



What does it take to get family forest owners to enroll in a forest stewardship-type program?

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ABSTRACT

We estimated the probability of enrollment and factors influencing participation in a forest stewardship-type program, Minnesota's Sustainable Forest Incentives Act, using data from a mail survey of over 1000 randomly-selected Minnesota family forest owners. Of the 15 variables tested, only five were significant predictors of a landowner's interest in enrolling in the program: compensation amount, intention to obtain a forest management plan, opposition to the program's land covenant, prior awareness of the program, and total acres of forest land owned. The estimated median minimum compensation required was approximately \$24 per acre per year. One-fourth of the survey respondents were undecided about whether they would participate in the stewardship program, suggesting there may be potential to capture additional interest and participation. Marketing efforts to raise program awareness, increasing annual stewardship payments, and eliminating the land covenant are likely to be effective strategies for increasing program participation.

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1. Introduction

Stewardship is a widely recognized land management ethic whose roots were formally established nearly 60 years ago (Leopold, 1949). Worrell and Appleby (2000) define stewardship as “the responsible use (including conservation) of natural resources in a way that takes full and balanced account of the interests of society, future generations, and other species, as well as of private needs, and accepts significant answerability to society.” Sustainable forestry, described by the Forest Service, U.S. Department of Agriculture as management to sustain a healthy, productive resource that supports and perpetuates a range of economic, social and environmental forest-based benefits, is often used synonymously with forest stewardship (USDA, 2004). The Forest Stewardship Council's ten principles¹ similarly define stewardship as environmentally responsible, socially beneficial and economically viable management of forest resources (FSC, 2003).

Although the stewardship concept embodied in these definitions has broad appeal conceptually, securing stewardship of the nation's private forest land has been an elusive societal goal (Greene et al.,

2005). While many private landowners voluntarily embrace stewardship as an overarching tenet of forest land ownership, a variety of regulatory and incentives programs are used to encourage additional owners to adopt this philosophy. The former includes regulatory measures implemented at state and local levels that prescribe what landowners can and cannot do on their forest land (for example, see: Ellefson et al., 2006; Mortimer et al., 2006). The latter includes a suite of programs offered by federal, state, private, and non-profit organizations to assist forest landowners in undertaking stewardship efforts such as reforestation, development of a forest management plan, and silvicultural treatments such as thinning or pruning. Most of the economic and policy research on strategies to encourage stewardship on private forest lands has focused on specific incentive or disincentive programs (Greene et al., 2005).

We were interested in documenting the opportunity cost associated with acquiring a commitment to stewardship on family forest lands, the latter defined in our study as private forests owned by non-corporate interests. To do so, we employed the contingent valuation method (CVM) to estimate a family forest owner's willingness to accept (WTA) compensation in return for making several commitments associated with being good forest stewards.

We use participation in Minnesota's Sustainable Forest Incentive Act (SFIA) program as a measure of forest stewardship. The SFIA program was enacted by the Minnesota Legislature in 2001 as a means of encouraging good stewardship of the state's private forests. Forest landowners participating in the SFIA program are required to enroll their land for a minimum number of years during which time they agree to acquire and follow a forest management plan, apply best

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¹ FSC's 10 principles of forest stewardship address: 1) compliance with laws and FSC principles and criteria; 2) land tenure and use rights and responsibilities; 3) indigenous people's rights; 4) community relations and worker rights; 5) benefits from the forest; 6) environmental impacts; 7) use of a written management plan; 8) monitoring and assessment of forest conditions and practices; 9) maintenance of high conservation value forests; and 10) use of plantations.

management practices to protect or enhance a wide range of forest values (e.g., water quality, riparian forests, wildlife habitat, aesthetics) when conducting timber harvesting and forest management activities, and keep the land in a forested condition for a minimum period of time. These are precisely the types of land management activities and commitments commonly associated with forest stewardship. In return for their participation in the SFIA program, landowners receive an annual “incentive” payment from the state based on the number of acres enrolled (Kilgore, 2002). The SFIA’s wide-ranging commitment to stewardship through planning, implementation of environmentally-responsible forest management practices, and land use restrictions distinguishes it from other more narrowly focused forestry incentive programs (Greene et al., 2005).

Although the SFIA program has been in existence since 2001, enrollment of family forest land has been very modest, with less than 2% of eligible family forest acres enrolled. We hypothesized a landowner’s interest in making a commitment to this program is a function of the following factors: 1) compatibility of past land management practices with those that define stewardship; 2) compatibility of future plans for the land with those that define stewardship; 3) awareness of programs that encourage forest stewardship; 4) perceived constraints of such a commitment on future land use and ownership options; and 5) cost of forest land ownership (e.g., annual property taxes); and 6) the annual SFIA payment amount.

Our study is the first we are aware of to identify the value (cost) family forest owners ascribe to making a commitment to forest stewardship broadly defined through the SFIA program. The most comparable study we could find was conducted by Sullivan et al. (2005), which estimated the value Virginia family forest owners attach to permanently foregoing timber and development rights by enrolling in The Nature Conservancy’s Forest Bank Program. Landowners participating in the Forest Bank Program cede future development rights and timber management responsibility (and associated timber sale revenue) to a third party in return for an annual or lump-sum payment. An important distinction is that the Virginia study values those management rights and responsibilities *relieved* of the landowner (i.e., as if these rights were conveyed through a permanent conservation easement), whereas our study values the additional stewardship *obligations* associated with enrolling in the SFIA program.

2. Background

2.1. Minnesota’s family forest land and its owners

Seven million of Minnesota’s 16.3 million acres of forest land (43%) are privately owned. Of these 7 million acres, 751,000 acres are owned by forest industry and 613,000 by other corporate entities. The remaining 5.6 million acres of private forest land are owned by individuals, estimated to number 150,000 (Miles et al., 1995). A general characterization of these forest lands and their owners is that the tracts are small (averaging 64 acres); more than half of the owners do not live on their forest; land tenure is considerable (median ownership length is 23 years); and individuals own forest land for many reasons, the most common being wildlife-related such as habitat or hunting. Studies of these owners and their forests have consistently found that timber management ranks low on the list of reasons for forest land ownership by individuals in Minnesota (Baughman, 1988; Rathke, 1993; Cervantes, 2003; Kilgore et al., 2007; Snyder et al., 2007; Kilgore and MacKay, 2007).

2.2. SFIA program

Our study used Minnesota’s SFIA program as a proxy to evaluate a family forest owner’s interest in making a commitment to forest

stewardship. To enroll forest land in the SFIA program, the following eligibility requirements must be met (Minnesota Statutes, 2006).

- *Contain at least 20 contiguous acres.* A landowner may apply to enroll all or part of a land parcel, provided the enrolled property is at least 20 contiguous acres in size and at least 50% of that land is defined as forest land.
- *Obtain and follow a forest management plan.* All enrolled land must have a forest management plan prepared or updated within the past 10 years and be managed in a manner that is consistent with the plan.
- *Use timber harvesting and forest management guidelines.* All activities prescribed in the forest management plan must be carried out in a manner consistent with Minnesota’s voluntary guidelines for conducting timber harvesting and forest management practices (see: <http://www.frc.state.mn.us/FMgdline/Guidebook.html>).
- *Enroll for at least 8 years.* Forest land must be enrolled for a minimum of 8 years. After 4 years, a landowner can file to remove the land from the SFIA program. Withdrawal from the SFIA program will not commence, however, until 4 years after the landowner files a notice of intent to do so.
- *Record a covenant with the property deed.* The landowner must record a covenant on all SFIA-enrolled properties, restricting the land’s uses while enrolled to those consistent with the SFIA requirements. If the land is sold while enrolled in the SFIA, the new owner is subject to the covenant’s restrictions.

Owners of SFIA-enrolled land receive an “incentive” payment each year the land is enrolled. The total annual payment a landowner receives is based on the number of acres enrolled. Each year, the state Department of Revenue sets (by formula) the incentive payment amount. In 2006, the annual payment was \$5.24 per acre. All enrolled lands receive the same per acre payment amount regardless of the land’s location or value (Kilgore, 2002, J. Rosalez, MN Dept. of Revenue, personal communication, 15 Feb, 2007).

2.3. Survey

We administered a mail-back questionnaire to obtain information from Minnesota family forest landowners. Our choice of survey questions and potential explanatory variables was guided by reviewing the extensive body of research on family forest owner attitudes and motivations. This research suggests that individuals are a heterogeneous ownership group with diverse ownership objectives and motivations. As such, the questionnaire requested information on reasons for forest land ownership, perspectives on the SFIA program (e.g., interest in enrolling at a specified annual payment rate, attitudes toward the current SFIA requirements), historical and future planned forest management and land use activities, future ownership plans, and owner demographic information (e.g., land ownership tenure, number of parcels and acres of forest land owned, location of residence in relation to forest land owned, age). We decided not to include a question about the landowner’s annual income for two reasons. First, based on our prior interaction with family forest owners, we felt such a question would be considered too personal for many and reduce the overall survey response rate. Moreover, other CVM studies found income was not a significant predictor of family forest owner willingness to accept incentive payments (e.g., Kline et al., 2000; Sullivan et al., 2005).

The WTA payment question was posed in a dichotomous choice (DC) format in which respondents are asked to choose between two alternatives, one being the status quo and the other being a change in a program for a given cost or benefit. This format has been widely used to elicit preferences in survey research as well as a means to empirically estimate WTA values in a population (e.g., Bishop and Heberlein, 1979; Cameron, 1988). A primary reason for the utilization

of the DC format is because it is incentive compatible in many applications, meaning that respondents have incentive to truthfully and fully reveal their preferences (Carson and Groves, 2007).² Further, a ‘closed-format’ DC approach in which respondents are presented a dollar amount rather than asked to specify an amount they would be willing to accept is generally preferred because respondents may have little familiarity with the good they are being asked to value and may not be able to specify a reasonable value for the good (Arrow et al., 1993; Carson et al., 2001). Following the recommendations of the 1993 Report of the NOAA Panel on Contingent Valuation (Arrow et al., 1993), we included an “unsure” option in addition to the “yes” and “no” response to the WTA question. The rationale was to provide an option for respondents who are indifferent between a yes and a no choice, unable to make a decision without more time or more information, prefer another mechanism for making their decision, or are bored by the survey and anxious to end it as quickly as possible (Arrow et al., 1993). The DC question presented to our survey participants was as follows:

If you were guaranteed an annual payment of \$X for each acre of your forest land that was enrolled in the SFIA program under the conditions described above, would you participate in the SFIA Program? (For example, if you enrolled 20 acres in the SFIA program, you would receive \$X times 20 each year you were enrolled.)”

Survey participants were offered one of four payment levels (\$5, \$10, \$20, \$30). The levels were randomly assigned so that one-fourth of the participants was offered each payment amount. The smallest payment offered, \$5 per acre per year, approximated the actual payment made to SFIA program participants in 2006. The literature provides little guidance on the largest payment amount to offer. We chose a \$30 per acre payment because it is the upper-end value associated with enrolling in a comparable property tax program offered in a neighboring state, Wisconsin’s Managed Forest Law (Pingrey, 2005).

Parcels that were predominantly forested, undeveloped (i.e., contain no buildings), and at least 20 contiguous acres were included in the study. Assessors’ offices in Minnesota’s 15 counties with the largest acreage of family forest land were contacted to obtain information on forest land that met the study criteria. Information requested included the name and mailing address of the legal owner and information about the parcel (e.g., acres, estimated market value).

From this information, a list of potential recipients of the survey questionnaire was developed and subsequently screened to ensure only forested parcels that: were not enrolled in the SFIA program; owned by individuals (i.e., family forest owners); and whose owners had not received any surveys administered by the University of Minnesota’s Department of Forest Resources within the past 5 years were selected. Once the list of owners and associated parcel information was assembled, a random sample of 160 private forest landowners was drawn, with the sample weighted by the amount of family forest acreage in each county relative to the total acreage of family forest land in the 15 counties. This sample was used to pretest the draft survey questionnaire to ensure all survey questions were understandable by the respondents and the response data provided the information sought and in a usable format. The survey pretest produced a usable response rate of 48%. Once the survey pretest was complete, survey response data was evaluated. Slight modifications

were made to the survey instrument based on the results of the survey pretest.

The final survey questionnaire was mailed to 1024 family forest owners (again, with the sample weighted by the amount of family forest acreage in each county relative to the total acreage of family forest land in the 15 counties) who were randomly selected using the criteria and screening process previously described. The survey was administered between October and December 2006 following the method described by Dillman (2000). This method included mailing (sequentially) to the survey participants the following information a (n): initial contact letter; study questionnaire, SFIA fact sheet (see Appendix A), and cover letter; reminder postcard; second questionnaire, fact sheet, and cover letter; and final reminder letter.

From the initial 1024 randomly sampled family forest owners, nine were undeliverable due to incorrect mailing addresses, resulting in 1015 forest owners actually being contacted. Of these, 640 returned surveys, 37 returned blank surveys, and 338 did not respond. This yielded an overall response rate of 67%. Of the 640 returned surveys, 442 contained complete and useable information to all of the questions whose responses were incorporated in our model. Consequently, the information contained in these 442 surveys formed the data set for our study. The 198 returned surveys that were not complete were excluded from further analysis. An analysis of the survey respondents and non-respondents found no significant differences in key landowner metrics (e.g., acres of forest land owned) between the two groups, suggesting the data obtained and described in this report can be interpreted as being representative of Minnesota’s family forest landowners meeting the study selection criteria (e.g., own at least 20 acres, not currently participating in the SFIA program).

2.4. Estimation

We followed Hanemann (1984) in using a random utility model to estimate WTA in a DC format. Survey respondents who responded “yes” to the question about whether they would enroll in the SFIA program at an annual payment of \$X indicated the opportunity costs from the additional stewardship obligations associated with enrolling in the SFIA program are equal to or smaller than the proposed compensation payment of \$X. Landowner responses to this question were analyzed using a binary logit model to estimate the probability of enrollment in the SFIA program; identify landowner, forest, and SFIA program characteristics that influence participation in the SFIA program; and estimate WTA values (Hanemann, 1984; Richardson and Loomis, 2005).

In its simplest form, the logit model is:

$$\text{Logit}(Y) = \ln\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta'x \quad (1)$$

where:

| | |
|----------|--|
| π | probability of an outcome (a landowner will enroll in the SFIA program) |
| α | intercept |
| β' | vector of regression coefficients |
| x | vector of predictor variables (e.g., payment amount, forest management history, parcel size, etc.) |

Eq. (1) can be written in a way to enable us to estimate the probability of occurrence of a specified outcome (Peng et al., 2002).

$$\pi(Y|x) = \frac{e^{\alpha+\beta'x}}{1 + e^{\alpha+\beta'x}} = \frac{1}{1 + e^{-[\alpha+\beta'x]}} \quad (2)$$

We estimated Eq. (2) and then converted this logit equation to a WTA equation by dividing the constant term and each coefficient

² WTA or WTP questions posed as binding referendum are generally considered to be incentive-compatible (Carson et al. 2001). However, Carson et al. (2001) and Carson and Groves (2007) note that a dichotomous choice question does not have to be cast explicitly as a referendum question in order to be incentive-compatible. Rather, they suggest that if the question is structured as a one-time, ‘take-it-or-leave-it’ choice for which the government has the ability to provide a public good and collect or provide payment for it, then such a question is likely to be incentive-compatible as well.

(other than the coefficient on the payment amount variable) by the negative value of the payment coefficient following Cameron (1988). Median WTA was then estimated using this new equation, multiplying the transformed coefficients by the mean of each variable following Hannemann (1984).

3. Results

3.1. Survey

3.1.1. Sustainable Forest Incentives Act awareness and perspectives

Less than one-fourth of the forest landowners who responded to the survey had heard of the SFIA program prior to receiving the questionnaire and the SFIA information sheet that accompanied the questionnaire.

Survey respondents described the extent to which they agreed with each of the six major SFIA program requirements on a five-point scale, with a response of five meaning strong agreement and one indicating strong disagreement. The majority of respondents did not support the two SFIA program requirements that constrain future uses of the land the most: placing a deed restriction on the property while enrolled and waiting 4 years to withdraw from the program once giving notice of the intent to do so (Fig. 1). The average ratings for the deed restriction and 4-year waiting period are significantly lower than the other four major eligibility requirements ($p < 0.05$ using a Tukey post-hoc test).

3.2. Willingness to enroll

Table 1 is a summary of the survey responses to the contingent valuation question on willingness to accept a specified compensation level. Interest in participating in the SFIA program was very modest at an annual payment amount of \$5 per acre per year (which approximates the SFIA payment made in 2006), with only 15% indicating they would enroll their land. The percent of affirmative responses at both \$10 and \$20 per acre per year is almost identical (31% and 30%, respectively), while 39% expressed interest in enrolling when the payment amount offered was \$30 per acre per year.

Individuals who indicated they were not sure if they would enroll in the SFIA program at the payment amount presented provided did so for a variety of reasons. The most common reason cited for not being able to decide whether to enroll in the SFIA program at the payment amount offered was a lack of adequate information about the program—26% stated this as their reason for being unsure. Uncertainty regarding the covenant required to be filed if enrolled and the time and cost of enrolling their forest land were also repeatedly cited as

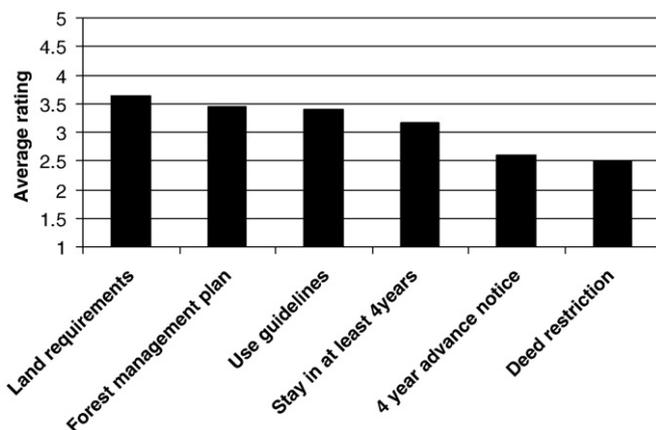


Fig. 1. Average rating of agreement with existing SFIA enrollment requirements among survey respondents. 5 = strongly agree; 1 = strongly disagree.

Table 1

Landowner willingness to enroll in the SFIA program at various annual per acre payment levels among survey respondents

| Per acre annual SFIA payment level offered | Response | Number of responses | % of responses |
|--|----------|---------------------|----------------|
| \$5 | Yes | 24 | 15 |
| | No | 100 | 64 |
| | Not sure | 32 | 21 |
| \$10 | Yes | 51 | 31 |
| | No | 66 | 41 |
| | Not sure | 45 | 28 |
| \$20 | Yes | 46 | 30 |
| | No | 58 | 38 |
| | Not sure | 50 | 32 |
| \$30 | Yes | 55 | 39 |
| | No | 50 | 35 |
| | Not sure | 37 | 26 |

reasons for not being able to decide whether to enroll in the SFIA program.

3.3. Treatment of “not sure” responses

Nearly 40% of the usable responses recorded that the landowner was “not sure” about whether or not to participate at the stated payment level. Could these responses be nevertheless used in the probability estimation? Neither the NOAA panel nor subsequent literature provide clear direction as to how best to handle uncertain/not sure/would not vote options (Arrow et al., 1993). Champ et al. (2005) and Caudill and Groothuis (2005) provide comprehensive reviews of the literature. Common approaches have been to: (1) drop the not sure responses from estimation analyses altogether (Kniivilä, 2006); (2) reassign all of the not sure responses to either the yes or no response category (Carson et al., 1998); (3) split the not sure responses between the yes and no response category based upon either follow-up questions to the DC question (Haener and Adamowicz, 1998) or inferences about the not sure respondents (Caudill and Groothuis, 2005); or (4) include the not sure responses in value estimations directly using maximum likelihood procedures (Wang, 1997).

Because we did not include follow-up questions to our referendum question, we could not use the Haener and Adamowicz approach (number 3, above) to assign the not sure responses. We could, however, formally address the question of whether assignment of all the “not sures” to either “yes” or “no” would be valid (approach 2, above). Cramer and Rider (1991) detail a procedure to test whether the regression coefficients, apart from the intercept, are statistically similar between a multinomial logit model where some response states are pooled to the coefficients and a model in which they are not pooled. If the test indicates that the coefficients are similar between the two models, separate response categories are not needed and the responses can be combined.

We first estimated two binary logit models where the response variable is “yes” or “no” and all “not sures” are all assigned to either yes or no, respectively. We then estimated a multinomial logit model where all three response categories are retained. We tested whether pooling or reassignment of all not sures to either yes or no categories is supported. The null hypothesis was that the coefficients on all of the variables hypothesized to affect no and not sure (or yes and not sure) responses are the same.

The value of the likelihood ratio test statistic, when testing whether not sure responses can be reassigned as no responses, is 31.26 with 15 degrees of freedom. The critical value of the chi-squared statistic at the 95% confidence level is 25.00, lower than our test statistic, so we rejected the null hypothesis. We could not reassign all of the not sure responses to no responses. Similarly, when testing whether the not sure responses can be reassigned to the yes response category, the value of the test statistic is 43.32, again larger than the critical value.

Table 2
Predictor variables thought to have an influence on family forest owner participation in the SFIA program

| Variable | Description | Hypothesized Effect on SFIA Program Interest |
|-------------------------------------|--|--|
| <i>SFIA program characteristics</i> | | |
| PAYMENT | A categorical variable indicating the SFIA payment offered (\$/ac/yr). | Positive |
| OPPDEED | A binary variable indicating whether the owner opposes the SFIA requirement to have deed restriction placed on the property's title; the most objectionable SFIA program requirement. | Negative |
| <i>Landowner characteristics</i> | | |
| AWARE | A binary variable indicating whether the owner had heard of the SFIA program prior to receiving the survey. | Positive |
| TENURE | A binary variable indicating whether the owner had owned the forest land for at least 15 years. | Negative |
| PARTIC | A binary variable indicating whether the owner has participated in a forest landowner program since owning the land (e.g., received cost-share assistance, attended a landowner education workshop). | Positive |
| TOTACRES | A continuous variable indicating the total number of acres of forest land owned by the landowner in Minnesota. | Positive |
| BEQUEATH | A binary variable indicating whether the owner plans to keep the land and pass it on as an inheritance. | Positive |
| PLANPLAN | A binary variable indicating whether the owner plans to obtain a forest management plan in the next 5 years. | Positive |
| PLANHARVEST | A binary variable indicating whether the owner plans to conduct a commercial timber harvest in the next 5 years. | Positive |
| ABSENTEE | A binary variable indicating whether the owner lives on the forest land. | Positive |
| <i>Forest land characteristics</i> | | |
| PARCACRES | A continuous variable indicating the size (acre) of the forest land inquired about in the survey. | Positive |
| EXISTPLAN | A binary variable indicating whether the owner has a forest management plan for the land. | Positive |
| PRIORMGMT | A binary variable indicating whether the owner has undertaken forest management (e.g., planted trees) since owning the land. | Positive |
| PRIORHARVEST | A binary variable indicating whether the owner has conducted a commercial timber harvest on the property since owning the land. | Positive |
| VALUE | A continuous variable indicating the 2005 assessor's estimated market value per acre of the land (\$ per acre). | Positive |

We also rejected the null hypothesis in this case. Because we could not combine the not sure responses with either the “yes” or “no” categories, we excluded them, as is advocated in approach 1 above, from the estimation (Model I).

3.4. Probability estimation

Guided by the five factors we hypothesized would influence a landowner's decision to enroll in the SFIA program (compatibility of past land management practices with those that define stewardship; compatibility of future plans for the land with those that define stewardship; awareness of programs that encourage forest stewardship; perceived constraints of such a commitment on future land use and ownership options; and cost of forest land ownership), a number of potential explanatory variables from the survey data set were identified. High levels of collinearity were found between variables measuring landowner support for the six SFIA program requirements (ranging from 0.454 to 0.617). Consequently,

we limited our choice of explanatory variables measuring support for SFIA requirements to landowner agreement with the requirement to have a restriction on the property's deed while enrolled, as this was the least supported SFIA requirement of the six (see Fig. 1). By including it, we felt it would best capture the full range of landowner opinion on current requirements (i.e., half of the respondents supported the deed restriction requirement; half opposed it).

We then pared the number of potential predictor variables to 15, with the highest correlation among predictor variables being 0.389 (landowner has a forest management plan and has participated in a landowner assistance program). Eighty-nine percent of the pairwise correlations are less than 0.1 in absolute value. Table 2 describes these 15 variables and the expected influence each has on a landowner's decision to enroll in the SFIA program. Table 3 contains the descriptive statistics for each variable in the final data set.

The probability that a family forest landowner who responded to our survey would choose to enroll in the SFIA program (Eq. (2), above)

Table 3
Descriptive statistics of SFIA survey respondents

| Variable | Includes not sure responses | | | | Excludes not sure responses | | | |
|-------------------------------------|-----------------------------|--------|-----|-------|-----------------------------|--------|-----|-------|
| | Mean | Max | Min | SD | Mean | Max | Min | SD |
| <i>SFIA program characteristics</i> | | | | | | | | |
| PAYMENT | 15.60 | 30 | 5 | 9.60 | 15.89 | 30 | 5 | 9.53 |
| OPPDEED | 0.50 | | | | 0.50 | | | |
| <i>Landowner characteristics</i> | | | | | | | | |
| AWARE | 0.24 | | | | 0.23 | | | |
| TENURE | 0.47 | | | | 0.46 | | | |
| PARTIC | 0.10 | | | | 0.08 | | | |
| TOTACRES | 177 | 4,000 | 20 | 314 | 170 | 4,000 | 20 | 295 |
| BEQUEATH | 0.78 | | | | 0.78 | | | |
| PLANPLAN | 0.14 | | | | 0.15 | | | |
| PLANHARVEST | 0.35 | | | | 0.33 | | | |
| ABSENTEE | 0.90 | | | | 0.90 | | | |
| <i>Forest land characteristics</i> | | | | | | | | |
| PARCACRES | 64 | 720 | 20 | 75 | 62 | 720 | 20 | 68 |
| EXISTPLAN | 0.21 | | | | 0.19 | | | |
| PRIORMGMT | 0.41 | | | | 0.40 | | | |
| PRIORHARVEST | 0.44 | | | | 0.43 | | | |
| VALUE | 1,102 | 13,673 | 28 | 1,015 | 1,130 | 14,873 | 28 | 1,063 |

Table 4
Model results (dependent variable is SFIA enrollment probability)

| Variable | Model I | | | Model II | | | Model III | | |
|-------------------------------------|----------------------------|-----------|--------|--------------------------------|----------|--------|-------------------------------|----------|--------|
| | Not sure responses ignored | | | Not sure responses recoded YES | | | Not sure responses recoded NO | | |
| | Coefficient | Wald | S.E. | Coefficient | Wald | S.E. | Coefficient | Wald | S.E. |
| <i>SFIA program characteristics</i> | | | | | | | | | |
| PAYMENT | 0.0575*** | 17.0569 | 0.0139 | 0.0385*** | 11.2816 | 0.0115 | 0.0514*** | 17.4161 | 0.0123 |
| OPPDEED | -1.5134*** | 29.3857 | 0.2792 | -1.1228*** | 26.3467 | 0.2187 | -1.2575*** | 25.8930 | 0.2471 |
| <i>Landowner characteristics</i> | | | | | | | | | |
| AWARE | 0.6910** | 4.7083 | 0.3185 | 0.6095** | 5.2657 | 0.2656 | 0.5727** | 4.5563 | 0.2683 |
| TENURE | 0.1880 | 0.4487 | 0.2806 | -0.1046 | 0.2166 | 0.2248 | 0.2473 | 1.0006 | 0.2472 |
| PARTIC | 0.1460 | 0.0915 | 0.4828 | -0.2934 | 0.4597 | 0.4327 | 0.3612 | 0.6975 | 0.4325 |
| TOTACRE | 0.0007* | 2.8129 | 0.0004 | 0.0004 | 1.2912 | 0.0004 | 0.0006** | 3.2733 | 0.0004 |
| BEQUEATH | -0.1254 | 0.1530 | 0.3206 | -0.1668 | 0.4108 | 0.2602 | -0.2379 | 0.7268 | 0.2790 |
| PLANPLAN | 1.5454*** | 14.9170 | 0.4001 | 1.2823*** | 13.1646 | 0.3534 | 0.9586*** | 10.1562 | 0.3008 |
| PLANHARVEST | -0.2114 | 0.5060 | 0.2972 | -0.2523 | 1.1096 | 0.2395 | -0.0282 | 0.0118 | 0.2600 |
| ABSENTEE | 0.3026 | 0.4197 | 0.4670 | 0.3689 | 1.040 | 0.3617 | 0.2132 | 0.2693 | 0.4108 |
| <i>Forest land characteristics</i> | | | | | | | | | |
| PARCACRES | 0.0017 | 0.8692 | 0.0018 | 0.0001 | 0.3730 | 0.0016 | 0.0020 | 1.5581 | 0.0016 |
| EXISTPLAN | 0.17164 | 0.2274 | 0.3599 | 0.1292 | 0.1819 | 0.3029 | 0.3547 | 1.2707 | 0.3146 |
| PRIORMGMT | -0.1326 | 0.2034 | 0.2940 | -0.1528 | 0.4178 | 0.2363 | 0.0191 | 0.0056 | 0.2571 |
| PRIORHARVEST | 0.1789 | 0.3552 | 0.3002 | 0.1866 | 0.6127 | 0.2384 | 0.0311 | 0.0142 | 0.2610 |
| VALUE | <0.0001 | 0.1748 | 0.0001 | <0.0001 | 0.6079 | 0.0001 | <0.0001 | 0.0927 | 0.0001 |
| Constant | -1.5414** | 5.5644 | 0.6534 | -0.4020 | 0.5857 | 0.5253 | -1.8864*** | 10.7701 | 0.5748 |
| -2 Log likelihood | | -350.623 | | | 524.917 | | | 460.241 | |
| Model Chi-square | | 100.351** | | | 79.655** | | | 91.719** | |
| McFadden's R ² | | 0.223 | | | | | | | |
| Obs. with payment acceptance=1 | | 140 | | | 251 | | | 140 | |
| Obs. with payment acceptance=0 | | 191 | | | 191 | | | 302 | |
| Overall % correct | | 74.3 | | | 69.2 | | | 73.8 | |

* $p \leq 0.1$ ** $p \leq 0.05$ *** $p \leq 0.01$.

was estimated using binomial logistic regression (SPSS 15.0 for Windows), which is a maximum likelihood estimation technique. Table 4 summarizes the results of this estimation. Recall that Model I excludes respondents who provided a 'not sure' response to the payment question. WTA estimates and median WTA for each model are shown in Table 5.

The middle line (no markers) in Fig. 2 illustrates the probability of a landowner enrolling under different SFIA incentive payment levels when all independent variables except the payment amount are set at their mean values using Model I. At the 2006 payment level of \$5 per acre, the estimated probability of enrollment is only 25%. Doubling the per acre annual payment to \$10 only increases the estimated

Table 5
Contribution of independent variables on WTA (dependent variable is SFIA enrollment probability)

| Variable | Model I | | Model II | | Model III | |
|-------------------------------------|----------------------------|----------------------------------|--------------------------------|----------------------------------|-------------------------------|----------------------------------|
| | Not sure responses ignored | | Not sure responses recoded YES | | Not sure responses recoded NO | |
| | Coefficient | Contribution to WTA ¹ | Coefficient | Contribution to WTA ¹ | Coefficient | Contribution to WTA ¹ |
| <i>SFIA program characteristics</i> | | | | | | |
| OPPDEED | 26.29 | \$13.21 | 29.15 | \$14.50 | 24.48 | \$12.18 |
| <i>Landowner characteristics</i> | | | | | | |
| AWARE | -12.00 | -\$2.91 | -15.83 | -\$3.66 | -11.15 | -\$2.58 |
| TENURE | -3.26 | -\$1.53 | 2.72 | \$1.24 | -4.81 | -\$2.21 |
| PARTIC | -2.54 | -\$0.24 | 7.62 | \$0.62 | -7.03 | -\$0.57 |
| TOTACRE | -0.01 | -\$2.13 | -0.01 | -\$1.98 | -0.01 | -\$2.13 |
| BEQUEATH | 2.18 | \$1.70 | 4.33 | \$3.36 | 4.63 | \$3.60 |
| PLANPLAN | -26.84 | -\$3.89 | -33.30 | -\$5.01 | -18.66 | -\$2.81 |
| PLANHARVEST | 3.67 | \$1.29 | 6.55 | \$2.16 | 0.55 | \$0.18 |
| ABSENTEE | -5.26 | -\$4.71 | -9.58 | -\$8.64 | -4.15 | -\$3.75 |
| <i>Forest land characteristics</i> | | | | | | |
| PARCACRES | -0.03 | -\$1.89 | -0.03 | -\$1.61 | -0.04 | -\$2.47 |
| EXISTPLAN | -2.98 | -\$0.64 | -3.35 | -\$0.65 | -6.91 | -\$1.33 |
| PRIORMGMT | 2.30 | \$0.94 | 3.97 | \$1.57 | -0.37 | -\$0.15 |
| PRIORHARVEST | -3.11 | -\$1.37 | -4.85 | -\$2.09 | -0.61 | -\$0.26 |
| VALUE | <-0.01 | -\$0.95 | <0.01 | -\$2.35 | <0.01 | \$0.69 |
| Constant | 26.77 | \$26.77 | 10.44 | \$10.44 | 36.73 | \$36.73 |
| Median WTA (\$/ac/yr) | | \$23.65 | | \$7.90 | | \$35.12 |

¹coefficient multiplied by the variable's mean value.

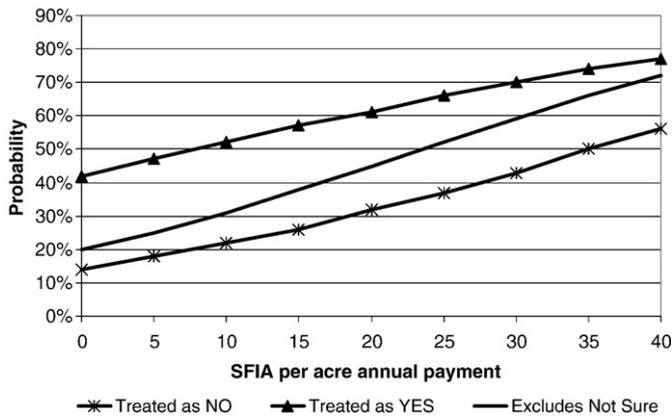


Fig. 2. Predicted probability of SFIA program enrollment at different annual per acre payment levels depending on the treatment of NOT SURE responses (all variables other than the payment amount are set at their mean value).

enrollment probability by 6%. As indicated by the model, it is estimated to cost nearly \$25 per acre per year to increase the likelihood of a landowner enrolling in the SFIA program to 50%.³

The shape of this enrollment probability curve (Fig. 2) suggests a portion of the curve may fall below the zero payment value (e.g., at zero payment, the model estimates a 20% probability of enrollment), suggesting some owners are willing to make a commitment to forest stewardship without requiring any monetary compensation (negative WTA). The phenomenon of having negative willingness to pay (WTP) or WTA values in contingent valuation studies has been widely discussed (see, for example, Bohara et al., 2001). It has also been documented in previous research on incentive payments to family forest owners (e.g., Kline et al., 2000). Many individual's ownership objectives align with society's interest in private forest land, namely sustainably managing their land for timber and non-timber outputs such as enhanced habitat or improved water quality (Greene et al., 2005). This was certainly true among the landowners we studied. Survey respondents commonly cited wildlife, recreation, and amenity values as being principal reasons for forest land ownership. Many such owners consider themselves to be good forest stewards and are willing to perpetuate these values with little or no financial incentive. This possibility is confirmed by a recent study which found a small portion of Minnesota's family forest owners would be willing to pay to have their forest land certified (Kilgore et al., 2007). Both forest certification and the SFIA program contain common elements that reflect principles of forest stewardship (e.g., use a forest management plan, follow best management practices when harvesting timber, keep the land in a forested condition).

3.5. Significant predictors of enrollment

Five of the 15 variables are significant predictors of a landowner's interest in enrolling in the SFIA program at $p \leq 0.10$ in Model I (Table 4). The SFIA payment amount (\$ per acre per year), owner's intention to obtain a forest management plan in the next 5 years, and opposition to the requirement to record a covenant on the property's deed while enrolled in the SFIA program were significant at $p \leq 0.01$. Landowners who planned to acquire a forest management plan were nearly five times more likely to enroll than those who did not. Those family forest owners who had heard of the SFIA program prior to participating in

the survey were nearly twice as likely to participate over those who had not heard of it ($p \leq 0.05$). The total number of forest land owned was significant at $p \leq 0.10$.

Several factors we thought would have an influence on landowner participation in the SFIA were not significant. A landowner's history of forestry activity as evidenced by the existence of a forest management plan, having conducted a timber harvest, or participated in landowner education or assistance programs did not influence participation tendency. This finding was particularly surprising for those owners with a forest management plan, given that the plan is a key prerequisite for SFIA enrollment. Absentee owners were no more likely to enroll in the SFIA program, which also was unexpected given such owners may be looking for ways to reduce ownership costs given their assumed less frequent use of the land than owners who live on their property. We also anticipated that the size of the parcel and its per acre value (a rough proxy for the parcel's property tax liability) would be statistically significant predictors of enrollment as higher values of each increase the cost of ownership, although total forest acreage owned was significant at $0.05 \leq p \leq 0.10$.

3.6. Alternative treatment of not sure responses

Although we showed earlier the necessity to exclude "not sure" responses from our estimation because we could not justify exclusive assignment to either the "yes" or a "no" category, for illustration purposes we can show how such an assignment would have affected our results. Models II and III in Tables 4 and 5 show the results of estimation under "conservative" (all not sures assigned to no) and "optimistic" (all not sures assigned to yes) approaches. Four of the five variables that were significant in Model I (SFIA payment, opposition to the deed restriction requirement, prior awareness of the SFIA program, and the landowner's intention to obtain a forest management plan) were also significant in both supplemental models. In addition, the total forest land acreage owned in Minnesota was significant at $p \leq 0.05$ in Model III. The median WTA for Model II (\$8 per acre per year) is approximately one-third the Model I median WTA. Conversely, median WTA increases to over \$35 per acre per year when the undecided responses are recoded as no votes (Model III).

Fig. 2 uses the estimated models to chart the probability of enrollment under these alternative treatments of the not sure responses. The middle line (no markers) excludes the not sure responses, while the upper line estimates enrollment probability when not sure responses are treated as yes and the lower line estimates enrollment probability when not sure responses are treated as no. Estimated enrollment probability approaches 50% at the current SFIA payment level (\$5 per acre per year) when not sures are assumed to be affirmative responses, yet less than 20% if these same respondents would not, in fact, enroll when offered a \$5 payment.

4. Conclusion

We draw three insights about a landowner's interest in the SFIA program. First, as measured by the BEQUEATH variable, an individual's future forest ownership intentions had no influence on SFIA program participation, suggesting considerable opportunity cost associated with limiting future ownership options. We anticipated owners who planned to sell their forest land, either in part or whole, would not be interested in enrolling in the SFIA program. The encumbrances associated with SFIA enrollment could substantially limit the sale price of forest land, particularly if the purchaser's intended land uses (e.g., build a seasonal or permanent home) are inconsistent with what is allowed under the SFIA program. However, we expected individuals who planned to bequeath their forest land on to their heirs to be more likely to participate in the SFIA program, as many such owners expressed interest in passing the forest land on as a legacy to their children. One could conclude from our study that while the desired

³ As a reviewer noted, WTA estimates systematically underestimate true WTA to the extent there would have been "yes" responses to payments higher than those actually offered to respondents. Consequently, our model—indeed, any WTA model that is bounded—is deprived of potentially relevant information about higher payment levels. As a result, our model likely overestimates enrollment probability for a given payment level and underestimates the payment level for a given probability of enrollment.

legacy of the current owner is an undeveloped forest for the heirs to enjoy, an overriding interest is increasing the heir's financial welfare.

Second, the study provides insights on how to generate landowner interest in participating in programs like the SFIA that promote forest stewardship. Of the five significant predictors of enrollment, three can be directly influenced by policy makers: SFIA program awareness, SFIA payment amount, and opposition to the deed restriction. Family forest owners who had heard of the SFIA program at the time they were surveyed were twice as likely to participate as those who had not heard of the program. This finding suggests that a marketing effort that raises SFIA program awareness among the state's family forest owners may be an effective strategy to increase program participation. The model also suggests increasing the SFIA payment and eliminating the deed restriction can increase program interest. By concurrently increasing the SFIA payment from \$5 to \$10 per acre per year, raising program awareness among family forest owners from 25% to 50% through an aggressive program awareness campaign, and eliminating the requirement to place a deed restriction on the property, the estimated enrollment probability increases from 25% to 54%.

A final insight from the study is directed at those landowners who are uncertain whether to participate in stewardship-type programs like the SFIA. A substantial portion of the family forest landowners responding to our survey were undecided about whether they would participate in the SFIA program at each payment level offered. This finding suggests the potential to capture additional interest among the state's family forest owners is considerable, and the manner in which programs like the SFIA convey the concept of stewardship to forest landowners is important.

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