Maple Syrup Producers' Willingness to Diversify Forest for Increased Resilience[1]

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Abstract

Diversifying forests can enhance their resilience to extreme weather events and serve as an adaptation strategy to climate change. However, we know little about landowners' willingness to diversify their forests for increased resilience. We focus on the U.S. maple forests that are characterized by a monoculture that relies on one tree species for maple production. We use a choice experiment to elicit producers' preference for diversification, focusing on diversification intensity, trade-offs between long-run environmental benefits of increased resilience and immediate yield penalty, and the contract features. Using a region-specific prediction of future syrup production under RCP 8.5 as an information intervention, we assess how anticipated climate impacts on syrup production influence producer's willingness to diversify. Findings from a pilot survey reveal a nonlinear preference for diversification intensity and contract length, favoring moderate levels of diversification, possibly due to perceived diminishing marginal benefits to diversification due to interspecies competition. Surveyed producers prefer longer contracts, which is consistent with the timeframe needed to realize the slow-maturing environmental benefits of increased resilience. These results highlight the need for public incentives that balance private costs with ecological and economic gains, advocating for policies that support moderate diversification and address immediate yield concerns to enhance both forest resilience and economic sustainability in response to climate variability .We also find that Higher rates of diversification adoption by peers reduce the likelihood of own diversification efforts, possibly due to free riding on the diversification ecological benefits by others.

Key words: ecosystem services, forests, diversification, resilience, nonlinear preference

JEL: C35, Q23, Q57

1. Introduction

Climate change poses significant challenges to agriculture and natural resource management, impacting biodiversity, productivity, and sustainability across various ecosystems (Dawson et al., 2011; Weiskopf et al., 2020). In forest systems, it poses distinct risks, relative to annual crop agriculture, due to prolonged recovery periods from disturbances and the necessity for long-term investment and adaptation (Keenan, 2015; Roshani et al., 2022). Climate variability may occur at rates that exceed the natural adaptive capacity of forest species or ecosystems (Seppälä et al., 2009). The maple forest's vulnerability to climate change is exacerbated by the monocultural practices of the maple syrup industry, which heavily relies on a single tree species - the sugar maple (*Acer saccharum*). The monoculture practice, while economically beneficial in maple syrup production, significantly limits the industry's capacity to buffer and adapt to changing environmental conditions or even collapse (Knoke et al., 2005; Pontius et al., 2016; Wildberg & Möhring, 2019). This poses threats to the industry's sustainability and to the many ecological functions and ecosystem services maple forests provide such as wildlife habitat, biodiversity, and soil fertility (Iverson et al., 2019).

In this context, diversification stands out as a crucial strategy for enhancing socio-ecological resilience within forest-based industries. Increasing ecological evidence shows that diversity in forest species composition can reduce a forest ecosystem's susceptibility to outbreaks and extreme weather events, thereby mitigating risks from climate change (Bauhus et al., 2017; Jactel et al., 2021; Macpherson et al., 2017). Integrating naturally occurring syrup-producing tree species, such as beech, birch, and sycamore into maple forests could potentially bolster ecological resilience and enhance the economic stability of the maple syrup industry (Jactel et al., 2017; Jactel et al., 2021; Knoke et al., 2005; van den Berg et al., 2023).

Economic theory and empirical evidence suggest that diversification in agriculture and forestry can increase economic returns on average, minimize the fluctuations of economic returns, and decrease economic risk (Goodman, 1975; Ives & Carpenter, 2007; Liebman & Schulte, 2015). However, although diversification reduces the risk of production (Di Falco & Chavas, 2008; Di Falco & Chavas, 2009), it might concurrently cause yields to decline due to competition for resources or the introduction of new tree species (Wildberg & Möhring, 2019). Furthermore, the benefits of diversification - increased resilience and ecosystem service provision, are non-excludable, thereby highlighting its nature as a public good. Consequently, since diversification incurs private costs but offers spillover benefits to the wider community, the privately-optimal level of diversification falls is likely to be lower than socially-optimal level (Hanley et al., 2012).

Currently, there are no public incentive programs in the US specifically designed to support forest diversification. Moreover, we lack insight into whether producers are willing to diversify their forests and what specific program characteristics might encourage participation. Therefore, we designed a choice experiment (CE) that elicits maple syrup producers' preferences and their willingness to adopt (WTA) forest diversification in the context of a Payment for Ecosystem Services (PES) program. Our CE asked maple syrup producers to make choices over different diversification programs, characterized by seven attributes. Key among these is the diversification intensity, indicated by the ratio of non-maple to maple species. The proposed program also described two attributes representing the consequences of diversification: the annual syrup yield reduction due to interspecies resource competition (e.g., shading) or new species introduction, and enhanced resilience, indicated by a reduced likelihood of below-average yields resulting from extreme weather in 15-20 years. These two attributes capture a major trade-off faced by producers: the immediate yield penalty versus the long-term benefits of enhanced resilience. Importantly for a program design, we also included among the attributes the diversification contract length. Given the regional dimension of forest resilience and the importance of peer adoption in the conservation literature, we also included the diversification adoption rates.

We derive key hypotheses for empirical testing from existing theoretical frameworks, given the lack of empirical evidence on producers' preferences for forest diversification program attributes. First, we hypothesize that producers have a nonlinear preference for diversification intensity, based on the ecological theories of diminishing marginal benefits of biodiversity due to interspecies interactions, such as competition for resources. Second, we posit that producers have a nonlinear preference for contract length. Producers may opt for longer contracts to secure long-term investments and planning, as well as to realize the long-term maturation of environmental benefits from forest diversification. However, they may also favor shorter contracts for flexibility with fewer constraints on their practices. Third, we hypothesize that regional adoption rates influence individual diversification efforts. While shared pest and disease regulation benefits could cause the diversification decisions among neighbors to be complements, the public nature of these benefits might foster free-riding, potentially diminishing individual diversification efforts.

We further investigate how region-specific information on climate change affects producers' willingness to diversify. We utilize projections about the future syrup production across the U.S. under RCP 8.5 as our information intervention (Rapp et al., 2019). We hypothesize that the information treatment will influence producers' willingness to adopt, though the overall impact remains ambiguous due to geographical heterogeneity. While the Midwest is projected to face more severe impacts, the Northeast currently accounts for a larger share of total production.

Using conditional logit and mixed logic models, our findings from the pilot study indicate that diversity intensity, yield reduction, peer adoption, and payment significantly influence producers' preferences. We observe a nonlinear preference for diversification intensity; a 25% diversification increases the likelihood of program adoption, whereas a higher intensity reduces it. This non-linear pattern aligns with ecological studies that identify diminishing marginal benefits of diversity shaped by complex interspecies interactions. Additionally, we find that increased resilience benefits increase the likelihood of program adoption, whereas a decline in maple yield decreases that likelihood. Notably, having 25% of diversified peers in a producer's region reduces their own likelihood of diversification, possibly due to free-riding on the diversification efforts of others. Furthermore, a 15-year contract term is associated with a higher probability of program adoption. This finding highlights a unique aspect of contract dynamics in perennial systems: unlike typical annual PES contracts in sustainable agriculture, forest diversification (or perennialization of agricultural systems) is characterized by longer-term planning and slower maturation of environmental benefits.

2. Literature Review

A substantial body of literature focuses on agricultural diversification, revealing the relationship among crop biodiversity, productivity, and risk, with a focus on annual crops (Di Falco, 2012). In terms of productivity, evidence consistently shows that crop diversity increases farm productivity (Smale et al., 1998), especially under poor environmental conditions (Di Falco et al., 2007). These studies draw their conclusions from observational data at the aggregate or farm level (Di Falco et al., 2010; Di Falco & Chavas, 2009; Omer et al., 2008; Smale et al., 1998; Widawsky & Rozelle, 1998). In terms of risk exposure, research indicates that crop diversity reduces the variance of yield (Di Falco et al., 2007; Di Falco & Perrings, 2005), and Di Falco and Chavas (2009) find the effect of diversity on skewness dominates its effect on variance, meaning that diversity reduces the cost of risk. However, crop diversity may reduce the mean of yield (Widawsky & Rozelle, 1998).

There has been limited research on the economics of diversification in perennial systems, where the dynamics can significantly differ due to the long-term nature of investments and biological cycles. Macpherson et al. (2017) employ a bioeconomic model to show how diversification in production forests can mitigate economic losses resulting from diseases. Similarly, Siddique (2019) explores optimal diversification levels in apple orchards through intercropping, suggesting strategic species selection can improve overall orchard health and economic outcomes.

Moreover, diversification has been proposed as a climate adaptation practice based on ecological evidence (Bauhus et al., 2017; Jactel et al., 2017; Messier et al., 2022), yet its benefits in enhancing resilience against extreme weather conditions remain underexplored in the economics literature. Most climate adaptation studies have primarily focused on annual crops rather than perennial systems, incorporating farmer adaptation behaviors to obtain a more accurate estimate of climate change's impacts on agriculture that account for adaptation (Chen & Gong, 2021; Cui & Xie, 2022; Hultgren et al., 2022; Yang & Shumway, 2016). Additionally, optimization-based studies shed light on how the optimal intensity of on-farm adaptation strategies can be determined (Ghorbani, 2021) .

In addition, the benefits of diversification discussed – increased resilience and ecosystem service provision, are non-excludable and non-rival, indicating its public good nature. Hanley et al. (2012) observe that the market typically fails to compensate for biodiversity enhancement as the private landowners usually receive no direct financial incentive to promote biodiversity. Consequently, diversification incurs opportunity cost to landowners – for instance if it requires to forgo profitable land intensification practice, but provides the benefits to wilder communities. Then the private optimal level of diversification is likely to be lower than social optimal level. This discrepancy underscores the necessity for an effective PES scheme to incentivize the adoption of diversification behaviors (Cooper, 2003; Piñeiro et al., 2020).

Research on the optimal PES scheme design focuses on conservation programs that involve short-run (often annual) decision-making of farmers in agricultural practice. Some literature feeds the estimation results of farmers' preference into contract optimization models for a stylized conservation scheme (Howard et al., 2023; Ruto & Garrod, 2009). Canales et al. (2024) further extend this approach by considering the risk of adoption and influence of off-farm environmental impacts. Notably, existing literature documents a preference among growers of annual crops for no or shorter contracts since they are not willing to be locked into a multi-year contract (Gramig & Widmar, 2018; Howard et al., 2023; Rabotyagov & Lin, 2013; Sheremet et al., 2018). However, in the context of forest diversification or the perennialization of agricultural systems, which involve longer-term planning and slower maturation of environmental benefits, longer contracts are often more beneficial. This aligns with findings from Ando and Chen (2011), who suggest that longer contracts maximize the environmental benefits in scenarios where environmental benefits mature slowly.

3. Data and Survey Design

3.1 Survey Design and Summary Statistics

The survey targets maple syrup producers primarily located in the Midwestern and Northeastern regions, which are the main areas of syrup production in the United States. Our planned sampling strategy for the full survey utilizes convenience sampling from databases held by syrup producer associations and forest extension services, and a sample from Dynata - a sampling company that generates address lists based primarily on government reporting, furnished sample addresses. We obtain the mailing addresses of maple syrup producers based on the SIC code. The dissemination of the survey involves a mixed approach of web and mail-push-to-web surveys. Respondents for whom we have physical addresses initially receive a letter containing a link to complete the survey online, followed by a mailed paper survey to those who do not respond after two reminders. Others receive emails from their producer associations and Extension agents.

We conducted our pilot survey at the International Maple Syrup Conference in December 2023, where we tested the survey instrument in-person with maple syrup producers and collected the pilot data. Based on the pilot findings, we incorporated additional questions focused on producers' current sugarbush practices, enabling us to separate within-maple and across-maple diversification, diversification across different locations, and their roles in the market chain. These characteristics enable us to assess whether those who have adopted within-maple species diversification are more likely to diversify beyond maple species. Additionally, we clarified the spatial boundaries of peer adoption rates within the same regions due to the extensive size of maple forests, which may lack neighboring producers. This allows for a more precise assessment of how peer networks influence diversification practices.

Our final survey consists of five parts. It begins by capturing the current situation (status quo) of producers' maple forests, including yield, syrup production, tree species composition, forest ownership, and syrup-related operations. Also, we ask about producer experience with drought, pests, and diseases, including questions about yield stability and the main drivers of yield fluctuation, as well as involvement in any insurance or disaster recovery programs. Following this, the survey explores the producers' perceptions of forest diversification, exploring potential motivations and barriers, and examines their beliefs related to climate change. Our CE is then introduced to elicit preferences for different forest diversification programs (details in the next subsection). We present all respondents with two identical sets of CE choice tasks (three tasks in each set, totaling six tasks). Between these sets, the treatment group receives a targeted information script, while the control group is given neutral information. Following the CE, the survey concludes with a section on demographic characteristics, capturing data on gender, age, education, and household income, as well as their risk preferences, time preferences, and loss aversions. A copy of the questionnaire is included in Appendix A.

Table 1 presents summary statistics for our respondents. Of the respondents, 63% are male, with an average age of 60 years old. A high education level is evident, as approximately 90% have at least a college degree. The average size of the sugarbush is around 100 acres. Ownership status shows that 42% own their sugarbush, 11% lease, and 47% have a combination of owning and leasing. Regarding syrup production income, 42% of respondents consider it somewhat important, 26% see it as a minor source, 16% as a primary source, and 16% as not a source of income. Responses on syrup yield stability are varied, with 61% describing it as somewhat stable, 22% as somewhat unstable, 11% as very stable, and 6% as very unstable. About 42% of the respondents have considered forest diversification, and a significant majority (95%) have no prior adoption of diversification, indicating the high reliance on one tree species (monoculture practice) within the industry.

3.2 Experimental Design for the Choice Experiment

3.2.1 Discrete Choice Experiment

In the CE, we present producers with two hypothetical scenarios, along with a status-quo option. The purpose of these scenarios is to elicit preferences for different diversification programs. Each hypothetical diversification program option (a choice alternative) is described by seven attributes: diversification intensity, two outcomes from diversification (yield decrease and enhanced resilience to weather shock), equipment needed, peers' adoption rates, contract length with annual inspection, and annual payment. The design of the seven attributes for the CE is summarized in Table 2. To promote consequentiality as suggested in Johnston et la. (2017), we stated the funding source from USDA and highlighted how the results will be disseminated, which could potentially influence the formulation of policies such as cost-share programs. To mitigate hypothetical bias due to respondents' limited experience or knowledge of forest diversification, the survey incorporates both visual and textual descriptions of forest diversification, including the benefits, economic trade-offs, and non-maple tree species that also be used to produce syrup.

We use a Bayesian approach to generate our choice set design (Scarpa et al., 2007). Firstly, we used the D-optimal approach to derive the choice design (zero priors) in the pilot phase. This was achieved through the maximization of the determinant of the information matrix |X'X|, which identified the best subset from all possible combinations. Then, based on the pilot data (19 respondents, 114 choice observations), we run the multinomial logit model and use the estimates as Bayesian priors to generate the final Bayesian D-efficient design for the final CE. The resultant CE was structured into three eight blocks, each comprising three choice cards, with a total of 24 choice scenarios. The respondents will be randomly assigned one block and they will do 3 choice tasks. Figure 1 illustrates an example of the choice card that presents two diversification program scenarios and an opt-out option.

The final design was generated accounting for main and interaction effects. There are two interaction effects: first, the link between diversification intensity and yield reduction, examining if increased non-maple species competition deters producers from adopting diversity due to yield losses; second, the impact of neighboring producers' adoption rates on individual decisions in diversification intensity, exploring whether producers reduce their diversification efforts to leverage collective resilience benefits while minimizing yield losses from diversification on their farms.

3.2.2 Information Treatment

We combine within- and between-subject variation in exposure to information (Charness et al., 2012). First, within-subject variation is achieved by presenting respondents with two sets of DCE choice tasks with an information script in-between, an approach inspired by the previous literature (Allcott & Taubinsky, 2015; Allcott & Wozny, 2014; Lang et al., 2021). The second source of experimental variation is between subjects and involves a control group and a treatment group. More specifically, after completing 3 choice tasks, half of the respondents are assigned to receive information interventions. Respondents then complete a second set of choice tasks (identical to the first set), which allows us to identify the impact of information on WTP estimates. Figure 3 illustrates the information treatment. Rapp et al. (2019) project the future syrup production across the U.S. by the year 2100 in an RCP 8.5 climate change scenario. Our goal is to identify how region-specific information of climate effects influences producers' willingness to diversify.

4. Empirical models

4.1 Hypothesis

The hypotheses are as follows:

(1) Producers have a nonlinear preference for diversification intensity. Ecological studies indicate a non-linear link between biodiversity and ecosystem functionality, due to diminishing marginal benefits of diversity in ecological systems shaped by complex interspecies interactions,

including competition (Baeten et al., 2019; Forrester & Bauhus, 2016), as well as a new variety of tree species.

(2) Producers have a non-linear preference for contract length. Unlike typical annual agricultural contracts, forest diversification (or perennialization of agricultural systems) is characterized by longer-term planning and slower maturation of environmental benefits. This is in line with Ando and Chen (2011), theoretically suggesting that longer contracts maximize environmental benefits in slow-maturing contexts, which is the case of forest diversification. Lennox and Armsworth (2011) also note that ecological uncertainty can significantly shift farmers' preferences between short and long contract durations. We do not know whether producers of perennial crops are more likely to accept longer contracts. They favor a longer contract length that would be consistent with the time it takes for benefits to materialize. However, they might dislike commitments that are too long, which is the typical finding for the producers of annual crops (Gramig & Widmar, 2018; Howard et al., 2023; Rabotyagov & Lin, 2013).

(3) Diversification by peers in the same region increases the probability of own diversification given the pest and disease regulation benefits of diversification and the complementary nature of disease and pest regulation provision on neighboring forests (Atallah et al., 2023). In contrast, free riding might reduce own diversification effort because of the public benefits of diversification (Hanley et al., 2012).

4.2 Econometric model

We utilize a random utility framework, incorporating random (unobserved) preference variation and heterogeneity. Maple syrup producer i's utility from choice j, denoted as U_{ij}, is a function of a vector of choice attributes $\boldsymbol{X_{ij}}$:

$$U_{ij} = V_{ij} + \epsilon_{ij} = \beta_i \boldsymbol{X_{ij}} + \epsilon_{ij} \tag{1}$$

Where V_{ij} is a deterministic component based on observable attributes of each alternative; and ϵ_{ij} is an unobserved stochastic component. We assume that ϵ_{ij} has the Type 1 extreme value distribution. β_i is a vector capturing producer i's latent preference parameters for the attributes of alternative j. $\boldsymbol{X_{ij}}$ is a set of attributes that include our CE attributes and alternative-specific constants (ASCs) for alternative j. Under this framework, the probability that producers i will select alternative j from a set of J alternatives in choice card t is given by:

$$Pr_{it}(j) = \frac{\exp{(\beta_i X_{ijt})}}{\sum_{k=1}^{J} \exp{(\beta_i X_{ijt})}} \tag{2}$$

To elaborate on our model, our choice attributes include our CE attributes, which are variable characteristics of the offered diversification programs, and an ASC for the status quo. The empirical model is as follows:

$$V_{ijt} = \beta_{i1} Intensity_{it} + \beta_{i2} Yield\_Reduction_{it} + \beta_{i3} Resilience_{it} + \beta_{i4} Equip_{it} + \beta_{i5} Contract\_Length_{it} + \beta_{i6} Payment_{it} + \beta_{i7} SQ_{it} \tag{3}$$

where $Payment_{it}$ is defined as a continuous variable, while the other variables are encoded as dummy variables to determine if there is a non-linear pattern in preferences.

To evaluate the effect of our informational interventions on post-treatment choices, while also controlling for the placebo intervention, we interact each attribute with a post-treatment indicator, $Post_t$, which is set to one if $t \in [4, 6]$, zero otherwise. The treatment indicator, T_i, equals to one if producer i is assigned to the information treatment, zero otherwise. Therefore, the post-treatment utility can be expressed as:

$$V_{ij}^{post} = V_{ij} + Post_t\ (\eta_{i1} Intensity_{it} + \eta_{i2} Yield\_Reduction_{it} + \eta_{i3} Resilience_{it} + \eta_{i4} Equip_{it} + \eta_{i5} Contract\_Length_{it} + \eta_{i6} Payment_{it} + \eta_{i7} SQ_{it}) + Post_t \cdot T_i \cdot (\gamma_{i1} Intensity_{it} + \eta_{i2} Yield\_Reduction_{it} + \eta_{i3} Resilience_{it} + \eta_{i4} Equip_{it} + \eta_{i5} Contract\_Length_{it} + \eta_{i6} Payment_{it} + \eta_{i7} SQ_{it}) \quad (4)$$

where the set of η_i parameters account for potential changes in the placebo group during the post-treatment period, and the set of γ_i represents average treatment effects on utility.

5. Result and Discussion

Utilizing pilot data, we applied conditional logit and mixed logit models, with the coefficient estimates informing the priors for a Bayesian design. Table 3 shows the preliminary results. These findings from the pilot offer suggestive evidence for our hypotheses.

The results show a non-linear preference for the diversification intensity, aligning with the diminishing marginal benefits of diversification. Specifically, a 25% diversification intensity shows a positive effect on adoption likelihood in both conditional and mixed logit models, albeit not statistically significant. However, a higher share of non-maple trees (50% and especially 75%) significantly reduces the likelihood of program adoption, possibly due to the perceived manageable risks and the potential for maintaining stable yields. While increased resilience may incentivize program adoption, yield declines significantly reduce the likelihood of program adoption, highlighting the immediate economic concerns of producers.

Notably, the influence of peer adoption rate demonstrates a potential free-riding effect, where having 25% of diversified peers in a producer's region reduces their own likelihood of diversification. Moreover, a 15-year contract term is associated with a higher probability of program adoption. This finding implies that producers in perennial systems with slowly maturing environmental benefits may be willing to forgo contractual flexibility in favor of ecological gains. As illustrated in the theoretical model by Ando and Chen (2011), longer contracts maximize environmental benefits in scenarios where these gains mature gradually.

6. Next Steps

These preliminary findings are critical for refining the full survey and program design. If confirmed by the full launch data, they would suggest that policymakers should consider moderate diversification targets and tailor financial incentives to offset immediate yield decline concerns. Understanding the diversity of producer preferences can lead to programs that encourage broad participation, improve forest resilience, and maximize the ecological and economic benefits of diversification. In addition, policy interventions should consider geographically heterogeneous response to climate change impacts to effectively encourage diversification.

TABLES

Table 1 Summary statistics of pilot survey data

Variable	Description	Mean	Std. Dev.
Male	=1 if male	0.63	
Age	Age of the respondent	60.26	13.99
High	=1 if go to high school or have a high school degree	0.11	
College	=1 if go to college or have bachelor's degree	0.79	
Post_Graduation	=1 if have a master's, doctoral or professional degree	0.11	
Income	Household income (in thousand dollars)	94.89	53.43
Size	Sugarbush size (acres)	100.79	124.63
Own	=1 if own the sugarbush	0.42	
Lease	=1 if lease the sugarbush	0.11	
Mix	=1 if own plus lease the sugarbush	0.47	
Imp_Income	=1 if it is not a source of income; =1 if it is minor source of income; =1 if it is somewhat importance; =1 if it is primary source of income;	15.79 26.32 42.11 15.79	
Yield_Stability	=1 if it is very unstable; =1 if it is somewhat unstable; =1 if it is somewhat stable; =1 if it is very stable;	5.56 22.22 61.11 11.11	
Div_cons	=1 if producers have considered the forest diversification	0.42	
NoPrior_Div	=1 if only take the monoculture practice (no diversification)	0.95	
Number of observations		19	

Table 2 Choice Experiment Attributes

Description of Attributes	Variable Name	Levels
Share of non-maple (e.g., birch or beech) relative to total (maple + non-maple) syrup trees	Non-maple Share	75, 50, 25 (%)
Annual decrease in maple syrup yield because of diversifying sugarbushes due to competition (e.g., shading) or the low yield from a new variety of tree species	Yield Decrease	20, 0 (%)
Reduction in the likelihood of weather-induced below-average yield as a results of diversifying sugarbushes in 15-20 years	Resilience	50, 0 (%)
New processing equipment needed (1= Yes, 0 = No)	Equip	1, 0
Share of your producer peers in the same region that have diversified their sugarbushes	Peer	75, 50, 25, 0 (%)
Multi-year contract with annual inspection	Contract Length	15, 10, 5, 0 (years)
Annual payment per diversified acre (above 10% share of non-maple)	Payment	500, 350, 150, 0 ($/acre/year)

Table 3 Conditional and mixed logit estimation results

	(1)	(2)	
	Conditional Logit Model	**Mixed Logit Model**	
	Coef (SE)	Coef (SE)	Std Dev (SE)
Share of Non-maple Trees: 75%	-0.533	-1.062	
	(0.436)	(0.646)	
50%	-1.109**	-1.791**	
	(0.475)	(0.792)	
25%	0.262	0.239	
	(0.350)	(0.591)	
Increased Resilience	0.294	0.374	0.912
	(0.268)	(0.600)	(1.069)
Maple Yield Decline	-0.546*	-1.137**	-0.914
	(0.328)	(0.525)	(0.763)
New Equipment Required	0.075	-0.044	0.940
	(0.339)	(0.484)	(0.594)
Share of Peers Diversifying Forest: 75%	0.084	0.242	-0.193
	(0.378)	(0.606)	(0.730)
50%	-0.039	0.587	-0.209
	(0.391)	(0.698)	(0.875)
25%	-0.506*	-1.082	0.050
	(0.274)	(0.779)	(0.732)
Contract Length: 15 years	0.612	0.329	
	(0.406)	(0.712)	
10 years	-0.778	-0.871	
	(0.686)	(0.766)	
5 years	0.310	0.244	
	(0.431)	(0.663)	
Annual Payment	0.001*	0.003*	
	(0.001)	(0.001)	
Neither	0.161	-1.041	3.711***
	(0.777)	(1.360)	(1.318)
AIC	237.92	209.33	
BIC	290.85	288.72	
Observations	324	324	

Note: Robust standard errors in parentheses. We drop one sample due to its failure to meet the criteria for incentive compatibility.
*** p<0.01, ** p<0.05, * p<0.1.

FIGURES

Now we kindly request that you review the following pairs of potential diversification programs and select the one you would pursue if it became available.

D8. **You are on Choice Card 1 of 6:** Please choose the bundle that you most prefer for diversifying your sugarbush: Option A, Option B, or 'Neither' if you prefer to maintain the current setup without any changes.

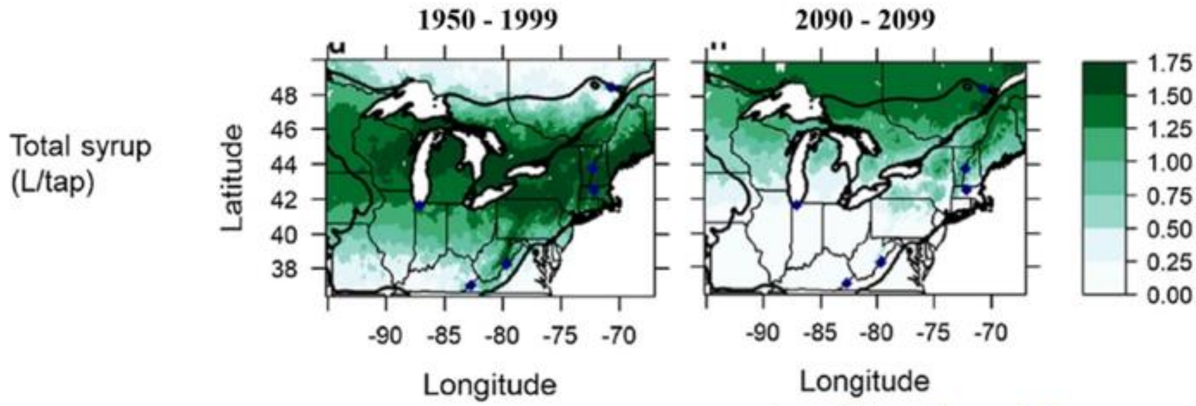
	Option A	**Option B**	**Neither**
Share of non-maple (e.g., birch or beech) relative to total (maple + non-maple) syrup trees	75%	25%	I prefer to stay in my current situation
Annual decrease in maple syrup yield because of diversifying sugarbushes due to competition (e.g., shading) or the low yield from a new variety of tree species	20% decrease ↓	20% decrease ↓	
Reduction in the likelihood of weather-induced below-average yield in 15-20 years as a result of diversifying sugarbushes	50% reduction↓	No reduction	
New processing equipment needed	No	Yes	
Share of your producer peers in the same region that have diversified their sugarbushes	0%	75%	
Multi-year contract with annual inspection	15 years	5 years	
Annual payment per diversified acre (above 10% share of non-maple)	350$/acre/year	500$/acre/year	
CHECK ONE:	○	○	○

What percentage of the land that you currently own or lease would you like to subscribe to the diversification program? Please enter a percentage ______________% (Note: The percentage could exceed 100% if you intend to buy or lease additional land that is allocated to this program. If you choose "Neither" option, leave this question blank).

Figure 1 An Example of Choice Card

D11. Please pay close attention to the total syrup production map. In your region, is the total syrup production going to increase or decrease in the future?

1. ☐ Increase
2. ☐ Decrease
3. ☐ Zip code of the region you focus: ______________



https://doi.org/10.1016/j.foreco.2019.05.045

Now please consider the following pairs of potential diversification programs and select the one you would pursue if it became available.

Figure 2 Information Treatment
Source: Rapp et al. (2019)

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