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# Factors Influencing Family Woodland Management Action After Calling a Public Agency Forester

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## Abstract

Many public agencies make foresters available to answer landowners' land management questions. We gathered data about landowner calls to private forest management (PFM) foresters employed by a Minnesota state agency in 2017 and 2018. We used a mailed questionnaire to assess the outcomes of these contacts, including land management actions taken and factors most influential the landowner's subsequent decision process. The most common topic landowners called about was enrolling in a property tax program, followed by harvesting and planting trees, obtaining financial assistance, and controlling forest pests. Eighteen months after the initial call, implementation rates and intent were high, ranging from 73%–91%. Across management actions, information from a PFM forester, likelihood of timely implementation, and expected benefit were highly influential. PFM calls also informed landowners about additional land management actions, many of which they implemented. Our results offer new insight into the value of landowner contact with public sector foresters.

**Study Implications:** Over one year in 2017–2018, about 2% of Minnesota family forest owners called a state service forester for information and advice. In declining frequency order, these landowners were primarily inquiring about enrolling in a property tax program, controlling forest pests, harvesting trees, obtaining financial assistance, and planting trees. The factors that most influenced their subsequent land management action were information from a private forest management forester, likelihood of timely implementation, and expected benefits. Our results highlight the value of professional advice and suggest an emphasis on advice for timely implementation and information about the benefits of potential management activities.

**Keywords:** private forests, nonindustrial private forest landowners, landowner assistance, engagement

Active land management by Minnesota's estimated 200,000 family forest owners can improve timber, recreation, wildlife habitat, and other outcomes (Butler et al. 2016), generating resources and ecological services that accrue beyond the acreage treated. To the extent that active management can increase forest resilience to changing ecological and environmental conditions, these impacts are all the more important. To encourage these public values, federal and state forestry agencies provide financial and technical assistance and

education to family forest owners (Kilgore and Blinn 2004, Kilgore et al. 2007).

The effects of public investments to support conservation on private lands have been well studied, including how access to professional information and advice influences land management behavior. For example, Kilgore et al. (2015) found that family forest owners who received assistance such as management plans, cost-sharing for conservation activities, or technical assistance are more likely to harvest timber or improve wildlife habitat than unassisted landowners. Private forest management (PFM) foresters with the Minnesota Department of Natural Resources (MN DNR) are the first point of contact for many Minnesota family forest landowners seeking information or assistance about their land. In Minnesota, PFM foresters have an essential role supporting management of the 5.8 million acres of forests owned by individuals and families (MNDNR 2020). These public-sector foresters promote a range of ecosystem goods and services from family forests (Cheng and Ellefson 1993).

The outcomes of landowner assistance programs can be hard to assess. Our research was designed to improve understanding of factors influencing a family forest owner's decision to implement a particular land management practice after discussing the practice with a PFM forester. Our study focused on a particular subgroup of Minnesota's family forest owner population: those who took the initiative to obtain information from a public sector professional forester about one of those practices. Understanding factors that motivate family forest owners to undertake or abandon a land management action after receiving advice or additional information about that action can inform outreach, planning, and other programs designed to foster sustainable management of family forest lands.

### Literature Review

Much of the literature on family forest owners explores the relationship between different types of assistance and forest landowner intentions and decision-making (Butler et al. 2014, Song et al. 2014, Kilgore et al. 2015, Ruseva et al. 2015). Technical assistance and cost-sharing can help engage family forest owners in active land management (Kilgore et al. 2015). Family forest owners who received advice or information were more likely to have carried out several different types of forest management activities, including enrolling in conservation programs, than those who had not (Esseks and Moulton 2000, Ma et al. 2011, Kilgore et al. 2015). Similarly, Sagor and Becker (2014) found a strong positive relationship between the number and diversity of a landowner's information sources and the number of management practices the landowner had implemented. Information and advice from forestry professionals reinforced landowners' preexisting objectives and helped them implement practices "the right way" (Andrejczyk et al. 2016).

What factors drive family forest landowners to complete various land management actions after receiving technical assistance and information? Silver et al. (2015) conducted an evidence-based review focused on timber harvesting behavior. The most common drivers in the studies they reviewed were parcel size and harvest price per acre (positively) and distance of the land from their residence (negatively). Floress et al. (2019) conducted a vote-count meta-analysis of 128 published studies exploring factors associated with family forest owner actions. Their analysis found that current and past actions, landowner knowledge of the desired action, and parcel size were the factors most often associated with timber harvesting. However, both studies highlight a need to explore what factors influence actual landowner behavior, not just stated intentions.

Few studies have explored the degree to which new information and technical assistance drove forest management behavior. Our study addressed this by targeting only landowners with sufficient a priori motivation to have sought out information from a professional forester. Our analysis excludes landowners unaware or opposed to forest management. The goal of our research was to better understand what factors most strongly influenced land management decisions and actions following an inquiry with a professional forester. We explored what factors influence a family forest owner's decision to implement (or not) a forest management action they were contemplating after proactively engaging a professional forester for assistance.

The specific objectives of this study were to (1) characterize Minnesota family forest owners who proactively sought information from an MN DNR forester over a 1-year period in 2017–2018, (2) identify the primary management action(s) about which landowners called a forester and whether or not that respondent completed the action, and (3) understand what factors were most and least influential in a landowner's decision to undertake the action being contemplated.

## Methods

### Landowner Contact Information Collection

At the time of our study, the MN DNR PFM capacity was sixteen full-time equivalents occupied by

eighteen individuals throughout the state. We asked these PFM foresters to document their communication with family forest owners who initiated contact with them between July 1, 2017 and June 30, 2018. They did so by using a standard spreadsheet template that we provided. In addition to the landowner's contact information, foresters noted forested acreage owned and the land management action(s) discussed during their call. This produced a list of 1,102 landowners who contacted PFM foresters during this 1-year period.

We then developed a questionnaire to obtain additional information from these landowners. In addition to providing contact information, PFM foresters helped us shape the questionnaire's content.

The questionnaire included questions about the following.

1. Characteristics of the family forest owners who reached out to a PFM forester
2. The primary land management action discussed during the initial contact with a PFM forester
3. Forest management actions taken or planned after the forester contact, and if appropriate, the acreage affected
4. Factors influencing the landowner's decision to implement the primary management action(s) initially discussed
5. Additional management actions taken or planned after contacting the forester

We asked respondents to rate the influence of seventeen factors across five categories on a five-point scale in their decision whether or not to undertake the action after contacting a PFM forester. We identified these factors first by reviewing relevant literature, then through a meeting with the PFM foresters who assisted in other phases of the study. The final selection of factors was informed by the foresters' perceptions from their daily conversations with members of our sample frame. The factors were categorized as follows.

> Information: The influence of different sources of information on the landowner's management decision. Sources included the PFM forester, other forestry professionals, neighbors and friends, and sources such as brochures and online publications.
> Feasibility: Factors including the availability of professional assistance and resources and likelihood of completing the action in a timely manner.
> Perceived benefits and costs: Self-explanatory. This was a single-item category; the questionnaire did not specify any particular benefits or costs.
> Agreement among owners: The potential barrier of achieving agreement among multiple owners of the parcel on which management was considered.
> The land: Factors related to the land, including the condition of the trees or concerns that a landowner might have about the consequences to their property, neighbors, or their values and ownership objectives.

We also asked respondents to indicate any other forest management actions they had completed or were planning in the next 2 years and planned acreage affected. Other questions addressed respondents' level of satisfaction with the information and assistance they received from their interaction(s) with a PFM forester.

The questionnaire also included several questions about the respondent's land ownership objectives and attitudes about their forest land. Finally, it included questions about the respondent's age, gender, education, land ownership tenure, and other demographic variables. The questionnaire concluded with an open-ended question asking respondents to provide any other information they would like to share with the study group. The University of Minnesota's Institutional Review Board reviewed our protocol and determined that it did not constitute human subjects research and was exempt from further review.

## Survey Deployment

We surveyed 1,102 landowners in the spring of 2019, following protocols discussed by Dillman (2009). We sent a prenotice postcard introducing the study and encouraging participation. The first survey mailing included a personally addressed cover letter, full questionnaire with ID number, and a prepaid return envelope. Approximately 10 days later, we sent a follow-up postcard with a reminder to complete and return the questionnaire. Another ten days later, we mailed nonrespondents a second questionnaire along with a cover letter and prepaid return envelope. We sent a final reminder postcard to nonrespondents after the second questionnaire. Only questionnaires returned by June 15, 2019, were considered for analysis.

## Data Analysis

All usable questionnaire responses were entered into a spreadsheet and data entry accuracy was verified by randomly checking 10% of entries.

We tested nonresponse bias using the original contact data collected by PFM foresters, which included information about parcel size and landowner's reason for contact. We verified that there were no significant

differences between respondents and nonrespondents with respect to parcel size or reason for contact at $\alpha = 0.05$ based on a statistical comparison of response and nonresponse groups using *t*- and chi-square tests.

We reviewed open-ended comments for recurring themes and illustrative quotes.

## Results

Of the 1,102 questionnaires mailed, 1 was returned as undeliverable. Between April 2019 and July 2019, we received 754 questionnaires from 727 respondents. Twenty-seven respondents returned two questionnaires, in which case we analyzed only the responses to the first. Of the 727 responses, 17 did not meet study eligibility criteria, generally because they had no memory of contacting a PFM forester or had sold their land since contacting the forester. The usable response rate was 65.5% (710/1,084). The response rate compares favorably with other recent mail-based family forest owner surveys (Butler 2008, Kilgore et al. 2008, Håbesland et al. 2016, Snyder et al. 2020).

### Initial Landowner Contact Information

The topics landowners most frequently contacted PFM foresters about were harvesting trees for sale, planting trees, enrolling in a forest property tax program, obtaining financial assistance, and controlling invasive species and pest issues (Table 1). A few topics that we anticipated would be frequently mentioned were not, including improving wildlife habitat.

### Respondent Demographics and Land Ownership

Respondent demographics corresponded well with those reported in similar studies of this population (e.g. Sagor and Becker 2014, Butler et al. 2021), including the National Woodland Owner Survey. Of the 697 respondents who indicated their gender, 585 (84%) identified as male. The average and median ages were 62 years, with a range of 22 to 93 years. Approximately 15% of respondents reported an education level of high school or less, whereas 85% had at least some college experience and coursework. Twenty-four percent had a graduate or professional degree.

Respondents owned an average of 139 ac of forest land in Minnesota, ranging from 0.5 to 2,771 ac. The median ownership size was 80 ac. These were relatively long-term landowners, with a median land ownership tenure of 22.5 years. With 1,102 unique callers out of 206,000 family forest owners statewide

**Table 1.** Land management actions and decision status for respondents who indicated a single primary topic of discussion with a PFM forester about 18 months after contacting the forester.

| | Primary action discussed | | | | | |
|---|---|---|---|---|---|---|
| Number and percent of respondents | Harvesting trees | Planting trees | Enrolling in tax program | Obtaining financial assistance | Controlling pests | Other[a] |
| Indicating this primary action | 92 (16%) | 64 (11%) | 176 (31%) | 66 (11%) | 95 (17%) | 82 (14%) |
| **Of this group, the number who:** | | | | | | |
| Indicated the current status of the action | 87 | 64 | 173 | 63 | 89 | 79 |
| Started or completed the action | 45 (52%) | 45 (70%) | 116 (67%) | 47 (75%) | 55 (62%) | 41 (52%) |
| Decided to implement and will do so soon | 18 (21%) | 7 (11%) | 28 (16%) | 10 (16%) | 17 (19%) | 26 (33%) |
| Were undecided about implementing the action | 14 (16%) | 10 (15%) | 22 (13%) | 6 (10%) | 9 (10%) | 11 (14%) |
| Decided against implementing the action | 10 (11%) | 2 (3%) | 7 (4%) | 0 (0%) | 8 (9%) | 1 (1%) |

[a]Common responses in the "Other" category included general information and advice, wildlife habitat management, and a forest management plan.

**Table 2.** Influence of factors in respondent's decision to undertake one of five management actions for those respondents who indicated a single topic of inquiry.

| Factor | n | Mean | Overall rank | Extremely influential | Very influential | Somewhat influential | Slightly influential | Not at all influential |
|---|---|---|---|---|---|---|---|---|
| **Information** | | | | | | | | |
| Received from PFM forester | 482 | 3.94 | 1 | 31% | 44% | 16% | 6% | 3% |
| From other professionals | 347 | 3.31 | 8 | 19% | 30% | 28% | 10% | 13% |
| From other sources e.g. online | 354 | 2.68 | 12 | 4% | 19% | 37% | 20% | 20% |
| From neighbors, friends, or relatives | 341 | 2.36 | 14 | 4% | 13% | 30% | 23% | 30% |
| **Feasibility** | | | | | | | | |
| Likelihood of timely implementation | 471 | 3.84 | 3 | 34% | 34% | 20% | 7% | 6% |
| Availability of help from a forester | 438 | 3.75 | 4 | 35% | 33% | 14% | 8% | 10% |
| Availability of needed resources | 470 | 3.67 | 5 | 28% | 36% | 19% | 9% | 8% |
| Physical ability to implement action | 416 | 3.48 | 6 | 26% | 31% | 20% | 7% | 14% |
| Availability of help from a logger | 305 | 2.94 | 11 | 22% | 20% | 18% | 8% | 31% |
| **Costs and benefits** | | | | | | | | |
| Expected financial benefits | 479 | 3.86 | 2 | 36% | 33% | 17% | 7% | 6% |
| Expected financial costs | 467 | 3.18 | 9 | 17% | 24% | 32% | 13% | 14% |
| **Agreement among owners** | | | | | | | | |
| Ability to get multi-owner agreement | 221 | 2.64 | 13 | 23% | 15% | 12% | 4% | 46% |
| **The forest land** | | | | | | | | |
| Need given land's physical condition | 471 | 3.42 | 7 | 24% | 31% | 23% | 6% | 15% |
| Concern for land appearance afterwards | 471 | 3.08 | 10 | 18% | 27% | 22% | 11% | 22% |
| Outcomes misaligned with objectives | 466 | 2.30 | 15 | 8% | 17% | 19% | 10% | 46% |
| Adverse effect on other land uses | 468 | 2.19 | 16 | 6% | 14% | 19% | 14% | 47% |
| Concern for impact to neighbors | 469 | 1.64 | 17 | 3% | 6% | 11% | 14% | 67% |

*Responses on a 5-point scale from 1 = not at all influential, 2 = slightly influential, 3 = somewhat influential, 4 = very influential, 5 = extremely influential. Overall rank refers to mean influence rating among all 17 factors. "Not applicable" responses are omitted.

(Butler et al. 2021) only about 0.5% of Minnesota family forest owners contacted a PFM forester during the 1-year study period. However, this group collectively owns and manages about 2.6% of the state's approximately 5.8M ac of family forest land (Butler et al. 2021), making their impacts on the land disproportionately high.

Respondents were distributed throughout fifty-five of Minnesota's eighty-seven counties. Matching the distribution of family forest lands in the state, most respondents were in northcentral and northeast Minnesota.

## Management Actions Discussed and Subsequent Activity

For those who discussed one primary land management objective with a PFM forester, we wanted to know which activity was most popular and the status of their follow-up activity. Of the 575 respondents who indicated discussing one primary land management action, enrolling in a forest property tax program was by far the most popular topic discussed, at about 30% of respondents. Harvesting trees and controlling invasive plants, diseases, or other forest pests were both the primary land management actions discussed by 16%, with other topics clustered between 10% and 13% of respondents (Table 1).

The questionnaire was administered 11 to 23 months after their initial PFM forester contact. By this time, of the 555 respondents who marked one primary action discussed with a PFM forester and also described their subsequent activity, 349 (63%) had already started or completed the action, 106 (19%) had decided to do it but not yet started, and only 100 (18%) were either undecided or had decided against the action (Table 1). In other words, over four in five of the landowners had begun, completed, or decided to implement the management action about which they had called a PFM forester for advice.

## Factors Influencing Action

We were specifically interested in what factors influenced respondents' decisions on any subsequent action taken after contacting the forester. Respondents rated influence factors using a 5-point scale from "not at all influential" (1) through "extremely influential" (5), with "not applicable" also available. Seventeen influence factors were categorized as "information," "feasibility," "costs and benefits," "agreement among owners," and "characteristics of the wooded land." For example, a respondent who had contacted a PFM forester primarily to discuss planting trees would indicate how each factor influenced their subsequent tree planting decision or activity. We calculated a mean influence score for each of these seventeen factors, excluding "not applicable" responses (Table 2).

Across all five management actions, "information from a PFM forester" was the most influential factor, with a mean rating of 3.94 (out of 5) and 75% of respondents reporting it as very or extremely influential in their decision whether to take action (Table 2). Information from other sources was far less influential, which is perhaps to be expected with responses conditioned on having actively sought information from the PFM forester.

## Factor Categories

The six factors with the highest influence scores were in the feasibility category. These include the likelihood of implementing the action in a timely manner, availability of professional assistance from a forester or logger, availability of resources needed to undertake the action, and the respondent's physical ability to undertake the action (Table 2).

Respondents ranked the influence of the expected benefits of undertaking a land management action higher than the influence of the expected financial costs of undertaking the action (Table 2). Expected benefit had the second-highest mean influence score among the seventeen factors. A total of 69% of respondents indicated the expected benefit from undertaking the action was extremely or very influential in their decision, whereas only 41% of respondents considered the expected financial cost to be extremely or very influential.

"Finding agreement among owners" appeared not to apply to most respondents, with only 221 rating its influence compared with a high of 482 for "information from a PFM forester." Among those rating this factor, it was relatively unimportant, ranking as the 13$^{th}$ most influential of the factors considered.

The influence of factors in the forestland category on decision-making varied but was generally low. Only one factor, the need to implement the action given the land's physical condition, ranked as one of the top ten factors. Fifty-five percent of respondents indicated that the need to implement the action given the property's condition was extremely or very influential. Although there was some concern about the land's appearance after treatment, the other three factors in this category were the lowest ranked among all factors considered.

**Table 3.** Highest- and lowest-ranked influential factors for combined and individual topics.

| Most influential factors | Mean value[a] | Category | Least influential factors | Mean value[a] | Category |
|---|---|---|---|---|---|
| **All management actions** | | | **All management actions** | | |
| Info received from a PFM forester | 3.94 | Information | Concern about impact to neighbors | 1.64 | Forest land |
| Expected benefit from the action | 3.86 | Bens & costs | Adverse effect on other land uses | 2.19 | Forest land |
| Likelihood of timely implementation | 3.84 | Feasibility | Outcomes misaligned w. objectives | 2.30 | Forest land |
| **Harvesting trees for sale** | | | **Harvesting trees for sale** | | |
| Info received from a PFM forester | 3.95 | Information | Concern about impact to neighbors | 1.83 | Forest land |
| Availability of help from a logger | 3.69 | Feasibility | Ability to get multi-owner agreement | 2.23 | Owner agreement |
| Availability of help from a forester | 3.63 | Feasibility | Info from other sources (e.g., online) | 2.32 | Information |
| **Planting trees** | | | **Planting trees** | | |
| Likelihood of timely implementation | 3.94 | Feasibility | Concern about impact to neighbors | 1.48 | Forest land |
| Info received from a PFM forester | 3.89 | Information | Adverse effect on other land uses | 2.06 | Forest land |
| Availability of needed resources | 3.84 | Feasibility | Outcomes misaligned w. objectives | 2.32 | Forest land |
| **Enrolling in forest property tax program** | | | **Enrolling in forest property tax program** | | |
| Expected benefit from the action | 4.08 | Benefits & costs | Concern about impact to neighbors | 1.58 | Forest land |
| Availability of help from a forester | 4.02 | Feasibility | Adverse effect on other land uses | 2.28 | Forest land |
| Info received from a PFM forester | 3.99 | Information | Outcomes misaligned w. objectives | 2.30 | Forest land |
| **Obtaining financial assistance** | | | **Obtaining financial assistance** | | |
| Expected benefit from the action | 4.17 | Benefits & costs | Concern about impact to neighbors | 1.48 | Forest land |
| Need given land's physical condition | 4.02 | Forest land | Adverse effect on other land uses | 1.71 | Forest land |
| Likelihood of timely implementation | 3.99 | Feasibility | Outcomes misaligned with objectives. | 1.98 | Forest land |
| **Controlling insects, disease, or invasive species** | | | **Controlling I&D or invasive spp.** | | |
| Info received from a PFM forester | 3.89 | Information | Concern about impact to neighbors | 1.79 | Forest land |
| Need given land's physical condition | 3.71 | Forest land | Adverse effect on other land uses | 2.14 | Forest land |
| Likelihood of timely implementation | 3.71 | Feasibility | Availability of help from a logger | 2.16 | Feasibility |

[a]Responses on a 5-point scale from 1 = not at all influential, 2 = slightly influential, 3 = somewhat influential, 4 = very influential, 5 = extremely influential.

## Completion Rates and Factors Driving Individual Actions

Implementation rates for the individual land management actions were variable but generally high, ranging from 52% for harvesting timber for sale to 75% for obtaining financial assistance (Table 1).

For individual actions, factor influence ratings varied by action (Table 3). Information received from a PFM forester was one of the top three factors influencing action for all but obtaining financial assistance. Availability of assistance from a forester and a logger were influential for harvesting timber and, in the case of a forester, for enrolling in a property tax program. Likelihood of timely implementation was influential for planting trees, obtaining financial assistance, and controlling insects, disease, or invasive species.

Table 3 displays the three most and least influential factors for all management actions in aggregate as well as for each individual management action. For combined management actions, the three most influential factors driving family forest owner decision-making were the information received from a PFM forester, the expected benefit from undertaking the action, and the likelihood of implementing the action in a timely manner.

Among the least influential factors, concern about impact to neighbors dominated, ranking as the least influential factor for all aggregated actions as well as for each individual action (Table 3). Outcomes of the landowner's primary action being poorly aligned with other management objectives was of little influence for most actions.

### Harvesting Trees for Sale

With the lowest completion rate among the individual actions at 52%, harvesting timber for sale had the highest percentage of respondents who were undecided or decided against the action at just over 25% (Table 1). This latter group includes both landowners who had decided against selling timber and those who might have wanted to but were unable to find a logger willing to purchase the stumpage. The most influential factors driving follow-up action were information received from a PFM forester, availability of help from a forester, and availability of help from a logger (Table 3).

The least influential factors driving follow-up action after discussing harvesting trees with a PFM forester were concern about impact to neighbors, ability to get multiple owners to agree, and information from other sources (Table 3).

Respondents added several comments describing their obstacles in undertaking a timber harvest, providing some context for why only slightly more than half who were interested in harvesting timber actually did so. Comments centered on a few themes: logger availability ("My biggest challenge is finding a logger willing and able to harvest trees and areas I need managed that aren't valuable timber"), stumpage prices ("It is very difficult to find loggers to assist in timber stand improvement-harvest at this time and stumpage prices are not good"), concern about the look of the property after harvest ("My concern was the limbs left and stumps after thinning. Won't be able to traverse to control thistles once sunlight hits forest floor. Plus, look unkempt - too messy"), and the property being unsuitable for harvest at the time of inquiry ("The forester gave me valuable information on trimming out smaller trees and allowing the trees to mature further before harvesting in order to maximize the value.")

### Enrolling in a Property Tax Program

The most popular action discussed, enrolling in a property tax program, had been started or completed by two-thirds of respondents inquiring about it (Table 1). Another 16% had decided to do so soon. The most important factors influencing whether landowners had started or completed the enrollment process were expected benefits, availability of help from a forester, and information received from the PFM forester (Table 3). Information in the form of contacts for other service providers are critical for landowners interested in enrolling in one of Minnesota's preferential forest property tax programs, both of which require a written management plan. PFM foresters rarely write these plans, but often provide landowners the names of consulting foresters who can prepare these plans.

The least important factors were concern about impact to neighbors, adverse effects on other land uses, and a misalignment between enrolling in a property tax program and other objectives for the land (Table 3).

### Obtaining Financial Assistance

This action had the highest implementation rate of the five, with 75% of respondents who contacted a PFM forester primarily to discuss financial assistance having started or completed it (Table 1). Another 16% had decided to obtain financial assistance and planned to do so soon. These rates are high considering that not all landowners are eligible for all financial assistance programs. Landowners may have been well informed about eligibility requirements before calling.

The most influential factors around this action were the expected benefit, the need given the land's physical condition, and the likelihood of timely implementation (Table 3). Timeliness of implementation was mentioned in several written comments as well, such as this one: "Satisfied with information received, very dissatisfied with complicated cost share (tree planting) process.… I never received cost share for tree planting from purchase from state forest nursery. Process needs to be simplified."

The least influential factors were the same as those for enrolling in a property tax program: concern about impact to neighbors, adverse effects on other land uses, and a misalignment between enrolling in a property tax program and other objectives for the land (Table 3).

Some research has questioned whether financial incentives actually foster land management or just reduce the cost of actions landowners would have taken anyway. Open-ended comments suggested that PFM foresters played important roles to help landowners implement their land management goals. Advice from PFM foresters improved outcomes: "With his assistance we were able to locate a very knowledgeable and dedicated professional forester who wrote our forest stewardship plan." Landowner assistance program information received from PFM foresters also made cost-prohibitive actions possible: "Taxes are very expensive and some of these programs help to cut down that expense.… I know if there wasn't these programs, I wouldn't be able to do these improvements." Similar to other comments we received, another respondent commented, "I would like to do even more but have to be able to afford the work. Cost share is critical to me doing conservation work. Without cost share, I would not have been able to afford any of the work done."

### Planting Trees

Implementation (and intention) rates were also high for planting trees, with 81% of respondents in this category either having completed, started, or decided to do it (Table 1). Although this topic was less popular than the others, landowners who called about it were likely to take action. It is possible that these callers were primarily inquiring not about the wisdom of tree planting in general but seeking advice on species or other technical assistance to guide their action.

The most influential factors driving follow-up action on tree planting were likelihood of timely implementation, information received from a PFM forester, and availability of needed resources, presumably seedlings and/or tree planting equipment (Table 3). "[PFM foresters] have always been very helpful: tree planting assistance, management techniques, invasive buckthorn - sumac control..." Another respondent stated that "I and another friend plant many trees - we are very dependent on the DNR to have tree planters available for us to rent."

The least important factors were concern about impact to neighbors, adverse effects on other land uses, and a misalignment between planting trees and other objectives for the land (Table 3).

### Controlling Insect, Disease, and Invasive Species Threats

A total of 81% percent of respondents who discussed this topic with a PFM forester had implemented or decided to implement control actions. Respondents who contacted a PFM forester about controlling invasive species, pests, or diseases varied in their issues and objectives. Many were overwhelmed by the scope of the project and needed financial assistance to get it done. Some respondents also reported that even with financial assistance, the project was cost prohibitive. The following comment was typical of several we received:

> I was pleased with the helpfulness of our forester. However, I was disappointed that I could not physically complete the project (removing buckthorn) on more of the property. It is an overwhelming task that I could not physically do on my own. Financial assistance or a grant of some sort to have professionals undertake this task would have been required.

The most influential factors around follow-up action here were the information received from a PFM forester, need to control invasive plants or pests given the physical condition of the property, and likelihood of controlling invasive plants or pests in a timely manner (Table 3). The least influential factors were availability of a professional logger, agreement among the landowners, concern that controlling invasives or pests would affect their neighbors, and concern that treatments would not align with their management objectives.

## Satisfaction With Service from PFM Forester

Nearly 90% of respondents were satisfied or very satisfied with the information and/or assistance they received from a PFM forester. Of the 687 individuals who responded to the question, 443 (64%) were very

satisfied and 166 (24%) were satisfied. Sixty-one respondents (9%) were neither satisfied nor dissatisfied, eleven (2%) were dissatisfied, and six (1%) were very dissatisfied.

## Discussion

Active management of the Lake States' vast family forest land base can help mitigate losses as a changing climate intensifies threats to forest health associated with insects, disease, invasive species, drought, and other threats (Swanston et al. 2018). Although extensive research has investigated methods to engage more landowners in active management (Crowley et al. 2019, Butler et al. 2020), a focus on motivating and supporting action on the part of those already seeking assistance has not received as much attention.

This study is one of the first to investigate the motivations and actions of a unique cohort of family forest landowners: those who actively sought information or assistance from a state service forester for an action they were contemplating. Our goal was to better understand the dynamics of family forest owner decision-making, specifically those factors that influence their decision to ultimately carry out one or more forest management practices under consideration. Understanding both the nature and frequency of land management topics landowners inquire about, as well as which factors lead most directly to family forest land management activity, can help public agencies better design and prioritize the information and assistance they provide.

Our results suggest that information provided by a professional forester has a substantial impact on landowner decision-making across a broad range of activities, reinforcing the important role of public sector foresters in family forest land management. For many family forest owners, information from a forester helped them make decisions and implement actions on their land they otherwise might not undertake. Although some landowners decided against implementing an action, it is possible that information provided by the PFM forester also influenced that decision. For example, some respondents who decided against harvesting trees may have learned that their acreage was too small or their trees not yet of merchantable size. Other landowners learned about land management opportunities beyond what they contacted a forester about, which may have facilitated additional land management activity. Among the seventeen economic, ecological, and social factors we evaluated, none was more impactful in influencing landowner decisions across a wide range of actions than the information provided by PFM foresters.

The value of information landowners received from PFM foresters is further indicated by the high level of satisfaction with that information. Landowners turned to a PFM forester seeking information about a potential land management action. Framed differently, these landowners were seeking support to engage as active land managers, which is seen as an important priority for forest policy makers (Schelhas et al. 2018, Snyder et al. 2018, Crowley et al. 2019). That they were so pleased with the information they received, and that so many took rapid action following their discussions, suggests that the availability of PFM capacity is important to build landowner engagement in land management. The frequency of calls about enrolling in a property tax program, along with a high level of follow-up implementation or intention, suggested that among the activities studied, PFM foresters may have the greatest influence on enrollment in programs designed to encourage the retention and management of family-owned forest land.

Our results suggest that, similar to a key finding of Andrejczyk et al. (2016), family forest owners contacting PFM foresters left the interaction feeling more confident and better informed about the actions they were considering, and a large percentage of landowners followed through on those actions. Whether these landowners were already motivated to act, or merely inquiring about possibilities and later gained motivation from the forester is not known. This level of insight into landowner motivation and the decision process is difficult to obtain, but several studies report positive relationships between landowner information sources and active land management (Sagor and Becker 2014, Floress et al. 2019).

### Implications for Service Forestry Programs

Our results suggest several opportunities for both PFM program administrators and foresters to increase their value and impact. First, information from a PFM forester was highly influential on a wide variety of subsequent land management actions. Simply making a professional forester available to answer landowner questions in a timely manner seems to have an important influence on landowners' decisions to implement a variety of land management and land conservation practices. Current PFM capacity limits the number of landowners that can be served.

## Wildlife Habitat

Although improving wildlife habitat was not a common topic about which family forest owners contacted a PFM forester, many expressed interest in learning more about it after discussing another land management topic (e.g., harvesting timber or planting trees). This suggests landowners may not fully understand the influence of many land management actions on wildlife habitat. It also suggests the potential value of messaging about opportunities to improve wildlife habitat by implementing appropriate forest management actions. In an educational needs assessment conducted in Minnesota in 2020, wildlife habitat ranked second behind woodland management as the topic family forest owners were most interested in learning about (UMN Extension Forestry 2021), providing additional evidence about the desire for more information on this topic.

## Other Sources of Assistance

A focus on sources of assistance also seems prudent in discussing a commercial timber harvest, particularly among woodland owners with small acreage available for harvest. To harvest timber for sale, most landowners would need the assistance of a logging contractor. To interest a logging contractor, the landowner would need sufficient available harvestable timber volume and quality. Also, even if a logger is available, local markets may not be favorable, which might lead the landowner to delay the harvest. Managing landowners' expectations with respect to these challenges, including the potentially long time-horizon associated with getting timber harvest operations done and how a harvested site looks immediately after a harvest and then a few years later, might help to avoid misguided hopes for a rapid and simple timber sale process.

For those family forest landowners inquiring about tree planting, after their contact with a forester, many expressed concern about the availability of supplies, equipment, and labor needed to undertake this activity. They also often did not appear to be very knowledgeable about financial assistance opportunities that could reduce their out-of-pocket tree planting costs.

## Managing Landowner Expectations

The time required to implement a land management action is important to many family forest owners. Likelihood of completing the action in a timely manner was consistently influential across land management actions. Knowing that small-acreage landowners tend to be less engaged in land management activities (Row 1978, Butler et al. 2014, Snyder et al. 2018), the long time between an initial inquiry and completing a timber sale, taking delivery of thousands of seedlings for a planting project, or completing enrollment in a property tax program can be a source of frustration and a potential barrier to action. Although in many cases, foresters can do little to shorten this time frame, they can address this concern by managing landowner expectations about the actions they are considering. The importance of timeliness, combined with the very high level of satisfaction of our respondents, suggests Minnesota's PFM foresters, as well as the logging contractors and private foresters on whose services landowners depend on for tax program enrollment, are effectively managing these expectations.

## Framing and Managing Communications

Enrolling in a forest property tax program was the most common topic among landowners during the year our study recorded landowner inquiries with the MN DNR. The cumulative nature of these requests means PFM foresters spend a considerable amount of time responding to these inquiries and providing background information on Minnesota's two forest property tax programs on a landowner-by-landowner basis. By examining the specific types of property tax program enrollment information landowners are seeking most frequently, public sector foresters may be able to better "package" the forest property tax information they provide, thereby reducing the amount of time required to respond to these inquiries.

The level of influence of different factors on follow-up implementation varied by land management action in ways that suggest opportunities for PFM foresters to target the information provided to landowners for greatest impact. For example, when considering controlling forest insects, diseases, and other pests, the most influential factors were information from a PFM forester, the need (for control) given the physical condition of the property, and the likelihood of timely implementation. Preliminary research with a similar respondent pool in Wisconsin suggests the value of loss framing to motivate action, which fits well with concerns about lost productivity and waste associated with forest health threats (Radler et al. 2020) among landowners earlier in their land management decision process. This framing may help PFM foresters to further motivate follow-up action later in the decision process as well.

However, our results also suggest an emphasis on factors related to self-efficacy. Several respondents

described actions to control invasive species as overwhelming in scope, and impossible without substantial professional assistance and/or cost-sharing. The likelihood of timely implementation was also important for dealing with forest health threats. These findings suggest that a focus by PFM foresters on sources of assistance and available financial or other resources could help motivate action to maintain forest health.

We found that different types of information and services PFM foresters provide to landowners (e.g., economic, ecological, geospatial), as well as the form of this data (e.g., fact sheets, videos, 'how-to' guides) affects landowner decisions differently. For example, many landowners expressed uncertainty and concern about the visual or aesthetic outcome of various land management actions. This uncertainty may inhibit some from carrying out certain land management actions such as a timber harvest. Better understanding of how landowners respond to different information on specific land management practices would enable service foresters to more effectively develop and target their landowner outreach efforts.

## Conclusions

Unlike many other studies, this one focused on family forest owners who had proactively contacted a professional forester for land management information or assistance; one might consider these "engaged" landowners. These engaged landowners are tremendously important to the local wood products industry and to providing the many other benefits of active forest management. In 2018, they supplied 36% of the state's total timber harvest (MNDNR 2020). During the 1-year study period, 0.5% of Minnesota family forest owners, owning 2.6% of the state's forest land, proactively contacted a PFM forester for information about one of five land management actions. These calls frequently led to land management activity: 72% of these landowners either already had completed or planned to complete those actions within 2 years of the initial call, suggesting that information from a local public sector forester is important to help landowners implement forest management activities. In addition to gaining confidence about how best to advance their land management ideas, landowners gained new ideas for further management and information about the likely outcomes of their actions, including wildlife habitat improvement, from PFM foresters. These landowners were overwhelmingly satisfied with the information and assistance they received and viewed PFM foresters as the single most important factor in helping them advance their land management goals. Understanding both the nature and frequency of land management topics landowners inquire about, as well as which factors lead most directly to family forest land management activity, can help public service foresters better identify and prioritize the format and content of information and assistance they provide.

This study reinforces the value and importance of public sector service forester capacity to advance family forest land management. To build on this work, future research should investigate whether inquiries to public sector foresters by previously engaged and unengaged family forest owners differ in the nature of the inquiry, the type of information sought, or the outcomes. Subsequent research should build on our understanding of landowners' pathways through a decision process toward land management action. For instance, it would be useful to know whether the contacts documented here were respondents' first attempts to seek information and assistance from a professional forester or merely the latest in a series of interactions. If multiple interactions occur, it would be useful to know the number it may take to position a landowner to act, and whether there are specific sequences of inquiries, information requests, and interactions with public foresters that build on one another in moving a landowner farther along a decision pathway. With this knowledge, public foresters may be better able to anticipate information and assistance needs and have richer discussions when landowners reach out with a specific question. Likewise, future research should include detailed information on what led the landowner to initiate contact and with whom. Future research could also explore whether factors deemed influential in family forest owner decision-making vary by demographic factors or regions of the country. Understanding how the nature and types of information sought by first-time versus repeat family forest owners differ may help the MN DNR more effectively engage with Minnesota's family forest owners and better target their efforts to facilitate stewardship behaviors by previously unengaged owners and sustain activity by previously engaged owners.

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