

Landowners, Bioenergy, and Extension Strategies

Abstract

Given increased energy demand from alternative sources, wood-based bioenergy is receiving significant policy and research attention in the United States. Many private forest landowners, who are the likely feedstock suppliers for wood-based bioenergy, however, are not completely aware of its opportunities and potential positive and negative impacts. This article, therefore, reviews the existing work on status of biomass availability and landowner motivations for supplying biomass for wood-based bioenergy industry. Some educational needs of landowners and the potential role of Extension professionals are highlighted.

Omkar Joshi

Forest Economist
Department of
Sustainable Forestry
Texas A&M Forest
Service
College Station,
Texas
ojoshi@tfs.tamu.edu

Donald L. Grebner

Professor
Department of
Forestry
Mississippi State
University
Mississippi State,
Mississippi
dgrebner@cfr.msstate.edu

James E. Henderson

Associate Extension
Professor
Department of
Forestry
Mississippi State
University
Mississippi State,
Mississippi
jhenderson@cfr.msstate.edu

Steven R. Gruchy

Natural Resource
Economist
Mississippi Fish and
Wildlife Foundation
Amory, Mississippi
sgruchy@wildlifemiss.org

Introduction

In recent years, the idea of utilizing woody resources for energy generation has received an unprecedented amount of attention in the United States. It is considered as a new opportunity to reduce and replace some of the unsustainable fossil fuel usage in the nation (Joshi & Mehmood, 2011a). There are several biofuel production facilities currently operating, but the growing need for sustainable energy would require a considerable increase in production to achieve certain energy goals (Hill, Nelson, Tilman, Polasky, & Tiffany, 2006). Given food security conflicts associated with using agricultural products in energy production (Hill, Nelson, Tilman, Polasky, & Tiffany, 2006), utilizing woody biomass seems a most viable option to generate bioenergy in the United States (Joshi & Mehmood, 2011a). Fortunately, the southern United States, often considered a wood-basket of the nation, is one of the most productive regions due to its climate and large amount of undeveloped land available for growing potential biomass feedstocks (Paula, Bailey, Barlow, & Morse, 2011; Foster, Mayfield, Jackson, & Silviera, 2005). Approximately 55 million tons of woody biomass is potentially available annually for the production of bioenergy and other bio-based products from this region (Foster, Mayfield, Jackson, & Silviera, 2005).

Given non-industrial private forest (NIPF) landowners are the largest forest ownership type in the United States, harvest strategies and landowner willingness to harvest could have significant implications on sustainable timber supply (Joshi, Grebner, Munn, Hussain, & Gruchy, 2013; Gruchy, Grebner, Munn, Joshi, & Hussain, 2012; Joshi & Mehmood, 2011a; Joshi & Arano, 2009). Therefore, determining NIPF landowner preferences and their effects on harvesting decisions has been a topic of intense research for many years. However, the harvest of logging and thinning residues, which are considered to be viable bioenergy feedstocks, are essentially a waste product and not a typical forest product included in the landowner's decision to harvest (Joshi & Mehmood, 2011a). Therefore, existing literature pertaining to timber harvesting behavior does not necessarily address NIPF landowners' motivations for harvesting biomass for wood-based bioenergy (Joshi & Mehmood, 2011a).

Given the policy interest in wood-based bioenergy, recent research has identified key attributes that influence private forest landowners' motivations to harvest woody biomass for wood-based bioenergy. These attributes are important in determining the attainability of biomass feedstock and the viability of establishing bioenergy production facilities. For instance, if changes in conventional harvesting practices take place, such as the removal of logging residuals and non-merchantable trees for bioenergy, it could significantly influence landowners' decision to harvest their forestland *whether today or in future* (Joshi, Grebner, Hussain, & Grado, 2013). Similarly, because wood-based bioenergy is a relatively new development, recent literature indicates the need for Extension to provide landowner education regarding wood-based bioenergy markets in the South (Gruchy, Grebner, Munn, Joshi, & Hussain, 2012; Joshi & Mehmood, 2011a; GC, 2009).

This article presents an overview on availability of woody biomass and the existing research pertaining to biomass harvesting behavior of private forest landowners in the southern United States. In particular, the article aims to discuss how Extension can meet educational needs of landowners and provide them with the information to evaluate wood-based bioenergy production systems and markets.

Availability and Market of Woody Biomass in the Southern United States

Research has highlighted that the southern United States offers a large amount of unused logging residues. Gan and Smith (2006) studied the accessibility and distribution pattern of logging residues in the United States. Their study revealed that while 13.9 million dry tons of woody biomass was available only from logging residue growing stocks, this accounting increased to 36.2 million dry tons, after adding estimates from other sources. About 67% of the total potential annual available logging residues were contributed by the Southeast and South Central region. In a statewide accounting of logging residue availability, the study revealed that Georgia, Alabama, and Mississippi were ranked as "top three states" having annual capacity of producing 1.257, 1.232, and 1.064 million dry tons of logging residues annually from growing stock, respectively Gan & Smith, 2006).

In recent past, wood-based bioenergy has received momentum in the U.S. South. As of first quarter 2014, there are about 25 wood-fueled biomass electric generation facilities and 36 wood pellet facilities in the region (Timber-Mart South, 2014). With more than 50 new announcements for bioenergy projects, southern United States seems to have sustainable bioenergy market in the future (Timber-Mart South, 2014).

NIPF Landowner Willingness to Harvest Biomass for Wood-Based Bioenergy

Unlike the case with timber harvesting behavior, few studies have focused on understanding the factors influencing NIPF landowner preferences to supply woody biomass for wood-based bioenergy industries. Recently, Shaw, Hazel, Bardon, and Jayaratne (2012) analyzed differences in landowners' motivations for bioenergy before and after an Extension forestry education programs in North Carolina. The authors found that many landowners even with higher than college level of formal education were not aware of market opportunities associated with wood-based bioenergy in advance of these educational programs.

Gruchy, Grebner, Munn, Joshi, and Hussain (2012) analyzed how private forest landowners rank different biomass harvesting plans when they receive a higher, an equal to, or lower revenue offer than a standard clear-cutting scenario. Interestingly, the authors reported that private forest landowners preferred bioenergy-harvesting plans even when marginal benefits obtained from those were less than a standard clear-cutting option. This revealed landowner preference for environmental benefits of bioenergy harvesting as clear-cutting impacts water balance and generally results with overall degradation of environmental quality (Keenan & Kimmins, 1993). The authors further revealed that landowners with university degrees and those having larger forestland holdings preferred wood-based bioenergy over a standard clear-cutting option.

Joshi, Grebner, Munn, Hussain, and Gruchy (2013) analyzed landowners' response when multiple harvesting options were presented to them. The authors indicated that landowners were interested in adopting a harvesting plan that provides them with the highest economic premium along with minimal disturbance to environmental quality. Similarly, landowners were interested in adopting a harvesting method that required limited site preparation and resulted in optimal utilization of logging residues.

Joshi, Grebner, Hussain, and Grado (2013) were interested to know whether landowner knowledge of wood-based bioenergy has any correlation with their willingness or unwillingness to harvest feedstock for wood-based bioenergy. Building upon the previous work pertaining to landowner woody biomass harvesting behavior, this research highlighted that many landowners in the southern United States are not aware of wood-based bioenergy. Arguably, given that landowners have incomplete information on the topic, landowner willingness or unwillingness does not reflect their true interest in wood-based bioenergy. The authors indicated that resident male landowners having more forestland and those having higher formal education were more likely to know of wood-based bioenergy. The authors realized that there is a need for bioenergy Extension education amongst female and those landowners who do not have a university degree.

Joshi and Mehmood (2011a) analyzed the potential influence of biophysical forest characteristics, forest management objectives, and socio-demographic attributes on southern landowners' motivations to harvest woody biomass for wood-based bioenergy. The authors indicated that landowners having planted pine and mixed forests were more likely to harvest woody biomass for wood-based bioenergy. While the landowners having timber production motives were less willing to harvest biomass, those having wildlife management objectives were more interested in harvesting woody biomass for bioenergy. Likewise, elderly (more than 60 year old) and landowners without a university degree were less likely to harvest biomass for wood-based bioenergy.

Joshi and Mehmood (2011b) segmented private forest landowners in the southern United States based on their forest management objectives and interest in supplying feedstock for bioenergy industry. The authors reported that the largest segment of the

landowners had multiple objectives and were mainly motivated towards producing timber from their forestland. Despite being wealthy and educated, a significant percentage of landowners in this group did not have knowledge about wood-based bioenergy. Majority among wealthy (having household income >\$85,000) landowners with university degree were willing to harvest trees for bioenergy.

Paula, Bailey, Barlow, and Morse (2011) explored landowner willingness to supply woody biomass for biofuel production in Alabama. The survey results revealed that landowners with larger forestland holdings were more interested in supplying woody biomass for biofuel production. Similarly, feedstock price, attractive biomass market, and low establishment costs, among others, were also found to be important factors in determining landowner motivations for biomass harvesting.

GC (2009) analyzed the NIPF landowner willingness to accept a variety of bid prices in Arkansas, Virginia, and Florida. The author found that landownership objectives, demographic characteristics, and past harvesting experience had a significant influence upon landowner preferences for woody biomass harvesting.

All in all, existing literature indicates that there are ample forest resources that can be used to generate wood-based bioenergy in the United States. Similarly, size of forestland; socio-demographic attributes such as age, education, and income; species composition in the forestland; price of woody biomass; and environmental impacts of biomass harvesting are important determinants in landowner motivation towards wood-based bioenergy. Similarly, existing literature clearly indicates that significant percentages of landowners are not aware of wood-based bioenergy in the United States.

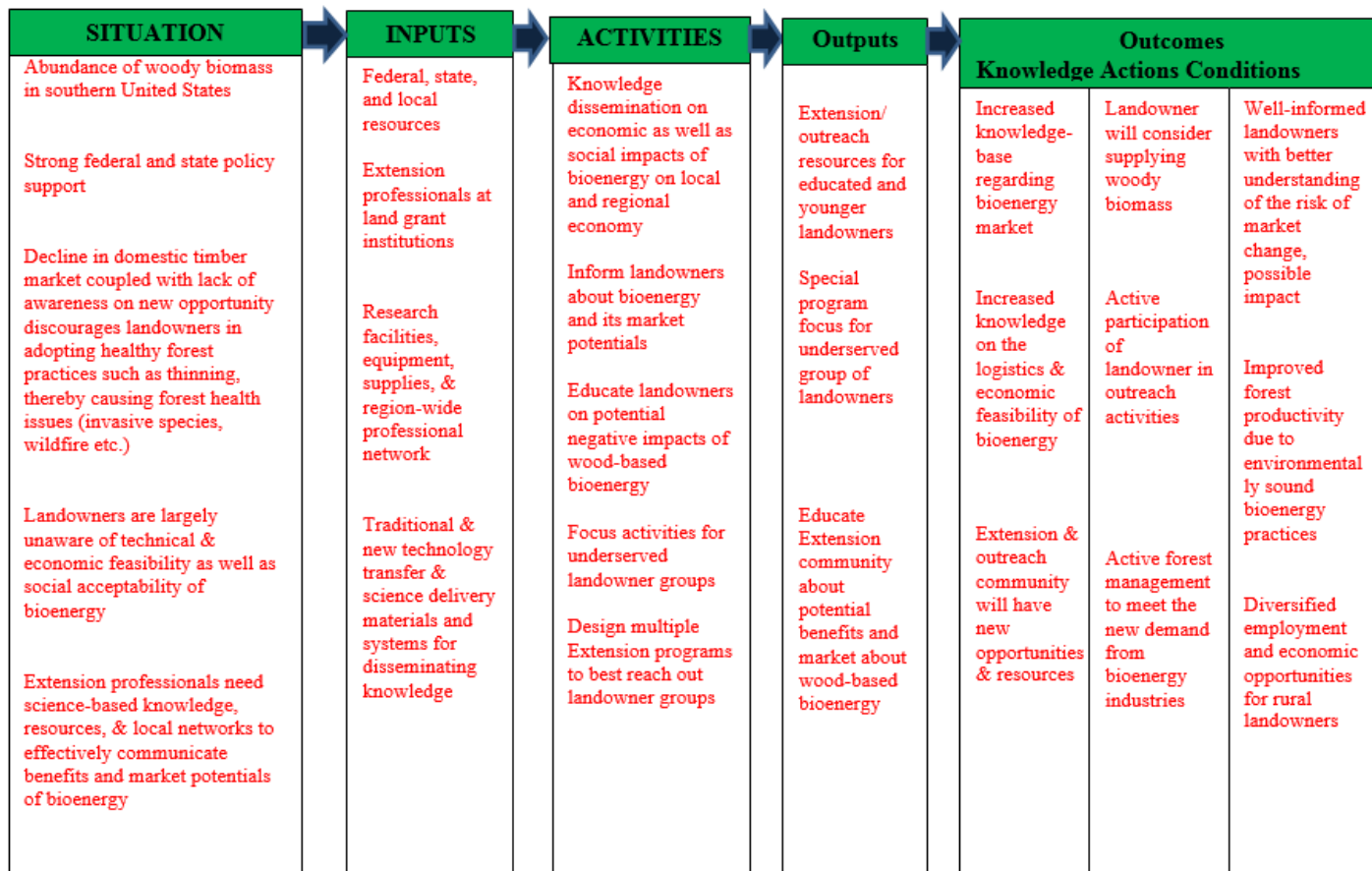
A numbers of important points are identified from this meta-analysis. First, there is abundance, market, and strong policy support for wood-based bioenergy in the United States. Second, while private forest landowners generally represent an educated group of people in the southern United States, the majority are not aware of wood-based bioenergy let alone its market potential. Third, many landowners having amenity and wildlife management interest were also interested in wood-based bioenergy, which contrasts with their harvesting motivations for conventional timber products. Fourth, given diversity among landowner segments, there cannot be a one-size-fits-all formula for Extension programming, and landowners need to be grouped into multiple segments for program planning. We have used underpinnings of the logic model (Taylor-Powell, Steele, & Douglass, 1996) for discussion on potential role of Extension in the following section.

Role of Extension in the Existing Situation

Competent strategies are critically important for success of any Extension program. We have used the underpinnings of basic logic model (Taylor-Powell, Steele, & Douglass 1996), which suggests inputs, outputs, and outcomes-impact as primary component of any program planning (Figure 1).

Figure 1.

Logic Model: An Integrated Approach to Educate Southern Landowners About Wood-Based Bioenergy



As research findings suggest, despite the availability of bioenergy feedstock, results indicate that many landowners in the United States, particularly in the southern region, are not aware of opportunities associated with wood-based bioenergy. Grebner, Perez-Verdin, Henderson, and Londo (2009) noted that even government officials working in the local and regional offices are not aware of the economic impacts associated with this opportunity. Given that wood-based bioenergy is a relatively new, and in some areas, a developing opportunity, these results are not surprising. Undoubtedly, the role of Extension professionals is vital in filling a knowledge gap among stakeholders, such as landowners and government officials, concerning wood-based bioenergy harvesting and production systems and market opportunities. In the following paragraphs, the role of Extension professionals and the issues that can be addressed by outreach and education are discussed.

Educate Extension Colleagues

A recent survey of Extension educators in the northeastern United States found that while respondents generally knew woody biomass as a potential bioenergy feedstock, many educators, other than those having expertise in forestry and natural resources education, were relatively less aware of sustainable harvesting practices associated with bioenergy (Germain & Ghosh, 2013). Similarly, many even did not know the concept of sustained yield management. Of importance, forestry and natural resource educators constitute less than 5% of the total Extension educators (Germain & Ghosh, 2013). Overall results from this study are applicable in the southern United States, where Extension professionals with expertise in forestry and natural resources need to educate their non-forestry peers. Likewise, they need to encourage foresters to incorporate bioenergy feedstock harvesting in stewardship and other management plans.

Educate Non-Industrial Private Forest Landowners

As existing literature revealed, another group requiring information on bioenergy are non-industrial private forest landowners. Often, bioenergy is perceived as a competitor of traditional timber products. Many landowners are not aware that leftover woody biomass from logging operations such as treetops, branches, and non-merchantable trees can be used to create bioenergy (Joshi & Mehmood, 2011a). Therefore, landowners won't necessarily displace traditional timber products (saw timber, chip-n-saw, and pulpwood) in the long run, if they choose to supply woody biomass feedstock for bioenergy. In other words, Extension professionals

should increase awareness of the landowners, forestry and natural resource professionals, and government officials and the public on the opportunities associated with wood-based bioenergy.

Explain Negative Impacts

Not only should Extension professionals discuss the benefits of bioenergy, but they need to inform landowners of potential negative impacts associated with excessive woody biomass use as well. This argumentation follows the previous findings by Decker, Lassoie, Goff, and Parrish (1988), who cautioned that participants having unrealistic aspirations diminish their interest in the long run. While wood-based bioenergy provides ample socio-economic and environmental benefits, excessive use of biomass can have negative impacts on the soil, wildlife habitat, and overall forest biodiversity (Cook & Beyea, 2000). Existing literature indicates that many landowners do not know of these facts. For instance, Joshi, Grebner, Munn, Hussain, and Gruchy (2013) found that Mississippi landowners preferred a clear-cutting plan, which requires cleaning 95% of woody biomass from planted pine forests. Harvesting at this level, however, might result in negative soil productivity in the long run (Perlack et al., 2005).

Use a Variety of Outreach Approaches

It is worth noting that despite knowing the opportunities associated with bioenergy, actual willingness for feedstock supply would, however, vary amongst landowners. This might be another concern for Extension professionals. As Joshi and Mehmood (2011b) noted, inherent heterogeneity amongst landowners, in terms of socio-demographics and management interest, dictate that they need to be educated through a variety of outreach approaches. For instance, some landowners prefer to manage their forestland passively. As research suggested (Joshi & Mehmood, 2011b), this group of landowners are generally older in age, have small landholding size, and mostly manage forestland for the purpose of bequest. As Hughes et al. (2005) explained, such landowners, characterized as underserved groups, rarely participate in outreach and Extension activities. Since most of underserved landowners are not familiar with the concept of generating energy from wood, similar to what Joshi and Mehmood (2011b) suggested, this group should be targeted for providing information about bioenergy.

Target Large Forestland Landowners with Multiple Management Objectives

Existing research indicates that landowners owning large forestland size and having multiple forest management objectives are more interested in harvesting biomass for wood-based bioenergy (Gruchy, Grebner, Munn, Joshi, & Hussain, 2012; Joshi & Mehmood, 2011a; Joshi & Mehmood, 2011b). As econometric studies suggest, such landowners are younger in age and likely to be more formally educated than others. Given that these are potential feedstock suppliers, spending more resources to train this group would, at least indirectly, help contribute in fulfilling feedstock supply needs of wood-based bioenergy industries. Therefore, this group should be a special target of Extension programs to ensure sustainable feedstock supply in the region.

As our logic model suggests, Extension efforts will help increase the existing knowledge base of landowners on logistic and economic feasibility of wood-based bioenergy opportunity. Similarly, landowners will fully understand potential risks of future market changes. In the long run, such programs are likely to result in improved forest productivity and ecosystem health through environmentally sustainable bioenergy system. Detailed description of program inputs, activities, and outcomes are reported in Figure 1.

Conclusion

The study reported here provides a meta-analysis of research findings on NIPF landowner motivations for wood-based bioenergy in the U.S. South. As the literature suggests, many landowners in the United States, particularly in the southern region, are not familiar with the potential benefits and negative impacts of wood-based bioenergy. Thus, a logic model is suggested for Extension program design and implementation. Because the sustainable feedstock supply for the bioenergy industry largely depends upon and is subject to the motivations of private forest landowners, Extension professionals can play an important role in fulfilling knowledge deficiency among landowners and government officials pertaining to wood-based bioenergy and increasing productivity. Most important, because all landowners are not likely to contribute to wood-based bioenergy, Extension and outreach activities need to be targeted to the younger and more formally educated landowners having higher tract of forestland and they are likely to have greatest interest in woody biomass harvesting. Landowners need to be educated on bioenergy market opportunities, harvesting and production systems, and issues associated with soil productivity that may result from the over harvest of woody biomass.

Reference

Becker, D. R., Skog, K., Hellman, A., Halorsen, K. E., & Mace, T. (2009). An outlook for sustainable forest bioenergy production in the Lakes States. *Energy Policy*, 37(12), 5687-5693.

- Bohlin, F., & Roos, A. (2002). Wood-fuel supply as a function of forest owner preferences and management styles. *Biomass and Bioenergy*, 22(4), 237-249.
- Cook, J., & Beyea, J. (2000). Bioenergy in United States: Progress and possibilities. *Biomass and Bioenergy*18(6), 441-455.
- Decker, D. J., Lassoie, J. P., Goff, G. R., & Parrish, K. (1988). Do workshops work? *Journal of Extension* [On-line],26(4) Article 4FEA5. Available at: <http://www.joe.org/joe/1988winter/a5.php>
- Foster, C. D., Mayfield, C., Jackson, S., & Silveira, S. (2005). Sustainable forestry for bio-energy and bio-based products. Retrieved from: <http://forestandrange.org/Biomass/index.asp>
- Gan, J., & Smith, C. T. (2006). A comparative analysis of woody biomass and coal for electricity generation under various CO₂ emission reductions and taxes. *Biomass and Bioenergy*, 30(4), 296-303.
- GC, S. (2009). *Analysis of non-industrial private forest landowners policy preferences for promoting renewable bioenergy*. M.Sc. thesis, University of Arkansas, Monticello, USA. 123 p.
- Germain, R. H., & Ghosh, C. (2013). Assessing Extension's ability to promote family forests as a woody biomass feedstock in the northeast United States. *Journal of Extension*. [On-line], 51(1) Article 1RIB6. Available at: <http://www.joe.org/joe/2013february/rb6.php>
- Grebner, D. L., Perez-Verdin, G., Henderson, J. E., & Londo, A. J. (2009). Bioenergy from woody biomass, potential for economic development, and the need for Extension. *Journal of Extension* [On-line] 47(6) Article 6FEA7. Available at: <http://www.joe.org/joe/2009december/a7.php>
- Grebner, D. L., Perez-Verdin, G., Sun, C., Munn, I. A., Schultz, E. B., & Matney, T. G. (2009). Woody biomass feedstocks: A case study on availability, production costs, and implications for bioenergy conversion in Mississippi. Chapter 12, In: Solomon & Luzadis, eds. *Renewable energy from forest resources in the United States*. Routledge, London. 330 p.
- Gruchy, S. R., Grebner, D. L., Munn, I. A., Joshi, O., & Hussain, A. (2012). An assessment of non-industrial private forest landowner willingness to harvest woody biomass in support of bioenergy production in Mississippi: A contingent rating approach. *Forest Policy and Economics*, 15(2), 140-145.
- Hill, J., Nelson, E., Tilman, D., Polasky, S., & Tiffany, D. (2006). Environmental, economic, and energetic costs and benefits of biodiesel and ethanol biofuels. *PNAS*, 103(30), 11206-11210.
- Hughes, G., Measells, M. K., Grado, S. C., Dunn, M. A., Idassi, J. O., & Zielinske, R. J. (2005). Underserved forest landowner workshops: Opportunities for landowners and Extension. *Journal of Extension* [On-line], 43(4) Article 4FEA5. Available at: <http://www.joe.org/joe/2005august/a5.php>
- Joshi, O., & Mehmood, S.R. (2011a). Factors affecting NIPF landowners' willingness to supply woody biomass. *Biomass and Bioenergy*, 35(1), 186-192.
- Joshi, O., & Mehmood, S. R. (2011b). Segmenting southern non-industrial private forest landowners on the basis of their management objectives and motivations for wood-based bioenergy. *Southern Journal of Applied Forestry*, 35(2), 87-92.
- Joshi, O., Grebner, D. L., Hussain, A., & Grado, S. (2013). Landowner knowledge and willingness to supply woody biomass for wood-based bioenergy: Sample Selection Approach. *Journal of Forest Economics*, 19(2), 97-109.
- Joshi, O., D.L. Grebner, Munn I.A., Hussain A., & Gruchy, S. (2013). Understanding landowner Preferences for Woody Biomass Harvesting: A choice-experiment based approach. *Forest Science*, 59(3), 549-558.
- Joshi, S., & Arano, K. (2009). Determinants of private forest management decisions: A study on West Virginia NIPF landowners. *Forest Policy and Economics*. 11(2), 118-125.
- Keenan, R., & Kimmins, J. (1993). The ecological effects of clear-cutting. *Environmental Reviews*, 1(2), 121-144.
- Lindsay, J., Gilbert, A., & Birch, T. (1992). *Factors affecting the availability of wood energy from non-industrial private forest lands in the northeast*. United States Department of Agriculture Forest Service Northeastern Forest Experiment Station Resource Bulletin NE-122.
- Paula, A. L., Bailey C., Barlow R. J., & Morse, W. (2011). Landowner willingness to supply for biofuel: results of an Alabama survey of family forest landowners. *Southern Journal of Applied Forestry*, 35(2), 93-97.

Perlack, R. D., Wright, L. L., Turhollow, A. F., Graham, R. L., Stokes, B.J., & Erbach, D.C. (2005). *Biomass as feedstock for a bioenergy and bioproducts industry: The technical feasibility of a billion-ton annual supply*. U.S. Department of Energy. Report: DOE/GO-102005-2135. Oak Ridge, TN.

Shaw, J., Hazel, D., Bardon, R., & Jayaratne, K. S. U. (2012). Landowners' knowledge, Attitudes, and Aspirations Towards woody biomass markets in North Carolina. *Journal of Extension* [On-line] 50(4) Article 6FEA7. Available at: <http://www.joe.org/joe/2012august/a9.php>

Copyright © by *Extension Journal, Inc.* ISSN 1077-5315. Articles appearing in the Journal become the property of the Journal. Single copies of articles may be reproduced in electronic or print form for use in educational or training activities. Inclusion of articles in other publications, electronic sources, or systematic large-scale distribution may be done only with prior electronic or written permission of the [Journal Editorial Office, joe-ed@joe.org](mailto:joe-ed@joe.org).

If you have difficulties viewing or printing this page, please contact [JOE Technical Support](#)