20248>.
- Dimitri, C. and L. Oberholtzer. 2009. Meeting market demand in the organic sector: handler–supplier relationships in the face of tight supply. *Renewable Agriculture and Food Systems* 24(2): 137–145. <https://doi.org/10.1017/S1742170509002518>.
- Dlamini, S.I. and W.C. Huang. 2019. A double hurdle estimation of sales decisions by smallholder beef cattle farmers in Eswatini. *Sustainability* 11(19): 5185. <https://doi.org/10.3390/su11195185>.
- Dong, H., B. Campbell and A.N. Rabinowitz. 2019. Factors impacting producer marketing through community supported agriculture. *PLoS ONE* 14(7): e0219498. <https://doi.org/10.1371/journal.pone.0219498>.
- Finn, C.E., A.L. Thomas, P.L. Byers and S. Serçe. 2008. Evaluation of American (*Sambucus canadensis*) and European (*S. nigra*) elderberry genotypes grown in diverse environments and implications for cultivar development. *HortScience* 43(5): 1385–1391. <https://doi.org/10.21273/HORTSCI.43.5.1385>.
- Greene W. 2008. *Econometric Analysis*, 7th edn. Prentice Hall, Upper Saddle River, NJ.

- Haile, K., E. Gebre and A. Workye. 2022. Determinants of market participation among smallholder farmers in Southwest Ethiopia: double-hurdle model approach. *Agriculture and Food Security* 11(1): 18. <https://doi.org/10.1186/s40066-022-00358-5>.
- Hakelius, K. and H. Hansson. 2016. Members' attitudes towards cooperatives and their perception of agency problems. *International Food and Agribusiness Management Review* 19(4): 23–36. <https://doi.org/10.22434/IFAMR2015.0219>.
- Hamlin, R., J. Knight and R. Cuthbert. 2016. Niche marketing and farm diversification processes: Insights from New Zealand and Canada. *Renewable Agriculture and Food Systems* 31(1): 86–98. <https://doi.org/10.1017/S1742170514000489>.
- Heckman, J. J. 1979. Sample selection bias as a specification error. *Econometrica* 47: 153–161. <https://doi.org/10.2307/1912352>.
- Hlatshwayo, S.I., M. Ngidi, T. Ojo, A.T. Modi, T. Mabhaudhi and R. Slotow. 2021. A typology of the level of market participation among smallholder farmers in South Africa: Limpopo and Mpumalanga Provinces. *Sustainability* 13(14): 7699. <https://doi.org/10.3390/su13147699>.
- Holloway, G., C. Nicholson, C. Delgado, S. Staal and S. Ehui. 2000. Agroindustrialization through institutional innovation Transaction costs, cooperatives and milk-market development in the east-African highlands. *Agricultural Economics* 23(3): 279–288. <https://doi.org/10.1111/j.1574-0862.2000.tb00279.x>.
- Hoque, M.M., G.M. Artz, D.H. Jarboe and B.J. Martens. 2015. Producer participation in biomass markets: farm factors, market factors, and correlated choices. *Journal of Agricultural and Applied Economics* 47(3): 317–344. <https://doi.org/10.1017/aae.2015.9>.
- Ibrahim, H., S.A. Rahman, E.E. Envulus and S.O. Oyewole. 2009. Income and crop diversification among farming households in a rural area of north central Nigeria. *Agro-Science* 8(2). <https://doi.org/10.4314/as.v8i2.51102>.
- Izaba, O.F.R. 2021. *Value-added strategies in the specialty crop industry: exploring farmers' drivers and strategies at the farm level*. Master's thesis, Purdue University, West Lafayette, IN.
- Izaba, O.F.R., A.P. Torres, M.I. Marshall and A.W. Thompson. 2023. Market access and value-added strategies in the specialty crops industry. *HortScience* 58(1): 32–39.
- Katchova, A.L., and M.J. Miranda. 2004. Two-step econometric estimation of farm characteristics affecting marketing contract decisions. *American Journal of Agricultural Economics* 86: 88–102.
- Key, N., E. Sadoulet and A.D. Janvry. 2000. Transactions costs and agricultural household supply response. *American Journal of Agricultural Economics* 82(2): 245–259. <https://doi.org/10.1111/0002-9092.00022>.
- Kim, J.O. and C. Mueller. 1978. *Introduction to factor analysis: What it is and how to do it* (No. 13). Sage, Thousand Oaks, CA.
- Kim, H.J. 2016. Opportunities and challenges of alternative specialty crops: The global picture. *HortScience* 51(11): 1316–1319. <https://doi.org/10.21273/HORTSCII0659-16>.
- Kirschenmann, F., G.W. Stevenson, F. Buttel, T.A. Lyson and M. Duffy. 2008. Why worry about the agriculture of the middle? In T.A. Lyson, G.W. Stevenson and R. Welsh (Eds) *Food and the mid-level farm: renewing an agriculture of the middle*. MIT Press, Cambridge, MSA, pp. 3–20.
- Kurdyś-Kujawska, A., A. Strzelecka and D. Zawadzka. 2021. The impact of crop diversification on the economic efficiency of small farms in Poland. *Agriculture* 11(3): 250. <https://doi.org/10.3390/agriculture11030250>.
- Lancaster, N.A. and A.P. Torres. 2019. Investigating the drivers of farm diversification among US fruit and vegetable operations. *Sustainability* 11(12): 3380. <https://doi.org/10.3390/su11123380>.
- Lee, J. and C.E. Finn. 2007. Anthocyanins and other polyphenolics in American elderberry (*Sambucus canadensis*) and European elderberry (*Sambucus nigra*) cultivars. *Journal of the Science of Food and Agriculture* 87(14): 2665–2675. <https://doi.org/10.1002/jsfa.3029>.
- Lovell, S.T., K. Krishnaswamy, C.H. Lin, N. Meier, R.S. Revord and A.L. Thomas. 2023. Nuts and berries from agroforestry systems in temperate regions can form the foundation for a healthier human diet and improved outcomes from diet-related diseases. *Agroforestry Systems* 97(8): 1347–1360. <https://doi.org/10.1007/s10457-023-00858-8>.

- Low, S.A. and S. Vogel. 2011. *Direct and intermediated marketing of local foods in the United States*. ERR-128, U.S. Department of Agriculture, Economic Research Service, Washington, DC. Available online at <https://ssrn.com/abstract=2114361>.
- MacDonald, J.M. 2015. Trends in agricultural contracts. *Choices* 30(3): 1–6.
- Makhura, M., J. Kirsten and C. Delgado. 2001. Transaction costs and smallholder participation in the maize market in the Northern Province of South Africa. In: *Integrated approaches to higher maize productivity in the new millennium, Proceedings of the Seventh Eastern and Southern Africa Regional Maize Conference. 5–11 February 2002. Nairobi, Kenya*.
- Mignouna, D.B., T. Abdoulaye, A. Alene, A.A. Akinola and V.M. Manyong. 2015. Drivers of market participation decisions among small-scale farmers in yam growing areas of Nigeria and Ghana (No. 1008-2016-80294). In: *International Association of Agricultural Economists (IAAE) 2015 Conference. 9–14 August 2015. Milan, Italy*.
- Mishra, A.K., H.S. El-Osta and C.L. Sandretto. 2004. Factors affecting farm enterprise diversification. *Agricultural Finance Review* 64(2): 151–166. <https://doi.org/10.1108/00214660480001160>.
- Mishra, A., C. Wilson and R. Williams. 2009. Factors affecting financial performance of new and beginning farmers. *Agricultural Finance Review* 69: 160–179. <https://doi.org/10.1108/00021460910978661>.
- Młynarczyk, K., D. Walkowiak-Tomczak and G.P. Łysiak. 2018. Bioactive properties of *Sambucus nigra* L. as a functional ingredient for food and pharmaceutical industry. *Journal of Functional Foods* 40: 377–390. <https://doi.org/10.1016/j.jff.2017.11.025>.
- Mohebalian, P.M., M.M. Cernusca and F.X. Aguilar. 2012. Discovering niche markets for elderberry juice in the United States. *HortTechnology* 22(4): 556–566. <https://doi.org/10.21273/HORTTECH.22.4.556>.
- Monson, J., D.Y. Mainville and N.V. Kuminoff. 2008. The decision to direct market: An analysis of small fruit and specialty-product markets in Virginia. *Journal of Food Distribution Research* 39(2): 1–11. <http://dx.doi.org/10.22004/ag.econ.55971>.
- Mpombo, L., M.J. Chegere and O. Osoro. 2022. Determinants of market orientation and market participation among smallholder rice farmers in Tanzania. *The African Review* 51: 1–26. <https://doi.org/10.1163/1821889X-bja10014>.
- Musah, A.B., O.A.Y. Bonsu and W. Seini. 2014. Market participation of smallholder maize farmers in the upper west region of Ghana. *African Journal of Agricultural Research* 9(31): 2427–2435.
- NatMed. 2021. *Supplement Sales Increase by 17%, Elderberry Takes Top Spot*. Available online at <https://naturalmedicines.therapeuticresearch.com/news/news-items/2021/november/supplement-sales-increase-by-17,-elderberry-takes-top-spot.aspx>.
- Nouteya-Jackson, M.S. 2022. *Small Business Strategies to Implement Product Diversification Effectively*. Thesis, Walden University, Minneapolis, MN.
- Olwande, J. and M.K. Mathenge. 2011. Market participation among poor rural households in Kenya. In *International Association of Agricultural Economists 2012 Conference, August 18–24, 2012, Foz do Iguacu, Brazil*: 126711.
- Omiti, J.M., D.J. Otieno, T.O. Nyanamba and E.B. McCullough. 2009. Factors influencing the intensity of market participation by smallholder farmers: A case study of rural and peri-urban areas of Kenya. *African Journal of Agricultural and Resource Economics* 3: 57–82. <http://doi.org/10.22004/ag.econ.56958>.
- Osmani, A.G. and E. Hossain. 2015. Market participation decision of smallholder farmers and its determinants in Bangladesh. *Economics of Agriculture* 62(1): 163–179. <https://doi.org/10.5937/ekoPolj1501163G>.
- Ouma, E., J. Jagwe, G.A. Obare and S. Abele. 2010. Determinants of smallholder farmers' participation in banana markets in Central Africa: the role of transaction costs. *Agricultural Economics* 41(2): 111–122. <https://doi.org/10.1111/j.1574-0862.2009.00429.x>.
- Paul, U.K., G. Das, M. Das and T. Mathur. 2021. Small growers' direct participation in the market and its impact on farm income. *Journal of Agribusiness in Developing and Emerging Economies* 11(3): 241–254. <https://doi.org/10.1108/JADEE-05-2019-0067>.
- Plakias, Z.T., I. Demko and A.L. Katchova. 2020. Direct marketing channel choices among US farmers: evidence from the Local Food Marketing Practices Survey. *Renewable Agriculture and Food Systems* 35(5): 475–489. <https://doi.org/10.1017/S1742170519000085>.

- Popp, M., G. Mahamba, J. Thompson, T. Malone and J. Popp. 2023. Marketing strategy selection for small-scale fruit and vegetable growers: lessons from the Mid-Southern United States. *Journal of Food Distribution Research* 54(3): 78–101. <http://dx.doi.org/10.22004/ag.econ.339708>
- Seuneke, P. and B.B. Bock. 2015. Exploring the roles of women in the development of multifunctional entrepreneurship on family farms: an entrepreneurial learning approach. *NJAS: Wageningen Journal of Life Sciences* 74(1): 41–50. <https://doi.org/10.1016/j.njas.2015.07.001>.
- Sigei, G., H. Bett and L. Kibet. 2014. *Determinants of market participation among small-scale pineapple farmers in Kericho County, Kenya*. MSc thesis, Egerton University, Njoro. <http://dx.doi.org/10.22004/ag.econ.243452>.
- Skevas, T. and N. Kalaitzandonakes. 2020. Farmer awareness, perceptions and adoption of unmanned aerial vehicles: Evidence from Missouri. *International Food and Agribusiness Management Review* 23(3): 469–485. <https://doi.org/10.22434/IFAMR2019.0151>.
- Skevas, T., R. Massey and J. Grashuis. 2022. Farmer adoption and intensity of use of extreme weather adaptation and mitigation strategies: evidence from a sample of Missouri farmers. *Climatic Change* 174(1–2): 18. <https://doi.org/10.1007/s10584-022-03439-3>.
- Stafne, E.T., T. Blare, B. Posadas, L. Downey, J. Anderson, J. Crane, R. Gazis, B. Faber, D.G. Stockton, D. Carrillo, J.P. Morales-Payan, M. Dutt, A. Chambers and D. Chavez. 2023. Survey of US passionfruit growers' production practices and support needs. *HortTechnology* 33(4): 357–366. <https://doi.org/10.21273/HORTTECH05240-23>.
- Stanek, E.C., S.T. Lovell and A. Reisner. 2019. Designing multifunctional woody polycultures according to landowner preferences in Central Illinois. *Agroforestry Systems* 93: 2293–2311. <https://doi.org/10.1007/s10457-019-00350-2>.
- Technavio. 2023. *Elderberry Market by Application, Distribution Channel, and Geography — Forecast and Analysis 2023–2027*. Available online at <https://www.technavio.com/report/elderberry-market-industry-analysis>.
- Thomas, A.L., P.L. Byers, P.L. Vincent and W.L. Applequist. 2020. Medicinal attributes of American elderberry. In: Á. Máthé (Ed.) *Medicinal and Aromatic Plants of North America* 6. Springer, Cham, pp. 119–139. https://doi.org/10.1007/978-3-030-44930-8_5.
- Torres, A.P. and M.I. Marshall. 2018. Identifying drivers of organic decertification: An analysis of fruit and vegetable farmers. *HortScience* 53(4): 504–510. <https://doi.org/10.21273/HORTSCI12792-17>.
- Torres, A.P., S. Philocles, O.F. Rodriguez and E.J. Velasco. 2021. Characterizing crop diversification in the US specialty crop industry. *Journal of Food Distribution Research* 52: 1–23.
- USDA National Statistics Service. 2022. *2022 census of agriculture*. Available online at <https://www.nass.usda.gov/AgCensus/>.
- Vassalos, M., W. Hu, T.A. Woods, J. Schieffer and C.R. Dillon. 2013. Fresh vegetable growers' risk perception, risk preference and choice of marketing contracts: a choice experiment. In *Southern Agricultural Economics Association 2013 Annual Meeting, February 2–5, 2013, Orlando, Florida*: 142506.
- Volza Grow Global. 2023. *United States elderberry imports*. Available online at <https://www.volza.com/p/elderberry/import/import-in-united-states/>.
- Woodridge, J.M. 2010. *Econometric analysis of cross section and panel data*, 2nd edn. The MIT Press, Cambridge, MA.

Appendix

Table A1. Estimation of determinants of market participation of sampled elderberry farmers.

Variable	Model1	Marginal effect	Model2	Marginal effect	Model3	Marginal effect	Model4	Marginal effect	Model5	Marginal effect
Regulatory and market barriers	-0.646** (0.329)	-0.113** (0.052)	-0.646** (0.329)	-0.113** (0.0522)	-0.553* (0.299)	-0.0992** (0.0493)	-0.460* (0.276)	-0.0844* (0.0474)	-0.475* (0.276)	-0.0880* (0.0476)
Information and resource gaps	-0.349 (0.236)	-0.061 (0.040)	-0.349 (0.236)	-0.0610 (0.0399)	-0.341 (0.229)	-0.0612 (0.0393)	-0.285 (0.226)	-0.0523 (0.0403)	-0.333 (0.214)	-0.0617 (0.0379)
Cooperative	0.281 (0.520)	0.049 (0.090)	0.281 (0.520)	0.0492 (0.0901)	0.260 (0.508)	0.0466 (0.0904)	0.322 (0.495)	0.0592 (0.0899)		
Elderberry acreage	0.111 (0.083)	0.019 (0.014)	0.112 (0.0830)	0.0195 (0.0138)	0.126 (0.0817)	0.0226 (0.0138)	0.127 (0.0787)	0.0232* (0.0136)	0.133* (0.0778)	0.0247* (0.0134)
Gender (base: Female)	-1.089* (0.625)	-0.190* (0.103)	-1.088* (0.626)	-0.190* (0.103)	-1.068* (0.626)	-0.191* (0.107)	-1.095* (0.605)	-0.201* (0.105)	-1.056* (0.597)	-0.196* (0.105)
Experience	0.603*** (0.189)	0.105*** (0.025)	0.603*** (0.189)	0.105*** (0.0254)	0.556*** (0.173)	0.0998*** (0.0242)	0.546*** (0.164)	0.100*** (0.0229)	0.548*** (0.164)	0.102*** (0.0228)
Value-added processing	0.689 (0.525)	0.120 (0.089)	0.689 (0.525)	0.121 (0.0886)	0.621 (0.511)	0.111 (0.0889)				
Age										
45–64	0.329 (0.567)	0.058 (0.100)	0.330 (0.567)	0.0585 (0.100)	0.298 (0.560)	0.0539 (0.101)	0.290 (0.544)	0.0537 (0.101)	0.322 (0.534)	0.0600 (0.0993)
≥65	-0.290 (0.655)	-0.051 (0.114)	-0.290 (0.655)	-0.0510 (0.114)	-0.223 (0.647)	-0.0402 (0.116)	-0.205 (0.632)	-0.0380 (0.116)	-0.128 (0.618)	-0.0239 (0.115)
Education										
College	-1.591 (1.096)	-0.243* (0.130)	-1.591 (1.096)	-0.243* (0.129)	-1.573 (1.094)	-0.245* (0.132)	-1.207 (0.973)	-0.200 (0.136)	-1.214 (0.961)	-0.201 (0.133)
Graduate	-1.494 (1.067)	-0.227* (0.126)	-1.495 (1.067)	-0.227* (0.127)	-1.476 (1.051)	-0.228* (0.127)	-1.195 (0.949)	-0.198 (0.133)	-1.211 (0.933)	-0.201 (0.130)
Location										
West	0.635 (0.686)	0.107 (0.114)	0.635 (0.686)	0.108 (0.115)	0.778 (0.653)	0.138 (0.111)	0.779 (0.651)	0.145 (0.115)	0.894 (0.636)	0.165 (0.108)
Southeast	2.691** (1.054)	0.404*** (0.085)	2.691** (1.054)	0.404*** (0.0853)	2.419** (0.981)	0.389*** (0.0973)	2.331** (0.917)	0.388*** (0.0952)	2.271** (0.910)	0.376*** (0.0951)

Table A1. Continued

Northeast	2.182*** (0.788)	0.348*** (0.090)	2.183*** (0.788)	0.348*** (0.0900)	1.946*** (0.735)	0.328*** (0.0972)	1.742** (0.703)	0.309*** (0.102)	1.744** (0.714)	0.306*** (0.101)
Household income										
\$50 000–\$99 999	-1.164 (0.721)	-0.203* (0.116)	-1.164 (0.722)	-0.203* (0.116)	-0.861 (0.652)	-0.155 (0.114)	-0.989 (0.644)	-0.181 (0.112)	-0.951 (0.635)	-0.176 (0.113)
\$100 000–\$149 000	-1.058 (0.755)	-0.183 (0.125)	-1.058 (0.755)	-0.183 (0.126)	-0.907 (0.714)	-0.164 (0.126)	-1.065 (0.691)	-0.195 (0.121)	-0.987 (0.669)	-0.183 (0.120)
≥ \$150 000	-1.997*** (0.756)	-0.344*** (0.104)	-1.998*** (0.756)	-0.344*** (0.104)	-1.782** (0.710)	-0.319*** (0.107)	-1.686** (0.687)	-0.312*** (0.111)	-1.723** (0.689)	-0.321*** (0.110)
Successor	0.593 (0.539)	0.103 (0.092)	0.593 (0.539)	0.104 (0.0917)						
Constant	-0.098 (1.168)		-0.0984 (1.169)		0.0798 (1.153)		0.296 (1.083)		0.314 (1.066)	
No. of observations	83	83	83	83	83	83	83	83	83	83
R ²	0.5350		0.5350		0.5234		0.5096		0.5058	
AIC	89.87		89.88		89.17		88.70		87.13	
BIC	135.83		135.83		132.71		129.83		125.84	
Log likelihood	-25.937		-25.938		-26.586		-27.354		-27.57	

Standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A2. Estimation of determinants of product diversification of sampled elderberry farmers.

Variable	Model1	Marginal effect	Model3	Marginal effect	Model4	Marginal effect	Model6	Marginal effect	Model7	Marginal effect
Regulatory and market barriers	-0.133 (0.177)	-0.198 (0.261)	-0.112 (0.157)	-0.168 (0.233)	-0.0728 (0.150)	-0.112 (0.230)	-0.0918 (0.141)	-0.142 (0.217)	-0.111 (0.139)	-0.173 (0.216)
Information and resource gaps	-0.362* (0.206)	-0.541* (0.291)	-0.357* (0.204)	-0.536* (0.289)	-0.253 (0.177)	-0.389 (0.265)	-0.229 (0.166)	-0.354 (0.251)	-0.223 (0.162)	-0.349 (0.249)
Cooperative	-0.246 (0.450)	-0.368 (0.662)	-0.246 (0.411)	-0.369 (0.608)	-0.148 (0.400)	-0.227 (0.611)				
Elderberry acreage	0.0238 (0.0253)	0.0356 (0.0373)	0.0220 (0.0243)	0.0330 (0.0361)	0.0102 (0.0215)	0.0157 (0.0330)	0.0118 (0.0192)	0.0182 (0.0297)	0.0162 (0.0187)	0.0254 (0.0292)
Gender (base: Female)	-0.108 (0.384)	-0.161 (0.573)	-0.0840 (0.369)	-0.126 (0.552)	0.0283 (0.351)	0.0435 (0.539)	0.0174 (0.333)	0.0269 (0.516)	0.00116 (0.332)	0.00181 (0.519)
Experience	0.0504 (0.0441)	0.0753 (0.0655)	0.0518 (0.0436)	0.0776 (0.0649)	0.0725* (0.0382)	0.111* (0.0570)	0.0661* (0.0363)	0.102* (0.0549)	0.0717** (0.0353)	0.112** (0.0534)
Value added processing	0.00475 (0.486)	0.00709 (0.726)								
Age										
45–64 years	0.131 (0.478)	0.162 (0.577)	0.109 (0.469)	0.138 (0.586)	-0.0468 (0.451)	-0.0627 (0.606)	-0.0278 (0.413)	-0.0373 (0.556)	-0.105 (0.412)	-0.145 (0.577)
≥65 years	0.730 (0.650)	1.236 (1.167)	0.633 (0.519)	1.058 (0.888)	0.481 (0.489)	0.847 (0.874)	0.502 (0.489)	0.888 (0.881)	0.417 (0.480)	0.754 (0.881)
Education										
College	-0.255 (0.612)	-0.478 (1.262)	-0.256 (0.610)	-0.477 (1.250)	-0.406 (0.595)	-0.808 (1.381)	-0.312 (0.538)	-0.602 (1.181)	-0.306 (0.534)	-0.595 (1.178)
Graduate	-0.575 (0.694)	-0.928 (1.316)	-0.550 (0.671)	-0.893 (1.284)	-0.629 (0.670)	-1.130 (1.449)	-0.547 (0.650)	-0.945 (1.306)	-0.543 (0.634)	-0.946 (1.287)
Location										
West	0.714 (0.603)	0.939 (0.987)	0.680 (0.584)	0.903 (0.971)	0.828 (0.544)	1.371 (1.141)	0.788 (0.543)	1.269 (1.090)	0.760 (0.551)	1.236 (1.115)
Southeast	0.717 (0.840)	0.944 (1.280)	0.653 (0.805)	0.856 (1.213)	0.365 (0.743)	0.469 (1.031)	0.416 (0.532)	0.546 (0.758)	0.372 (0.528)	0.488 (0.746)
Northeast	1.530* (0.804)	3.260 (2.343)	1.471* (0.765)	3.112 (2.200)	1.096 (0.676)	2.119 (1.625)	1.132* (0.591)	2.224 (1.494)	1.113* (0.585)	2.217 (1.490)

Table A3. Summary statistics of additional predictors included in the product diversification regression (Table A2) ($n=50$).

Variable	Definition	Unit	Mean	SD
Branding and advertisement	Increased or maintained branding/ advertising	0/1	0.80	0.40
Forward contracting	Increased or maintained forward contracting	0/1	0.22	0.41
Wholesale/broker marketing	Increased or maintained wholesale/ broker marketing	0/1	0.60	0.49
Value-added processing	Increased or maintained their engagement in value-added processing	0/1	0.74	0.44

Survey Questionnaire



University of Missouri



UNIVERSITY OF MINNESOTA

ELDERBERRY PRODUCTION AND MARKETING SURVEY

WE NEED YOUR HELP!



The purpose of this study is to understand your views about production and marketing of elderberries. There are no right or wrong answers because people have different production and marketing strategies. All responding participants will be entered into a raffle with a prize of one of ten \$100 Amazon gift cards.

YOUR OPINIONS MATTER

By completing this questionnaire, you are helping to inform the design of future policies and educational programs that better reflect the views and needs of elderberry producers.

The questionnaire is also available Online via a web-based form. If you wish to take the survey online, go to: tinyurl.com/mizzouAGsurvey

WHO SHOULD FILL OUT THIS SURVEY?

1. In the 2022 farm year, did you grow elderberries?
- No ⇒ *If NO, please do not fill out the questionnaire and return it to us in the provided prepaid envelope. Thank you for your time!*
- Yes ⇒ *If YES, please continue with the questionnaire.*

SECTION A: CURRENT ELDERBERRY PRODUCTION AND MANAGEMENT PRACTICES
--

- A1. How many acres of elderberries did you grow in 2022? _____ ACRES
(if other than acres please specify unit)
- A2. Approximately, how many years have you been producing elderberries? _____ YEARS
- A3. Do you consider yourself an elderberry:
- Commercial grower Hobby/homestead/lifestyle grower
- Both Other (please explain): _____
- A4. What elderberry cultivars did you grow in 2022 (*check all that apply*)
- Bob Gordon Adams Wyldewood
- Ranch York Pocahontas
- Blue elderberry European Elderberry Other (please explain): _____
- A5. Which production system did you use in 2022? (*check all that apply*)
- Conventional Certified Organic Non-certified organic
- Other (please explain): _____
- A6. Where have you sourced your elderberry plants within the last five years? (*check all that apply*)
- Regional nursery Mail-order nursery Cuttings from a farm Propagated myself
- Other (please explain): _____
- A7. What weed management methods (if any) did you use in 2022? (*check all that apply*)
- Woven weed barrier
- Plastic weed barrier
- Wood chip mulch
- Conventional pre-emergent and/or post-emergent herbicides
- Mechanical control (mowing, plowing, etc.)
- Perennial or annual cover crops
- Livestock grazing (sheep, geese, etc.)
- Other (please explain): _____
- None of the above – Did not control weeds
- A8. Which pests (if any) have been troublesome in the last year? (*check all that apply*)
- Mites Japanese beetles Spotted wing drosophila
- Sawfly Elder borer beetle Stink bugs or Jessie's bug
- Other (please explain): _____ None of the above

A9. What do you consider to be the most serious disease in your elderberry crop?

A10. What pest/disease management methods (if any) did you use in 2022? (*check all that apply*)

- Chemical control (e.g., insecticides) Protective nets Traps
 Fences and/or repellents Other (please explain): _____

A11. What type of pruning method(s) did you use in 2022? (*check all that apply*)

- Annual removal of all shoots Removal of shoots every other year
 Annual selective pruning Prune plants down to 2 or 3 feet
 Did not prune my elderberry plants Other (please explain): _____

A12. Did you irrigate your elderberry fields in 2022?

- Yes No

IF YOU ANSWERED YES:

a. What type of irrigation did you use? (*check all that apply*)

- Drip irrigation Micro sprinklers Other (please explain): _____

b. What sources of water did you use to irrigate your elderberries?

- Well water (e.g. farm well) Surface water (pond or river)
 Municipal water Other (please explain): _____

A13. In the next 5 years, how likely are you to change the area you have planted to elderberries?

	Definitely not	Unlikely	Unsure	Likely	Definitely will
Expand	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reduce	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stay the same	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION B: ELDERBERRY MARKETING PRACTICES

B1. Have you marketed your elderberry products in 2022?

- Yes No

⇒ *If NO, please skip to question B4 below.*

IF YOU ANSWERED YES:

a. What products did you market (*check all that apply*)

- Berries Flowers Cuttings Nursery plants Other (please explain): _____

IF YOU ANSWERED BERRIES:

b. What was the state of berries when sold? (*check all that apply*)

- Fresh Frozen Dried Juice Pomace Seeds Sanitized
 Other (please explain): _____

IF YOU ANSWERED FLOWERS:

e. What was the state of flowers when sold? (*check all that apply*)

- Fresh Frozen Freeze-dried Heat-dried
 Other (please explain): _____

B2. Which of the following marketing outlets did you use in 2022 to sell your elderberry products? (*check all that apply*)

- On-farm sales Farmers' market Pick-your-own
 Grower cooperative Other farmer Wholesale buyer/broker/packer
 Winery Other (please explain): _____

B3. If you selected more than one option in Question B2, which marketing outlet accounted for most of your sales? (otherwise skip to question B4): _____

B4. Please indicate your plans to increase, decrease, or maintain the following business activities throughout the next year.

Business activities:	Increase	Decrease	Stay the same	I do not do this
Direct to consumer marketing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wholesale/ Broker marketing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Value added processing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Branding and advertisement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Forward contracting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION C: YOUR OPINIONS ON CHALLENGES FOR INVESTING IN ELDERBERRY PRODUCTION

C1. To what extent do the following potential challenges affect your operation?

Challenges:	No/Very low	Low	Medium	High	Very high
Lack of information on production practices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Insufficient supply of plants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lack of dedicated equipment for mechanical harvesting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lack of labelled pesticides	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pests and diseases	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lack of grower support	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lack of fellow growers I can cooperate with and learn from	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lack of market access	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Existing prejudices on grape wine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Governmental regulations that do not allow promotion of the medicinal value of elderberries	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Laws prohibiting elderberry wine shipments to other states	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stringent requirements from buyers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lack of crop insurance options	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please explain): _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION D: BACKGROUND INFORMATION
 This last section asks for background information to help identify patterns among different kinds of producers. Your answers here are important and will be completely confidential.

D1. What is your age?

- 18–24 35–44 55–64 75–84
 25–34 45–54 65–74 85 or over

D2. What is your gender? Male Female Prefer not to answer

D3. Are you a member of a farmer cooperative or association? Yes No

- D4. How many acres of rural land did you own in 2022? _____ ACRES (if other than acres please indicate the land units here, otherwise, leave blank: _____)
- D5. Besides elderberries, what other crops (if any) did you grow in 2022? (*check all that apply*)
 - Row crops Vegetables Fruits and nuts
 - Ornamentals None Other (please explain): _____
- D6. Do you have a successor/heir who will work on the farm when you retire?
 - Definitely/very likely Likely Not sure Unlikely Definitely not
- D7. In what state/country is your farm located? _____
- D8. Do you have income from sources other than farming? Yes No
- D9. What is the highest level of education you have completed?
 - Some high school, no degree 4-year college degree
 - High school Some graduate work
 - Some college, no degree Graduate degree
- D10. What was your total household income in 2022 (if other than U.S. dollars please indicate the currency here, otherwise, leave blank: _____)
 - Less than \$25,000 \$100,000 to \$149,999
 - \$25,000 to \$49,999 \$150,000 to \$199,999
 - \$50,000 to \$99,999 \$200,000 and above
 - Prefer not to answer

Do you have any comments? (Optional)

THANK YOU

If you have questions about the research or any part of the questionnaire, you may contact: Dr. Teo Skevas by e-mail at skevast@umsystem.edu