

Session A3-2

Factors Influencing Nonindustrial Private Forest Landowner Willingness to Grow Short-Rotation Woody Crops for Bioenergy in Mississippi

Jaclyn D. Steen, Stephen C. Grado, Ian A. Munn, Marcus K. Measells, Anwar Hussain, James E. Henderson, Robert K. Grala, Donald L. Grebner, and Randall J. Rousseau
Email: jds616@msstate.edu

Forest and Wildlife Research Center, Mississippi State University

Abstract

Nonindustrial private forest (NIPF) landowners own over 70% of forest lands in the southeastern U.S. and are important to emerging biomass-based fuel and energy industries. Estimates of potential biomass supplies serving as inputs to biomass fuel and power generation would be misleading without having knowledge of NIPF attitudes and willingness to convert land to short-rotation woody crops (SRWC). Previous supply side research assumes NIPF landowner participation in emerging biomass markets without fully analyzing their attitudes, preferences, or concerns about woody biomass. Understanding whether or not, and how much land, NIPF landowners are willing to divert to SRWC is critical for estimating woody biomass supplies for biofuels and bio-power generation. Our study focuses on landowners in Mississippi and the lack of knowledge about their attitudes and concerns on this issue. The overall study objective was to contribute to a better understanding of the nature of biomass supplies from NIPF landownerships by: 1) classifying NIPF landowners based on their awareness of the significance of SRWC to produce biofuels and bio-power, and estimate the proportion of landowners willing to grow SRWC, and 2) estimating land area potentially available for SRWC, and determining the relative significance of the underlying factors. A mail survey was administered to 2,000 NIPF landowners across Mississippi who own at least 75 acres of land. Resulting data were extrapolated to the Mississippi forest landowner population. Results will determine the areal amount landowners are willing to convert to SRWC for bioenergy in Mississippi. This assessment of NIPF landowners provides information needed for estimation of the potential woody biomass supply. This information is valuable to wood products firms interested in investing in Mississippi, will guide the development of outreach SRWC publications and programs, and gleans insight into additional research needs relative to biomass supplies and landowner inclinations.

Introduction

Society, as a whole, is looking for alternative energy sources due to concerns over dwindling fossil fuel reserves and security concerns over fuel suppliers. With nonindustrial private forest (NIPF) landowners making up such a large component of the landownership, they could be an important feedstock for the emerging biomass-based fuel and power industry. By having NIPF landowners focusing on short-rotation woody crops (SRWCs), or trees intensively managed to obtain maximum yields in minimal periods, any food source competition for energy that could arise from utilization of agricultural crops would be mitigated to some extent. Additionally, SRWCs provide renewable energy feedstocks with adaptability to where they can be strategically placed in the landscape to conserve soil and water, recycle nutrients, and sequester carbon (Zalesny et al. 2012).

Estimates of potential biomass supplies could be misleading without having knowledge of private landowner attitudes and willingness to convert land to SRWCs. A clearer understanding of how much land NIPF landowners would be willing to divert to SRWCs will be utilized to better estimate potential biomass supplies in Mississippi. By determining landowner preferences about SRWCs and predicting future forest land use patterns involving SRWCs, Mississippi landowners will be better served by having access to this new information. Depending on the relative profitability of SRWCs in comparison to other land uses and landowner confidence in biomass demand, land use patterns may shift. These shifts are likely to vary across different types of landowners due to individual reasons for landownership. A variety of factors may influence NIPF landowner willingness to divert land to SRWCs. Factors could include size of landownership, perception of market risk, conflicts with other land uses and implied opportunity costs of growing SRWCs, location of bioenergy facilities, and barriers of a technical, financial, or informational nature. By achieving a better assessment of NIPF landowner concerns, Mississippi researchers, bioenergy industry stakeholders, landowners, communities, and policy makers can take steps to encourage greater strides toward renewable energy and energy security.

This study will focus on Mississippi landowners because of a lack of knowledge of landowner attitudes and concerns on this issue in the state. The overall study objective is to contribute to a better understanding of the nature of biomass supplies from NIPF landownerships by:

- a) classifying NIPF landowners based on their awareness of the importance of SRWCs to produce biofuels and bio-power, and estimate the proportion of landowners willing to grow SRWCs,
- b) estimating land area potentially available for conversion to grow SRWCs, and determine the relative significance of the underlying factors, and
- c) analyzing NIPF landowners concerns about reliability and security of markets for biomass, conflicts with other land uses (e.g., livestock, pasture, use of marginal lands), and barriers to conversion (e.g., technical, informational, and financial needs).

Literature Review

Many studies have analyzed availability of biomass from forest lands, its impacts on regional economics, and implications of diverting agricultural and forest lands to SRWCs for commodity prices and consumer welfare. In fact, Sullivan and Amacher (1999), Perez-Verdin et al. (2008), Grebner et al. (2009), Ranases et al. (1998), and Ugarte et al. (2007) all focused on

the economic impacts of conversion and industry growth and showed the potential market available for SRWCs. Landowner willingness and motivation to convert were not the focus of previous studies and concern for this oversight has emerged as a few studies have begun to evaluate NIPF landowner willingness in southeastern U.S. states. Jensen et al. (2007) analyzed Tennessee forest landowner attitudes, willingness, and motivation to divert their lands to SRWCs. Joshi and Mehmood (2009) performed a study of 1,600 randomly selected landowners from Virginia, Florida, and Arkansas and their willingness to supply woody biomass. Paula et al. (2011) conducted a mail survey of landowners in Lee County, Alabama with at least 20 acres of land to assess their willingness to convert land for biomass. Though these studies aid researchers, bioenergy industry stakeholders, policy makers, communities, and landowners to better understand attitudes, concerns, and willingness of some NIPF landowners in the southeastern United States, more research is needed especially in Mississippi.

It is rather evident that SRWCs could be beneficial to local economies and provide adequate profit to allow for growth. Studies are now focusing on who will supply SRWCs for bioenergy production, and our focus on Mississippi will allow for better insight into a potential feedstock provided by private landowners. Specifically it will contribute to a better understanding of the nature of biomass supplies from NIPF landowners by estimating willingness and conversion concerns.

Methods

Due to the diverse, yet related, study objectives a variety of descriptive and analytical statistical methods were utilized. Requisite data generated from a mail survey of Mississippi NIPF landowners was used to classify individuals, estimate potential land availability for conversion, and analyze landowner concerns. This survey was distributed among faculty members to pre-test the questionnaire for clarity and omissions of content, and then the survey was refined accordingly. To increase the response rate, the survey consisted of five mailing contacts (Dillman et al. 2008) including an introductory letter describing the study, a cover letter included with the first questionnaire, a thank you/reminder postcard, a second cover letter with replacement questionnaire, and a third cover letter with replacement questionnaire. Questionnaires were completed and returned in the provided self-addressed, stamped envelopes.

To extrapolate the research findings to the Mississippi forest landowner population, the resulting data was tested for non-response bias and representativeness. This process was performed by comparing the first sets of responses to later responses and assessing any differences. The later responses were assumed to be harder to obtain and, therefore, more like the responses of the non-respondents. If differences had arisen, additional contact with landowners who did not reply could have allowed for insight to establish a more clear representativeness.

Participants for the mail survey were selected from a list of all landowners from Mississippi's 82 counties with a substantial amount of land, at least 75 acres, to allow for a larger land base and, therefore, a higher willingness to convert any unutilized land. This list was obtained through a database available at the Forest and Wildlife Research Center, Mississippi State University. From this master list, 2,000 NIPF landowners were generated by extracting every 16th name from the list. This ensured a random pool of landowners from every county in Mississippi.

Within the questionnaire, landowners were asked to state on a scale of 1 (very familiar) to 3 (not familiar) the amount of familiarity they possess to producing alternative fuels from wood

and growing SRWCs. Collected information in conjunction with socio-demographic characteristics of landowners (such as age, gender, highest level of education, current residence, community involvement, household income, and percentage derived from land activities) will serve to classify them into homogenous clusters using cluster analysis. These clusters will be distinguished as Mississippi regions, which supplemented previous research on woody biomass supplies from other sources in Mississippi.

Landowners provided information on their acreage in various land uses (e.g., pastureland, forest land, agriculture). Landowners were asked to specify the proportion of this land potentially available for SRWC production without conflicting with other land uses. Any omissions concerning individual land categories were assumed to be zeros allowing for a more precise calculation of landowners' perceived availability for conversion and accurate values for percent calculations and projections. Land available for growing SRWCs ranged from 0 to 100%, so a two-limit Tobit regression (Long 1997, Maddala 1983) will be used to explain how the percent of land potentially available for SRWCs varies in response to changes in important factors. Some of the factors expected are land productivity and location, landowner socio-demographic characteristics, and technical, informational, and financial constraints faced by landowners.

Estimation based on the two-limit Tobit is appropriate because it constrains the predicted percentages of the land base to lie between 0 and 100%, and yields unbiased and consistent parameter estimates. Following Fernandez-Cornejo et al. (2001), the model is formalized as:

$$y_i^* = \beta'x_i + \varepsilon_i \quad i=1,2,\dots,N \quad \text{Eq. 1}$$

where y_i^* is a latent variable representing landowner willingness to convert land to SRWCs; x_i is a vector of independent variables influencing landowner willingness; β is a vector of unknown parameters; and ε_i is a disturbance term assumed to be independently and normally distributed with zero mean and constant variance. Denoting y_i (the % of acreage on which the SRWCs will be grown) as the observed counterpart to the latent dependent variable, their relation can be compactly written as:

$$y_i = \begin{cases} 0 & \text{if } y_i^* \leq 0 \\ y_i^* & \text{if } 0 \leq y_i^* \leq 1 \\ 1 & \text{if } y_i^* \geq 1 \end{cases} \quad \text{Eq. 2}$$

Last, landowners were asked to respond to a set of questions addressing their concerns about secure demand for biomass, SRWC conflicts with other land uses, and other barriers (e.g. technical, financial and informational) to growing SRWCs. Responses were invoked on a Likert scale of 1 to 5 with 1 (not concerned), 3 (concerned), and 5 (very concerned) and related to exogenous variables including ownership characteristics and landowner socio-economic and demographic characteristics. As these concerns about the implications of diverting land to SRWCs are defined on an ordinal scale, this study will use an ordered probit model written as:

$$y_i = \beta'x_i + \varepsilon_i \quad \varepsilon_i \sim N(0,1) \quad \text{Eq.3}$$

$$y_i = 0 \Rightarrow NC \quad \text{if } y^* \leq 0$$

$$y_i = 1 \Rightarrow C \quad \text{if } 0 < y^* \leq \mu_1$$

$$y_i = 2 \Rightarrow VC \quad \text{if} \quad \mu_1 < y^* \leq \mu_2$$

where y_i is related to a continuous latent variable y^* , indicating how concerned a landowner is; and μ_i (μ) are the unobserved thresholds parameters defining boundaries between different levels of concern (Greene 2003).

Preliminary Results and Conclusions

Survey data shows that although the majority of NIPF landowners sampled are not familiar with growing SRWCs, or the concepts of producing alternative fuels, they are willing to grow or consider growing SRWCs. These initial results are very promising but must be further evaluated. The predominately allocated categories for conversion were pine plantations, bottomland hardwoods, and pasture or fallow fields and landowners were very concerned with market price of potential SRWCs, securing a buyer, establishment and management costs, any possible tax implications, conflicts with land uses, and last, compatibility with forest certification. Further analysis is still being performed and will include a cluster analysis to classify participants, a two-limit Tobit regression to explain how the percent of land potentially available varies in response to changes, and a landowner concerns analysis utilizing an ordered probit model.

Although survey data analysis is not complete, initial results show that Mississippi NIPF landowners were not familiar, or only somewhat familiar, with the concepts of producing alternative fuels from wood and growing SRWCs. Their major concerns hinged on this lack of knowledge. More important though, landowners were willing to convert predominantly pine plantations and pasture or fallow fields to SRWCs for biomass utilization as long as it was profitable and compatible with their existing land management plans.

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