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Landowners' Knowledge, Attitudes, and Aspirations Towards Woody Biomass Markets in North Carolina

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Abstract: *Non-industrial private forest (NIPF) landowners are often not included in discussions of emerging woody biomass markets for energy, yet they will likely be principal suppliers of the resource. Surveys administered to 475 forest landowners before and after an Extension Forestry education program in 10 counties across North Carolina indicated that landowners have low knowledge levels of woody biomass. However, as a result of participating in the training, landowners increased knowledge, had more positive attitudes, and developed aspirations to harvest woody biomass on their land. Extension professionals can use our training model to develop similar woody biomass educational programs.*

Introduction

In recent years, the Cooperative Extension Service in the United States has expanded its educational focus to include woody biomass harvesting for energy (Grebner, Perez-Verdin, Henderson, & Londo, 2009). Already a variety of resources such as training guides and websites have been made available for Extension professionals to utilize when planning educational events (e.g., Ashton, McDonell, & Barnes, 2009; Hubbard, Biles, Mayfield, & Ashton, 2007; Gan et al., 2008; Monroe, McDonnell, & Oxarart, 2007).

Some of Extension's woody biomass outreach is targeted at non-industrial private forest (NIPF) landowners, the dominant forestland ownership group in the United States (Butler, 2008; Demchik, Zamora, & Current, 2009). Nationally, 11 million private forest owners make management decisions for 56% of the forestland in the United States (Butler, 2008). In North Carolina, where an estimated 479,000 private individuals or families own 65% of the state's forestland (Brown, New, Oswalt, Johnson, & Rudis, 2006), forest landowners mirror the national trend in ownership patterns, demographics, management effort, and reason for ownership (Butler, 2008). This highlights the significance of reaching this audience with needed Extension programs. Extension Forestry initiated an educational program to raise awareness of emerging woody biomass markets among forest landowners and timber-growers. However, there has been no published evaluation of a successful woody biomass education program for forest landowners, making the development of such a new Extension program a challenging task.

The limited research available suggests that many NIPF landowners are unaware not only of the social,

political, and environmental context, but also very basic information about woody biomass (Williamson, 2007; Xu, Li, & Carraway, 2008). Therefore, the current study addresses this research gap and can serve as a reference on how to design a woody biomass energy education program that best fits NIPF landowner needs. It also illustrates North Carolina NIPF landowners' thoughts about their participation in emerging markets for woody biomass energy.

Objectives

The research study reported here was intended to be a thorough evaluation of a woody biomass NIPF landowner educational program developed by Extension Forestry at North Carolina State University (NCSU) aimed at assessing landowners' knowledge, attitudes, and aspirations with regard to woody biomass utilization for renewable energy. Data on marketing Extension programs and preferred methods of delivery was also analyzed. The results presented here will help Extension professionals and other educators to develop effective woody biomass educational programs for forest landowners, with the goal of supplementing landowners' knowledge and informing their attitudes toward and aspirations for woody biomass markets.

The research was designed to answer the following questions with regards to woody biomass education.

- What Extension marketing strategy was the most effective in reaching this audience?
- What delivery method do landowners prefer?
- What was the program's impact in terms of changing knowledge, attitude, and aspirations of participants?
- Were landowners satisfied with the information presented?
- Were any concerns or questions not addressed?

Methods

Ten woody biomass landowner trainings entitled "Utilizing Woody Biomass for Renewable Energy in North Carolina: What it Means for Forest Landowners" were conducted between September 2008 and February 2009. We stratified the sample to include one county from all but one of North Carolina's six Extension districts in order to represent landowners from different regions. The counties where woody biomass trainings were held were Alamance, Edgecombe, Halifax, Harnett, Lenoir, Pender, Rutherford, Stanly, Wake, and Wilkes. Training locations exhibited potential for emerging woody biomass markets and had an interested county agent to help organize and market the meeting. We also worked with community groups in three of the counties to boost minority representation.

The 2-hour training consisted of presentations given by four Extension Forestry professionals from NCSU. The presenters used a variety of teaching methods from PowerPoint™ presentations to flip charts, but as much as possible made the same presentation at each meeting. Topics included renewable energy legislation, market information, and potential environmental and social impacts of woody biomass harvesting. Afterwards a question-and-answer discussion gave participants an opportunity to query presenters on specific points needing clarification or to voice their concerns. The meetings were conducted on a weeknight, and dinner was served (with the exception of one weekday morning and one Saturday meeting). Follow-up activities such as enhancement of a website <http://www.ces.ncsu.edu/forestry/biomass.html> are ongoing.

One of the main objectives of the program was to raise NIPF landowners' awareness of the role of woody biomass markets in their future forest management plans. Educators highlighted woody biomass harvesting as a "tool" by which other management objectives, including those associated with the production of commercial timber, could be obtained. The focus was on increasing knowledge, but NCSU Extension Forestry also hoped for changes in attitudes and intended behavior.

The evaluation instrument was designed in consultation with the program planners and included rank-order, forced choice, five-point and four-point Likert-scale, open-ended, close-ended, and partially close-ended questions. Demographic information on sex, age, ethnicity, education level, years of experience, and acreage owned was collected. Participants were asked how they found out about the training and the reason for attending—useful information for Extension agents looking to market similar woody biomass programs in the future. Because woody biomass energy is a new topic, questions on the participants' preferred method of receiving information were also asked (Roucan-Kane, 2008).

Ten true and false questions were included to test what landowners knew and how well they understood the topic. To document changes in knowledge, the same set of questions was asked before and after the educational session. Similarly, 10n statements with a five-point Likert scale were used to record changes in attitudes. In the post-test, four questions were included to determine the likelihood that participants would apply what they learned. Because learning environment can contribute to changes in knowledge, attitudes,

and aspirations, participant satisfaction was also documented with this program (Terry & Israel, 2004).

While not a large component of the research, responses to open-ended questions and participant observation at the meetings supplemented the quantitative survey data. We collected observation data by watching, listening, and documenting reactions and behavior of participants at the meetings. Data were then sorted by content, categorized, and coded by common themes (Patton 2002). In coding the data, the study applied emergent rather than preset categories.

The evaluation instrument was assessed for validity by a panel of four NCSU faculty with expertise in research methods, Extension forestry, and evaluation. Points of confusion or misunderstanding were corrected before the printing of the final instrument. To test for reliability, a pilot test of the evaluation was conducted in Chatham County, North Carolina. Eight local landowners, consulting foresters, and other natural resource professionals participated. Results indicate a Cronbach's alpha of 0.60 for the 10-item attitudinal scale used in the study, which is acceptable for exploratory study (Nunnally, 1970; Santos, 1999).

Statistical Package for Social Sciences (SPSS) software (version 17.0) was used to analyze the quantitative data with descriptive statistics, t-tests, and Pearson's correlation coefficient.

Results and Discussion

Four hundred and seventy-five participants attended the meetings, a mean of 42 per meeting, representing 60 of North Carolina's 100 counties. Of the total 475 surveys administered, 395 partly or fully completed questionnaires were returned and entered into the final data set. This comprised an overall response rate of 83.2%.

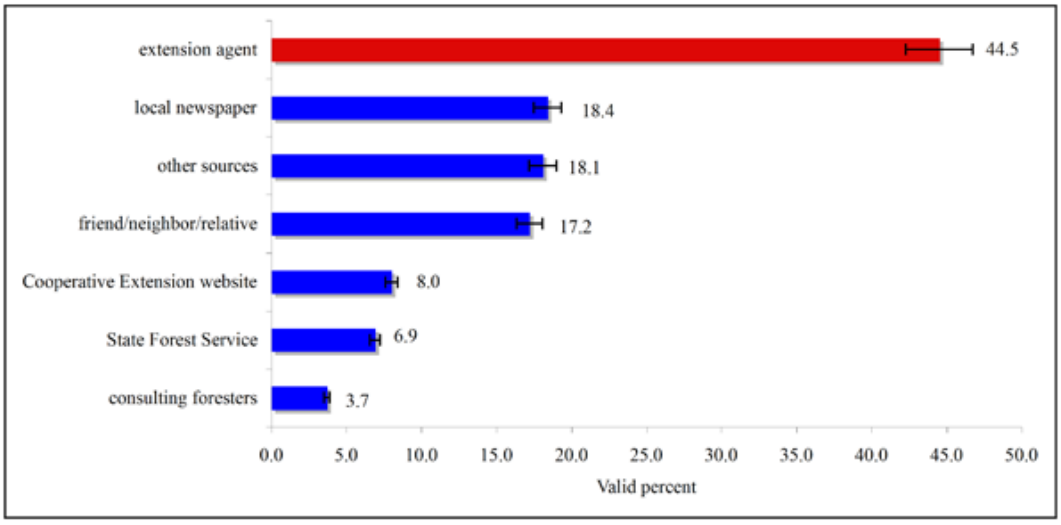
Demographics of Respondents

Sixty-nine percent of the participants were male. Of the respondents, 88% were Whites (Non-Hispanic), 11% were African Americans, and 1% were multi-racial people. The majority (97%) of the respondents were a well educated group of people, with 19% having a graduate degree, 28% having a Bachelor's degree, 31% having an associate degree or some college education, and 19% having a high school diploma or equivalent. The age of respondents ranged from 21 years to 93 years, with the mean of 61 years. In average, the respondents own 180 acres of forestland. The mean of the years of forestland ownership among the participants was 28. These demographics are similar to what is seen nationally and reported by Butler (2008).

Marketing Extension Programs

Although participants learned about the program from a variety of modes including newspaper, Internet, and word of mouth, Extension agents were the most important in marketing the program successfully (Figure 1). 18.1% learned about the training from sources other than those we had anticipated. This group was primarily minority and underserved landowners, who do not have a strong relationship with county Extension agents. They learned about the program from non-governmental organizations operating in communities. Only 8% of all participants learned about the trainings from the Cooperative Extension website.

Figure 1.
How Landowners Learned About the NC Woody Biomass Trainings

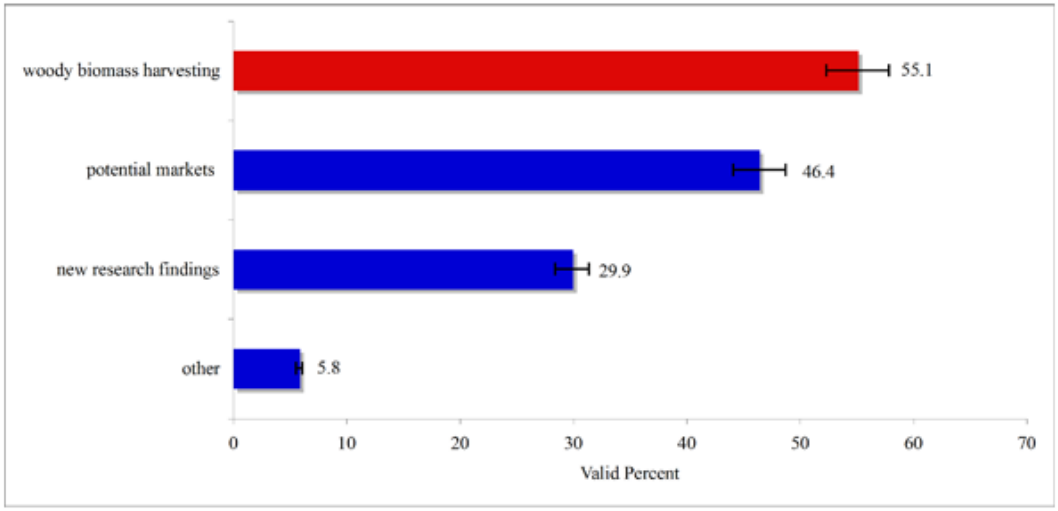


Note. Error bars represent 95% confidence intervals.

In marketing the program, it was found that more landowners were interested in all aspects of biomass

harvesting, as opposed to specifically in "potential markets" (Figure 2).

Figure 2.
What Landowners Came to Learn at the NC Woody Biomass Trainings

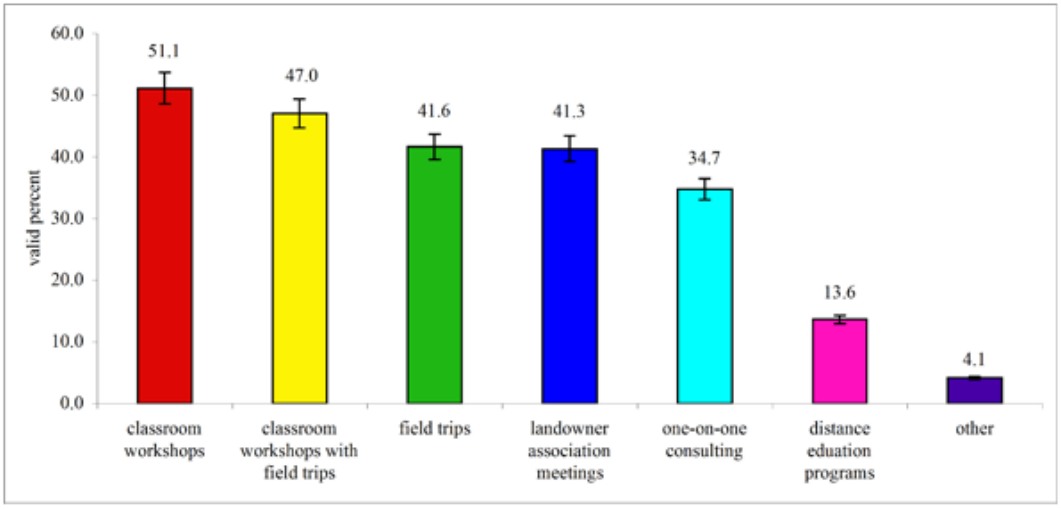


Note. Error bars represent 95% confidence intervals.

Methods of Delivery

The majority of the landowners preferred traditional methods for receiving information about woody biomass harvesting (Figure 3). When respondents were asked to indicate all the methods they prefer to learning about woody biomass harvesting, 51.1% of the participants indicated classroom workshops, 47% indicated classroom workshops combined with field trips, and 41.6% indicated field trips. Only 13.6% of the participants indicated distance education as a method for receiving information.

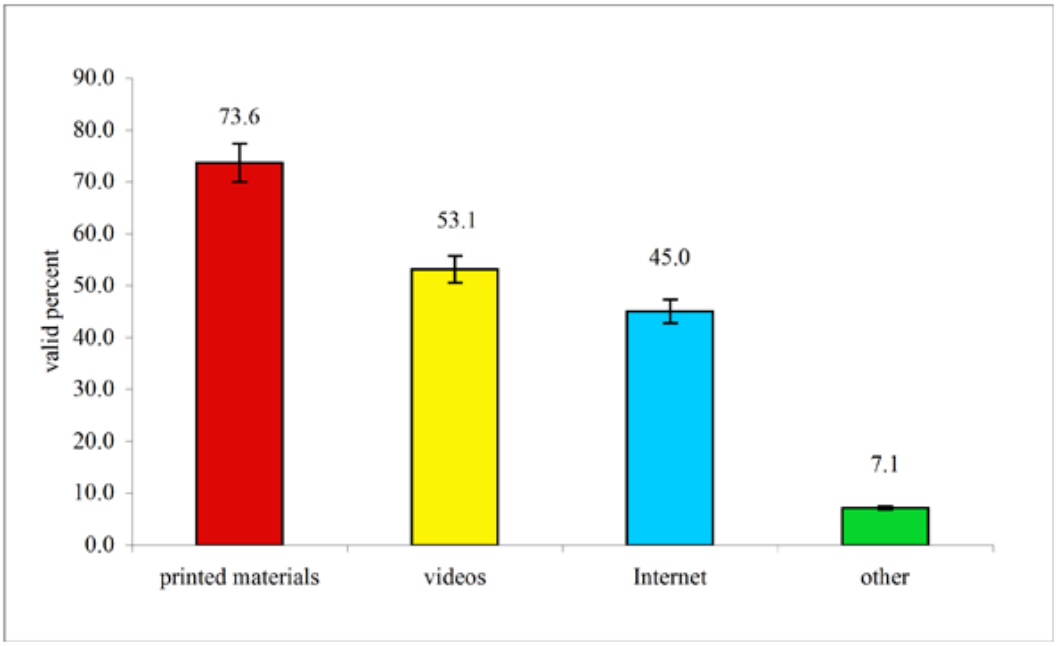
Figure 3.
Forest Landowners' Preferred Methods of Learning about Woody Biomass Harvesting



Note. Error bars represent 95% confidence intervals.

When respondents were asked to indicate all the types of source materials they prefer to learning about woody biomass harvesting, the majority (76%) of the participants indicated printed materials as the most preferred medium of receiving information. Videos (49.8%) and Internet (44.4%) were identified as second and third most preferred mode of receiving information (Figure 4). When developing woody biomass education programs, educators should provide a variety of resources for accessing the information, particularly printed materials, which were most preferred by program participants.

Figure 4.
Participants' Preferred Resources for Additional Information about Woody Biomass Harvesting



Note. Error bars represent 95% confidence intervals.

Changes in Knowledge and Attitude

An important objective of the study was to find out what North Carolina's landowners know, think, and are aspiring to do about woody biomass harvesting as a result of attending an Extension education program. Although most landowners in the study were well educated (78.4% of participants attending the training possessed some college or higher level of education), overall they had little prior information on the topic and were unaware of future opportunities in woody biomass markets.

The mean of the correctly answered questions at the pre-test was 4.4, and the mean of the correctly answered questions at the post-test was 8.1 out of 10 questions. Paired sample t-test for the comparison of pre- and post-test means indicates that participants' knowledge improvement was statistically significant at the $p<0.001$ level (Table 1). The comparison of pre and post knowledge test scores for individual respondents indicates that 87.6% of the respondents were able to improve their knowledge about woody biomass harvesting (Table 2).

Table 1.
Comparison of Pre- and Post-test Knowledge Score Means of Participants at NC Woody Biomass Trainings (N=314)

Variable	Pre-Test Mean	Post-Test Mean	*t*	*p*
Knowledge test score (out of 10)	4.37	8.08	24.08	0.000**
**significant at p<0.001 (2-tailed)				

Table 2.
Distribution of Participants at NC Woody Biomass Trainings by Change in Knowledge

Change category	*n*	%
Participants who had positive change	275	87.6
Participants who had no change	33	10.5
Participants who had negative change	6	1.9

Landowner attitudes towards woody biomass harvesting became more positive as well, but with some reservations. On a scale from 10 being the most negative to 50 being the most positive attitude about biomass harvesting, the mean of the participants' attitudes toward woody biomass harvesting at the pre-test was 34.9, and the mean of the participants' attitudes at the post-test was 37.9. Even though this was a relatively small change, paired sample t-test indicates that it was statistically significant at the $p<0.001$ level

(Table 3). The comparison of pre- and post-attitude scale scores for individual respondents indicates that 67.6% of respondents were able to develop more positive attitudes toward woody biomass harvesting (Table 4).

Table 3.
Comparison of Pre- and Post-test Attitude Score Means (N=309) of Participants at NC Woody Biomass Trainings

Variable	Pre-Test Mean	Post-Test Mean	*t*	*p*
Attitude test score (out of 50)	34.90	37.87	9.22	0.000**
**significant at p<0.001 (2-tailed)				

Table 4.
Distribution of Participants at NC Woody Biomass Trainings by Change in Attitude

Change category	*n*	%
Participants who had positive change	209	67.6
Participants who had no change	29	9.4
Participants who had negative change	71	23.0

Approximately one-third (32%) of the program participants were attending their first Extension meeting. By using an independent samples t- test to compare mean scores of these population subgroups, we found those attending their first Extension meeting had lower pre-test knowledge scores but showed greater knowledge change than those who had previously attended Extension meetings (Table 5). The two groups did not demonstrate significant differences in changes in attitude (Table 6).

Table 5.
Comparison of Knowledge Change with Extension Experience of Participants at NC Woody Biomass Trainings

Comparison Value	Mean for Previous Attendees of Extension Meetings	Mean for Participants Attending First Extension Meeting	*t*	*p*
Pre-test Knowledge	4.69	3.33	4.374	0.000**
Post-test Knowledge	8.14	7.93	1.096	0.274
Knowledge Change	3.36	4.40	3.124	0.002*
*significant at p<0.05 (2-tailed) **significant at p<0.001 (2-tailed)				

Table 6.
Comparison of Attitude Change with Extension Experience of Participants at NC Woody Biomass Trainings

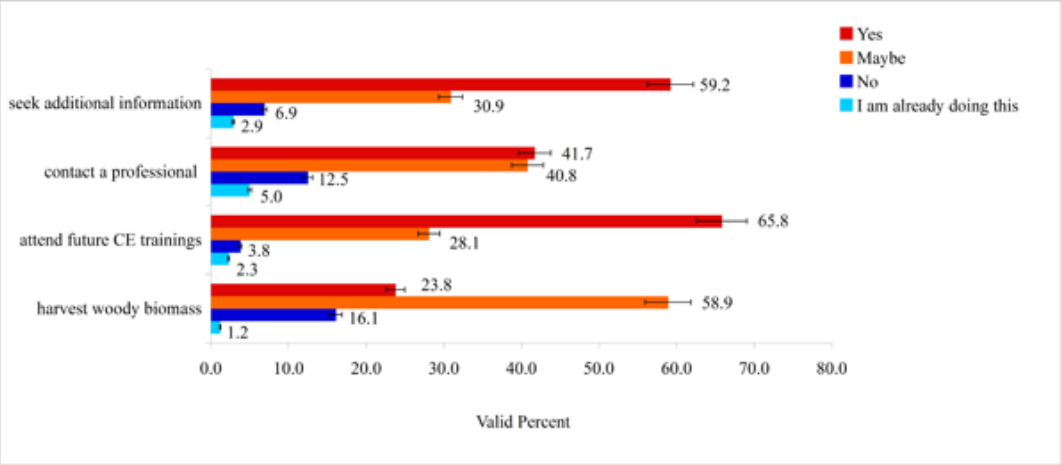
Comparison Value	Mean for Previous Attendees of Extension Meetings	Mean for Participants Attending First Extension Meeting	*t*	*p*
Pre-test Attitude	34.97	33.81	1.562	0.119
Post-test Attitude	37.78	38.04	0.486	0.627
Attitude	2.60	3.70	1.554	0.121

Change				

Changes in Aspirations

It is hoped that knowledge and attitude change are also ultimately correlated to practice change. Nearly 60% of respondents reported that, as a result of this training, they intend to seek out additional information related to woody biomass harvesting. Participants were more definite about seeking further educational opportunities for learning about woody biomass harvesting rather than actually harvesting woody biomass on their land (Figure 5), indicating they would like more information before committing to adopting practices in the management of their land.

Figure 5.
Participants' Aspirations of Landowners at NC Woody Biomass Trainings

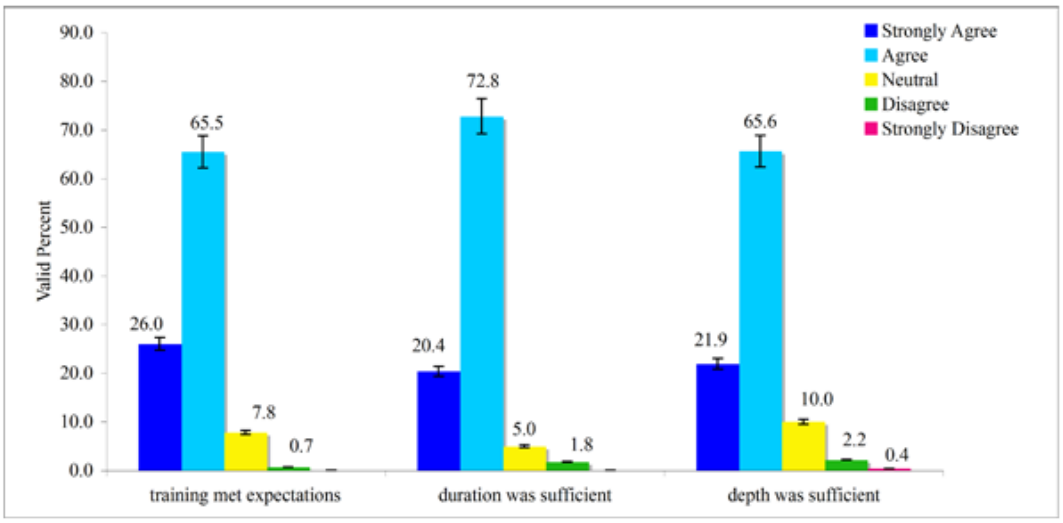


Note. Error bars represent 95% confidence intervals.

Participants' Satisfaction

Of the participants, 91.5% agreed or strongly agreed that the training met their expectations, that the duration was sufficient for materials covered (93.2%), and that the depth of the material covered was sufficient (87.5%) (Figure 6).

Figure 6.
Participant Satisfaction at the NC Woody Biomass Trainings



Note. Error bars represent 95% confidence intervals.

Participants enjoyed the training for the subject area itself. Because most participants were not aware of woody biomass harvesting prior to attending, they found the training informative and timely. As one participant summed up, "what I liked best was learning that biomass marketing may help me clean up my logging mess." Another commented, "I enjoyed learning information I didn't know before and learning that my

forest management plan may ultimately incorporate biomass harvesting." Participants also appreciated the diversity and expertise of speakers, the "practical solutions," and "balanced view considering pluses and minus."

Some constructive criticism was offered, pointing to areas needing improvement. Three main themes emerged as the least favorite parts of the training: lack of depth, lack of local markets, and lack of venue comfort. "I would like more details, more easily understood info—the presentation was too high tech" one participant complained, and many agreed that the training was "short on future directions of biomass use." Others believed "too much time was spent on basics that most of us woodland owners already know." Another major source of frustration was participants not seeing the local applicably of the training's information.

Of the participants, 97.8% would recommend the program to others, primarily for raising awareness about possibilities on their woodlands. Many thought the training would "get more people involved in forestry" and "encourage them to seek professional management," which they saw as positive outcomes. Of the few who would not recommend the training, reasons given related to not being able to see the local applicability of the topic. In designing future trainings, Extension professionals should be sure to emphasize real potential of local markets in the area where the meeting is being held and practical application on the land.

Questions and Concerns of Participants

When asked what additional information they would like to receive, landowners' responses came down to who, what, when, where, and how:

- Who are specific practitioners and companies that do biomass harvesting?
- What are the costs?
- When will this become an option locally?
- Where is the closest facility to sell?
- How do I get started?

Once they realized that much of this information has yet to materialize, many voiced that they would like to be kept up to date through future Extension trainings.

Although the majority of participants were overall satisfied with the training program, respondents also voiced a number of concerns for soil, wildlife, air quality, sustainability, forest health, and productivity impacts of woody biomass harvesting. Although the training specifically allocated time to address such concerns, several landowners remained unsatisfied with the answers given. Others rejected biomass harvesting completely. Extension needs to address these concerns early on to avoid a situation similar to that for agricultural biofuels, which quickly went from being considered "green" to being an environmental disaster (Hance, 2008).

Conclusions and Implications

Harvesting of woody biomass is a new topic in Extension education. Extension agents and adult educators planning and conducting these woody biomass Extension programs for forest landowners can use the program described here as an effective model with measurable program impacts. Extension professionals should have success with woody biomass education programs for landowners in regions similar to North Carolina, with abundant forestland, a large number of NIPF landowners, and access to wood energy markets.

With regard to program impact, it was discovered that forest landowners in North Carolina have low knowledge levels of woody biomass harvesting. Knowledge level increased as a result of participation in the program. Landowners' attitudes also became more positive after participating in the training; however, landowners still had several reservations about participating in woody biomass markets due to potential social, environmental, and economic impacts.

It remains to be seen if landowners will increase harvesting of woody biomass on their land as a result of participation in this program. Landowners indicated they would seek additional information and professional consultation, but were more reluctant to agree to harvesting woody biomass on their land, partly due to lack of convenient markets. The positive correlation between knowledge and attitude change could potentially correlate to behavior change (Jayeratne, Harrison, & Bales, 2009). Future studies could assess longitudinal impact of the program and measure landowner behaviors as they relate to woody biomass harvesting.

In the continuation or development of new woody biomass education programs, we found that we need to:

- Specify local and practical applications of woody biomass harvesting at trainings

Make a conscious effort to include minority and underserved landowners in programs so that these populations are not excluded from biomass opportunities

- Pay more attention to addressing social, environmental, and economic concerns of landowners
- Target audiences with the greatest changes in knowledge and attitudes such as those attending their first Extension meeting

Because the diverse audience included first-timers to an Extension meeting, those who do not have a management plan, and those who have never used a consulting forester, some time had to be spent on basic forestry. Above all, it is important to present locally applicable information on how to get woody biomass harvesting endeavors started.

Extension professionals looking to develop similar woody biomass education programs can utilize these findings in their program planning process. For example, participants indicated they preferred short programs, a variety of teaching methods, and printed materials to video or Internet resources. Indeed, while only a few hours in length, short Extension programs are useful to landowners and can result in increased knowledge, more positive attitudes, and increased aspirations among participants about harvesting woody biomass energy. In addition, one should work with local county Extension agents to market the program, but also contact non-governmental organizations to reach minority and underserved landowner groups.

Overall, the findings of the study reported here strengthen the perception of the importance of woody biomass educational programs as an important component of renewable energy adoption plans. However, policy makers must be cautious in overestimating the amount of woody biomass available based on the number of NIPF landowners in an area. Landowner willingness to participate in future woody biomass markets is dependent upon several factors, and if local markets do not emerge in the next few years, interest may fade. While landowners are interested and want to support renewable energy, their support is not guaranteed.

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