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# Assessing Extension's Ability to Promote Family Forests as a Woody Biomass Feedstock in the Northeast United States

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***Abstract:*** *The study reported here surveyed Extension educators' awareness and knowledge of woody biomass energy and assessed their desire and ability to reach out to family forest owners—a critical feedstock source. The results indicate Extension educators are aware of the potential of woody biomass to serve as a renewable source of energy. Respondents representing forestry/natural resources disciplines registered higher awareness and willingness to diffuse scores than agriculture, horticulture, and community development educators. The study provides a baseline measurement of awareness and knowledge of woody biomass as an energy source, and desire to promote forest management for woody biomass to FFO.*

## Introduction

Interest in the use of woody biomass for large-scale bioenergy production in the United States (US) has increased substantially in recent years (Patton-Mallory, 2008). For instance, a US Department of Energy and US Department of Agriculture study examined the feasibility of generating sufficient biomass in the US to displace 30% of current petroleum consumption (Perlack, Wright, Turhollow, Graham, Stokes, & Erbach, 2005). Family forest owners (FFO) (private forestland owned by families and individuals) will likely serve as a source of woody biomass for energy production, particularly in the northeast US, where they dominate forestland ownership. The northeast region has 78 million acres of timberland—accessible and capable of growing at least 20 $ft^3$/acre/year. An estimated 75% of the timberland is controlled by FFO (RPA, 2007; Butler, 2008). The majority of FFO do not manage their forestland, nor do they intend to harvest in the coming decade (Butler 2008). Harvesting events are often serendipitous and exploitative, with no link to sustained yield management (Fajvan, Grushecky, & Hassler, 1998; Germain, Anderson, Bevilacqua, 2007; Munsell & Germain, 2007). Increased focused on woody biomass for energy production could serve as a catalyst to improve forest stewardship on family forests.

## Study Objectives

The study reported here sought to survey Extension educators of the region to assess awareness, knowledge and perceptions of woody biomass as an energy source. The most effective and efficient manner to promote an innovation, in this case the adoption of forest management by FFO to promote woody biomass for energy, is to first engage the change agents who have contact with FFO. If the change agents are not knowledgeable and committed to the innovation, there is little chance of successfully diffusing it to millions of FFO (Rogers, 2003; Fortson, 2006; Grebner, Perez-Verdin, Henderson, & Londo, 2009). In this case, the change agents in question are Cooperative Extension System (Extension) educators across 16 states in the northeast U.S. The purpose of the study was to measure Extension educators' awareness and knowledge of woody biomass as an energy source, as well as assess their desire and ability to successfully diffuse the innovation of forest management for woody biomass to FFO.

## Methods

The study focused on the northeastern U.S., including the states of Connecticut, Illinois, Indiana, Iowa, Maine, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Vermont, and Wisconsin. For each state, the Extension website was identified, and Extension educator names and email and mailing addresses were collected (excluding land-grant university campuses). In total, 1,061 Extension educators were identified.

The survey was sent in two waves. The first wave consisted of a paper mailer; the second was an electronic copy of the same mailer. The first wave of the survey was sent to all 1,061 educators in early April 2010. The online survey was sent in mid-May to educators who had listed email addresses and had not yet responded to the mailer. Due to wrong addresses and undeliverable email addresses, the final sample was 1,018, representing approximately 25% of the population of regional Extension educators.

The first section of the survey requested information on area of expertise, years working in area of expertise, and percentage of time working with family forest owners. The second section of the survey instrument used Likert-type statements to create a summated scale to measure respondent awareness and knowledge about the use of woody biomass for energy uses. The third section consisted of statements seeking the level of agreement on various management issues associated with woody biomass use. This section provided an option of "don't know."

Respondent awareness was measured with a nine-item construct (Likert statements A1 - A9). The reliability of the awareness scale, as measured by Cronbach's alpha coefficient, was 0.93, which indicates that the scale was effective in communicating the underlying construct (Carmines & Zeller, 1979; Spector, 1992). Awareness scores were also summarized by area of expertise, years in area of expertise, and respondents working with FFO or not. Comparisons within the groups were evaluated using the Chi-square statistic of the Kruskal-Wallis test, a generalized form of the nonparametric Wilcoxon-Mann-Whitney test. Kendal Tau coefficients for correlation were calculated between awareness and years in area of expertise. An alpha of 0.10 was used to test significance. Because Likert-type scales are often considered non-continuous by many, nonparametric analyses were used to improve robustness (Gibbons, 1995; Johnson, 1995). The data were skewed to the right, further supporting the use of nonparametrics (Clason & Dormody, 1994).

## Results

We had a total of 192 responses from the adjusted initial mailing of 1,018 surveys, representing a response rate of 19%. We received 113 surveys by mail and 79 through the online survey. The respondents represented 16 states in the region. We measured non-respondent bias by using 79 late respondents represented by the online survey (Armstrong & Overton, 1977). We compared each item in the survey between late and early respondents and found statistically significant different responses for three items in the awareness scale and five items in the management issues section. In all cases, the early respondents registered higher scores than the late respondents.

The respondents were generally aware of the potential for woody biomass to serve as a means of energy, with most averages above 4.0. Awareness was also relatively high (>4.0) with respect to sources of woody biomass. Noteworthy is the relatively low awareness score (3.5) related to the potential of woody biomass to be transformed into a liquid or gaseous fuel (A4) (Table 1). The mean for the summated rated scale representing awareness and knowledge was 4.20.

**Table 1.**

Mean Awareness Scores and Standard Deviation (SD) for All Respondents

| **Respondent Awareness Statements+** | **Mean** | **SD** |
|---|---|---|
| A1 Woody biomass can be used to produce heat, hot water and energy for home and commercial use. | 4.58 | 0.86 |
| A2 Woody biomass includes woody waste from logging, lumber production, and construction. | 4.51 | 0.9 |
| A3 Trees regardless of age or species can be used to provide woody biomass. | 4.19 | 1.09 |
| A4 Woody biomass can be converted into a liquid or gaseous fuel. | 3.47 | 1.47 |
| A5 Branches, needles, and leaves can contribute to woody biomass. | 4.01 | 1.17 |
| A6 Woody biomass is a clean renewable source of energy. | 4.61 | 0.79 |
| A7 Woody biomass energy is an alternative to fossil fuels. | 4.47 | 0.96 |
| A8 Woody biomass has a smaller ecological impact than fossil fuel energy sources. | 3.96 | 1.22 |
| A9 Woody biomass can be harvested on a sustained yield basis from Non-industrial Private Forests (NIPF). | 3.97 | 1.18 |
| Construct Mean | 4.20 | 1.15 |

Note: +Statements scale: 1-Unaware to 5-Aware

The mean scores associated with woody biomass management issues (Table 2) indicate general agreement that woody biomass can improve the financial viability of forest management (B1), can offer new markets for low-quality growing stock (B5), and can provide a means to defer management costs (B2). There was mild agreement associated with the statement addressing financial incentives programs

for FFO (B9) (Table 2).

In terms of where woody biomass management stands with respect to broader issues of social responsibility and ecological sustainability, there was mild agreement with mean scores just below "4." The respondents agreed that using a renewable source of energy will help the environment (B10) and also agreed that managing for woody biomass was a means to promote energy independence (B11), but were just above neutral with regards to whether using a renewable source of energy was patriotic (B7). The last statement (B14) of the section addressed the willingness of Extension educators to diffuse the innovation of woody biomass management by making connections between early adopters and the potential target audience. The mean score was relatively low, not far above neutral (Table 2).

**Table 2.**

Mean Agreement Scores and Standard Deviation (SD) for Management Issues for all Respondents

| | **Management Issues Statements Associated with Woody Biomass Use+** | **Mean** | **SD** |
|---|---|---|---|
| B1 | Managing for woody biomass can improve the financial viability of forest management. | 4.09 | 0.72 |
| B2 | Managing for woody biomass can help defer management costs. | 3.76 | 0.78 |
| B3 | Managing for woody biomass is socially responsible. | 3.98 | 0.78 |
| B4 | Managing for woody biomass is ecologically sustainable. | 3.92 | 0.83 |
| B5 | Managing for woody biomass provides new markets for low-quality growing stock. | 4.24 | 0.69 |
| B6 | Woody biomass harvesting can sometimes leave a more open forest understory. | 4.00 | 0.75 |
| B7 | Providing a renewable source of energy is patriotic. | 3.54 | 0.88 |
| B8 | Woody biomass can provide markets for previously low-value or unmarketable woody biomass. | 4.27 | 0.60 |
| B9 | Financial incentives are available for some NIPF owners managing for woody biomass production | 3.42 | 0.83 |
| B10 | Helping provide a renewable source of energy is a way to help the environment. | 4.21 | 0.69 |
| B11 | Providing woody biomass as a renewable source of energy can promote energy independence. | 3.93 | 0.80 |
| B12 | Production of woody biomass can be incorporated into existing management plans. | 4.19 | 0.65 |
| B13 | Managing for woody biomass involves making permanent changes to management plans. | 3.39 | 0.84 |
| B14 | I would be willing to make connections between forest owners who manage for woody biomass and individuals who are considering such management. | 3.60 | 0.88 |

Note - +Statements scale: 0-Don't know 1-Strongly disagree 2-Disagree 3-Neutral 4-Agree 5-Strongly agree

The respondents self-identified areas of expertise. In order to facilitate the analysis, we consolidated the areas into four groups: agriculture 54% (n = 98), horticulture 22% (n = 41), 14% forestry (n = 26) and community & economic development 10% (n = 18). Nine respondents did not provide enough information to classify area of expertise. It is important to note that a post-hoc Web-based census of 4,333 Extension educators from the region, using the same selection criteria, yielded the following distribution: agriculture (21%), horticulture (6%), forestry (3%), community & economic development (6%), youth (24%), administration (10%), and miscellaneous (30%). This indicates that our survey attracted high participation from agricultural, horticultural and natural resources disciplines, with little response from youth educators.

Given the subject matter, it is not surprising that the respondents working in the area of forestry and natural resources had a significantly higher overall mean for woody biomass awareness than the other disciplines. The agriculture and horticulture categories were significantly different from each other. Similarly, the agriculture and the community development categories were significantly different from each other. The forestry category registered higher agreement scores for all nine items, of which five statements were statistically higher than the other disciplines (A3, A4, A5, A8, A9) (Table 3).

In the management issues section, the agriculture respondents had a significantly lower agreement score than the other categories on the item related to the social responsibility of woody biomass (B3). The forestry category registered the highest scores on the two items related to biomass energy providing new markets for lower grade stocking (B5, B8). Also, the forestry group, not surprisingly, registered a significantly higher score than all other categories on the item indicating that woody biomass production can be incorporated into existing management plans (B12) (Table 3).

**Table 3.**

Comparison of Mean Scores and Standard Deviation (in parenthesis) to Survey Statements Based on Different Areas of Expertise

| **Statements** | **Agriculture** | **Forestry** | **Horticulture** | **C&E[1]** | **P- value** |
|---|---|---|---|---|---|
| A1 | 4.60 (0.80) | 4.79 (0.50) | 4.49 (0.93) | 4.18 (1.38) | 0.387 |
| A2 | 4.56 (0.79) | 4.79 (0.50) | 4.31 (1.12) | 4.12 (1.32) | 0.148 |
| | a | b | a | a | |

| | | | | | |
|---|---|---|---|---|---|
| A3 | 4.22 (1.03) | 4.72 (0.74) | 4.03 (1.12) | 3.94 (1.30) | **0.022** |
| A4 | 3.59 [a] (1.35) | 4.04 [a] (1.44) | 3.05 [b] (1.56) | 3.12 [ab] (1.69) | **0.081** |
| A5 | 3.95 [a] (1.18) | 4.58 [b] (0.76) | 3.77 [a] (1.20) | 3.88 [a] (1.32) | **0.025** |
| A6 | 4.63 (0.71) | 4.83 (0.47) | 4.55 (0.83) | 4.24 (1.39) | 0.349 |
| A7 | 4.53 (0.83) | 4.75 (0.72) | 4.26 (1.05) | 4.12 (1.58) | 0.129 |
| A8 | 3.83 [a] (1.20) | 4.38 [b] (1.15) | 3.97 [a] (1.15) | 3.82 [ab] (1.59) | **0.058** |
| A9 | 3.95 [a] (1.12) | 4.63 [b] (0.71) | 3.74 [a] (1.30) | 3.47 [a] (1.62) | **0.031** |
| Construct mean | 4.20[a] (1.08) | 4.60[b] (0.87) | 4.03[c] (1.22) | 3.88[c] (1.47) | **<0.0001** |
| | | | | | |
| B1 | 3.99 (0.74) | 4.21 (0.65) | 4.20 (0.72) | 4.00 (0.65) | 0.280 |
| B2 | 3.68 (0.71) | 3.57 (1.08) | 3.87 (0.76) | 3.86 (0.66) | 0.483 |
| B3 | 3.86 [a] (0.71) | 4.13 [b] (0.85) | 4.11 [b] (0.82) | 4.25 [b] (0.68) | **0.040** |
| B4 | 3.81 (0.79) | 4.08 (0.91) | 4.09 (0.83) | 4.00 (0.73) | 0.244 |
| B5 | 4.20 [a] (0.62) | 4.52 [b] (0.83) | 4.25 [ab] (0.76) | 3.94 [a] (0.68) | **0.064** |
| B6 | 3.94 (0.73) | 4.13 (0.91) | 4.11 (0.75) | 3.71 (0.73) | 0.270 |
| B7 | 3.41 (0.83) | 3.60 (1.08) | 3.53 (0.89) | 4.00 (0.88) | 0.209 |
| B8 | 4.22 [ac] (0.56) | 4.61 [b] (0.50) | 4.35 [ab] (0.60) | 4.00 [c] (0.63) | **0.007** |
| B9 | 3.39 (0.78) | 3.67 (1.08) | 3.26 (0.82) | 3.11 (0.60) | 0.406 |
| B10 | 4.13 [a] (0.63) | 4.42 [b] (0.58) | 4.18 [ab] (0.79) | 4.33 [ab] (0.72) | **0.115** |
| B11 | 3.84 (0.78) | 4.09 (0.88) | 3.94 (0.78) | 4.00 (0.82) | 0.481 |
| B12 | 4.15 [a] (0.56) | 4.48 [b] (0.66) | 4.09 [a] (0.77) | 4.07 [a] (0.70) | **0.104** |
| B13 | 3.41 [ab] (0.83) | 3.05 [a] (0.85) | 3.60 [b] (0.81) | 3.08 [a] (0.76) | **0.118** |
| B14 | 3.52 (0.83) | 3.95 (0.73) | 3.63 (1.00) | 3.56 (0.96) | 0.390 |

Note - Bold p-value for a row indicates that the differences of mean among the groups are statistically significant based on Kruskal-Wallis test ($p<0.1$);

[1] C&E - Community and Economic development;

[a,b,c] Means with different superscripts within a row are significantly different at the at listed significance level

Roughly 45% of the respondents have been working in their area of expertise for over 15 years. Nearly 15% have 10 - 15 years of experience, 25% have worked in their area for 5 - 10 years, while the remaining 15% have less than 5 years in their area of expertise. The mean and median were 15 and 14 years, respectively. The respondents with the most experience registered a significantly higher overall mean for woody biomass awareness than the other three younger cohort groups. At the individual item level, the veteran group had three

of the nine statements showing statistical significance (A2, A4, A5) (Table 4). It is, however, important to note the weak correlation between awareness score items and "years in area of expertise," in which only two items (A2, A4) were even statistically significant (Table 5).

In the management issues section of the survey there were significant differences between some categories on five items (B3, B5, B9, B10, B13), but no patterns that can be associated with "years in area of expertise" (Table 4).

**Table 4.**

Comparison of Mean Scores and Standard Deviation (in parenthesis) to Survey Statements Based on Years in Area of Expertise

| **Statements** | **<=5** | **5-10** | **10-15** | **>15** | **P- value** |
|---|---|---|---|---|---|
| A1 | 4.45 (1.03) | 4.50 (0.91) | 4.30 (1.06) | 4.71 (0.73) | 0.154 |
| A2 | 4.48[a] (0.85) | 4.38[a] (0.93) | 4.22[a] (1.09) | 4.63[b] (0.90) | **0.057** |
| A3 | 4.00 (1.10) | 4.25 (1.08) | 3.87 (1.18) | 4.36 (1.00) | 0.137 |
| A4 | 3.32[ab] (1.54) | 3.38[ab] (1.48) | 2.87[b] (1.58) | 3.78[a] (1.37) | **0.066** |
| A5 | 3.84[ab] (1.19) | 4.13[a] (1.11) | 3.36[b] (1.26) | 4.13[a] (1.14) | **0.035** |
| A6 | 4.61 (0.76) | 4.56 (0.79) | 4.30 (1.11) | 4.68 (0.73) | 0.247 |
| A7 | 4.35 (1.20) | 4.59 (0.82) | 4.26 (1.21) | 4.51 (0.86) | 0.871 |
| A8 | 4.03 (1.30) | 4.08 (1.07) | 3.77 (1.34) | 3.87 (1.29) | 0.776 |
| A9 | 3.87 (1.38) | 3.90 (1.30) | 3.83 (1.23) | 4.01 (1.09) | 0.950 |
| Construct Means | 4.11[a] (1.22) | 4.19[a] (1.12) | 3.87[b] (1.30) | 4.30[c] (1.08) | **<0.0001** |
| | | | | | |
| B1 | 4.13 (0.68) | 4.08 (0.60) | 3.90 (1.02) | 4.07 (0.69) | 0.920 |
| B2 | 3.84 (0.75) | 3.84 (0.680 | 3.75 (0.79) | 3.63 (0.82) | 0.541 |
| B3 | 4.07a (0.87) | 4.14a (0.64) | 3.60b (0.82) | 3.97a (0.74) | **0.069** |
| B4 | 4.07 (0.78) | 3.94 (0.71) | 3.57 (0.99) | 3.96 (0.81) | 0.214 |
| B5 | 4.29a (0.64) | 4.22a (0.75) | 3.86b (0.65) | 4.31a (0.69) | **0.059** |
| B6 | 4.07 (0.96) | 4.00 (0.77) | 3.95 (0.72) | 3.96 (0.72) | 0.817 |
| B7 | 3.43 (1.01) | 3.69 (0.86) | 3.43 (0.93) | 3.47 (0.84) | 0.640 |
| B8 | 4.39a (0.56) | 4.24ab (0.55) | 4.00 [b] (0.62) | 4.31a (0.58) | 0.114 |
| B9 | 3.50ab (0.95) | 3.70b (0.82) | 3.12a (0.70) | 3.19a (0.73) | **0.044** |
| B10 | 4.19ab (0.75) | 4.45b (0.60) | 4.00a (0.76) | 4.14a (0.65) | **0.050** |
| B11 | 4.14 (0.83) | 3.95 (0.80) | 3.67 (0.86) | 3.87 (0.76) | 0.156 |
| B12 | 4.17 (0.66) | 4.26 (0.66) | 4.04 (0.71) | 4.16 (0.63) | 0.683 |

| | | | | | |
|---|---|---|---|---|---|
| B13 | 3.73a (0.87) | 3.23ac (0.80) | 3.25bc (0.72) | 3.27c (0.82) | **0.087** |
| B14 | 3.36 (1.03) | 3.81 (0.79) | 3.52 (1.03) | 3.61 (0.78) | 0.418 |

Note - Bold p-value for a row indicates that the differences of mean among the groups are statistically significant based on Kruskal-Wallis test ($p<0.1$);

[a,b,c] Means with different superscripts within a row are significantly different at the at listed significance level

**Table 5.**

Correlation (Kendall Tau) Between Years in Area of Expertise and Awareness

| | **Years in Area of Expertise** | |
|---|---|---|
| **Statements** | **Correlation** | **P-value** |
| A1 | 0.091 | 0.130 |
| A2 | 0.105 | 0.078 |
| A3 | 0.072 | 0.215 |
| A4 | 0.109 | 0.051 |
| A5 | 0.049 | 0.393 |
| A6 | 0.038 | 0.525 |
| A7 | 0.008 | 0.893 |
| A8 | -0.013 | 0.826 |
| A9 | 0.043 | 0.457 |

Note - Bold p-value indicates significance ($p < 0.10$)

The majority of respondents do work with FFO, with 105 respondents indicating "yes," 79 respondents indicating "no," and the balance with no answer. The respondents who work with FFO registered a significantly higher overall mean for woody biomass awareness than their counterparts that do not. This group had significantly higher awareness scores on all but one item (A8). With respect to the management issues section, those working with FFO are more willing to make connections between forest owners managing for woody biomass and those owners who are considering such management (B14) (Table 6).

**Table 6.**

Comparison of Mean Scores and Standard Deviation (in parenthesis) regarding Whether Respondents Work with Family Forest Owners based on Wilcoxon Test

| **Statements** | **Yes - FFO** | **No - FFO** | **P- value** |
|---|---|---|---|
| A1 | 4.75 (0.54) | 4.31 (1.14) | 0.012 |
| A2 | 4.72 (0.62) | 4.21 (1.14) | 0.002 |
| A3 | 4.41 (0.88) | 3.89 (1.29) | 0.008 |
| A4 | 3.70 (1.35) | 3.20 (1.59) | 0.042 |
| A5 | 4.19 (0.99) | 3.72 (1.35) | 0.037 |
| A6 | 4.75 (0.54) | 4.42 (1.03) | 0.046 |
| A7 | 4.63 (0.72) | 4.23 (1.21) | 0.038 |
| A8 | 3.96 (1.20) | 3.89 (1.28) | 0.812 |
| A9 | 4.13 (1.03) | 3.71 (1.35) | 0.057 |
| Construct Mean | 4.36 (0.98) | 3.95 (1.32) | 0.0001 |
| | | | |
| B1 | 4.06 (0.75) | 4.12 (0.66) | 0.763 |
| B2 | 3.65 (0.81) | 3.86 (0.69) | 0.154 |
| B3 | 3.94 (0.78) | 4.00 (0.79) | 0.637 |
| B4 | 3.86 (0.86) | 3.99 (0.75) | 0.447 |
| B5 | 4.27 (0.67) | 4.20 (0.71) | 0.532 |
| B6 | 3.99 (0.74) | 4.02 (0.79) | 0.980 |
| B7 | 3.40 (0.87) | 3.68 (0.88) | 0.054 |

| | | | |
|---|---|---|---|
| B8 | 4.29 (0.54) | 4.23 (0.68) | 0.682 |
| B9 | 3.47 (0.94) | 3.31 (0.60) | 0.235 |
| B10 | 4.12 (0.69) | 4.31 (0.68) | 0.064 |
| B11 | 3.79 (0.84) | 4.07 (0.73) | 0.051 |
| B12 | 4.23 (0.66) | 4.10 (0.63) | 0.167 |
| B13 | 3.26 (0.87) | 3.53 (0.82) | 0.072 |
| B14 | 3.81 (0.74) | 3.32 (0.95) | 0.001 |

Note - Significantly different mean scores are in bold font ($p < 0.10$)

## Discussion

Extension educators represented by the study reported here are generally aware about the potential of woody biomass to serve as a renewable source of energy. Not surprisingly, respondents with more experience in their respective disciplines registered higher awareness scores than those with less experience. Respondents who work with family forest owners registered higher awareness scores than those who do not. Furthermore, respondents representing the forestry and natural resources discipline category, most commonly associated with the FFO client base, registered higher awareness scores than the other disciplines. Unfortunately, based on the results of the study, forestry and natural resources Extension educators represent a minority within the ranks of Extension field offices. Actually, the 14% representation by forestry and natural resources educators identified in the study is higher than the estimated regional representation for the population, which is less than 5%.

In particular, the Extension educators represented by the study were highly aware that woody biomass can be used to produce heat, hot water, and energy for home and commercial use. They were less aware that woody biomass can be harvested on a sustained yield basis, with a smaller ecological impact than fossil fuel energy sources. The lower awareness scores may be due to the small percentage of educators with backgrounds in forestry. Consequently, the bulk of educators are not familiar with the concepts of sustained yield management and forest operations.

Nonetheless, all respondents strongly agreed that woody biomass management, in general, is "good for the environment." They agreed that it can provide new markets for low-quality growing stock, which can improve the financial viability of forest management. However, the Extension educators were less agreeable that managing for woody biomass can help defer management costs and that some of these management costs can be subsidized with financial incentive programs.

Given the consistently low stumpage rates ($1 - $3/green ton) reported by various state stumpage reports for woody biomass over the past decade, it is not surprising that respondents did not perceive woody biomass as a means for deferring forest management costs. Financial incentive programs are customarily linked to individual State Renewable Energy Portfolio Standards, coming in various forms such as promoting sustained energy feedstock, start-up cost share programs, lower capital costs of investments, tax deductions, and production subsidies. An estimated 40 states across the nation have adopted financial incentives that address feedstock supply and demand (Aguilar and Saunders, 2010). The low score on this statement makes sense as only the most diligent Extension educator will be familiar with incentive programs that target landowners.

Finally, the premise linking a renewable source of energy such as woody biomass with patriotism did not seem to resonate with respondents. This result was somewhat surprising given the potential of this renewable resource to contribute to energy independence (Patton-Mallory, 2008).

## Conclusions

The study reported here provides a baseline on the level of Extension educators' awareness and knowledge of woody biomass as an energy source and their desire and ability to successfully diffuse the innovation of forest management for woody biomass to FFO. The burgeoning woody biomass market could serve as a catalyst to improve forest stewardship on family forests, which to date has been mediocre at best (Fajvan, Grushecky, & Hassler, 1998; Germain, Anderson, & Bevilacqua, 2007; Munsell & Germain, 2007; Butler 2008). Extension educators could play an important role in making family forests a sustainable source of woody biomass feedstock. Extension would be in a better position to help FFO with forest management by increasing their expertise in forestry and natural resources management (Demchik, Zamora, & Current, 2009). This could be accomplished by increasing staffing levels in these disciplines or expanding the responsibilities of current educators in closely related fields of agriculture and horticulture.

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