Agricultural Producer Attitudes and Perceptions Towards New Bio-based Business Opportunities

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Abstract

In this study, we surveyed 2,964 agricultural producers in the Delta region of Louisiana and Mississippi to discern perceptions regarding bio-based industry participation and potential opportunities. Just over half of respondents said that they would participate in biomass activities and markets assuming it was viable relative to current farming activities. Results suggest older respondents were more likely to agree that harvesting agricultural biomass will negatively impact the environment and had a higher propensity to agree that government programs should not be provided for biomass establishment, selling, and utilization. In addition, larger producers were less likely to agree that harvesting biomass will negatively impact the environment and were more likely to agree that government programs should be provided for biomass establishment, selling, and utilization.

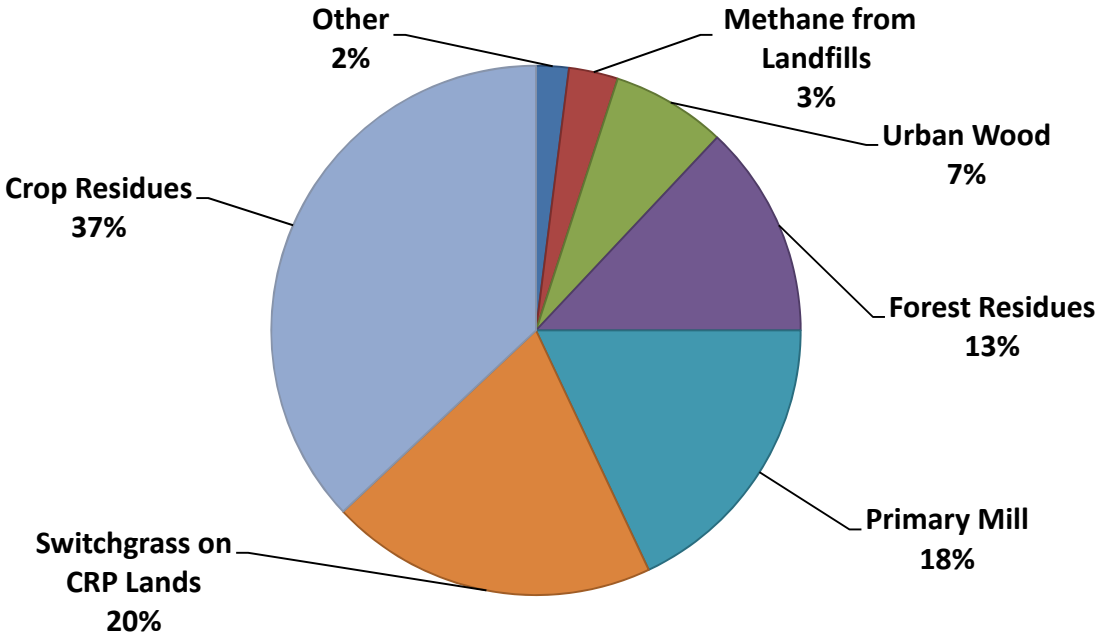
Introduction

Biomass from agricultural crops is a major potential source of feedstock for renewable energy (biofuel) (Millbrandt, 2005). It has several advantages, such as lowering carbon dioxide emissions and stabilizing energy dependence. Louisiana and Mississippi are rich in biomass resources, with approximately a third of each state in farmland acreage (U.S.D.A., 2010b 2010c). Most of these farms are privately owned by either individuals or families (U.S.D.A., 2010b 2010c). Small-family farms, with values averaging less than $250,000 make up 88 percent of U.S. farms and account for 63 percent of total farm land (Hoppe and Banker, 2010). The decisions of these farmers could affect key supply and sustainability issues associated with producing renewable energy from agricultural crops, so, so it is important to understand their knowledge of key biomass issues and concepts as well as their willingness to participate in biofuel-associated activities.

Globally, agricultural productivity grew around 2.2 percent annually from the years of 1961-2007, with variations across commodities and regions (Fuglie, 2010). The total potential production of bio-ethanol from crop biomass and residues has been estimated at 491 GL (129.7 billion gallons), which could displace about 32 percent of the total worldwide consumption of gasoline (Kim and Dale, 2004). Using the global distribution of potential plant production, abandoned agriculture land could produce between 1.6 and 2.1 billion tons of above-ground biomass per year, accounting for approximately ten percent of energy needs for most nations (Campbell et al., 2008).

Although the U.S. currently produces about three percent of its total energy production from renewable resources, the development and expansion of a biomass industry in the U.S. will require the use of bioenergy crops and agricultural residues (Walsh et al., 2003). In 2007, over 2.2 million farmers within the U.S. owned about 922 million acres of farmland, accounting for $300 billion in total product sales (U.S.D.A., 2009). More than half of these farmland revenues came from the sale livestock and poultry (and by-products,) with approximately $9 billion from chicken broiler sales alone (measured in head) (U.S.D.A., 2009). A study by Millbrandt (2005) suggests crop residues have the largest percentage of available feedstock for biomass (**Figure 1**). Considering current sustainable biomass resources, the availability of biomass for bioenergy production from cropland in the U.S. is about 194 million dry tons annually, which is about 16 percent of total plant material produced (Perlack et al., 2005).

Figure 1. Percent Feedstock from Total Biomass (Source: Millbrandt 2005).



Agriculture provides a major portion of the economic productivity in rural areas of the Southeast. In 2007, the Southeast region was comprised of over 51,000 farms averaging approximately $374,000 in total income (Hoppe and Banker, 2010). Louisiana and Mississippi exemplify these southeast regional farm ownership and revenue patterns. Total farmland in Louisiana is a little over 8 million acres, 29 percent of the total land area. The 30,000 Louisiana farmland owners account for $1.77 billion dollars in final crop output in 2007 (U.S.D.A., 2009). Family or individual owners, of which 88 percent are males with an average age of 57 years, account for 85 percent of farm ownership in Louisiana (U.S.D.A, 2009). Mississippi has over 11 million acres of farmland, which is 38 percent of the state's total land area. Family or individual owners account for 86 percent of farm ownership in Mississippi. Similar to Louisiana, the majority of Mississippi farmers are males that average 58 years in age (U.S.D.A., 2009). In both states, 94 percent of agricultural farms were less than 999 acres as of 2007 (U.S.D.A., 2009).

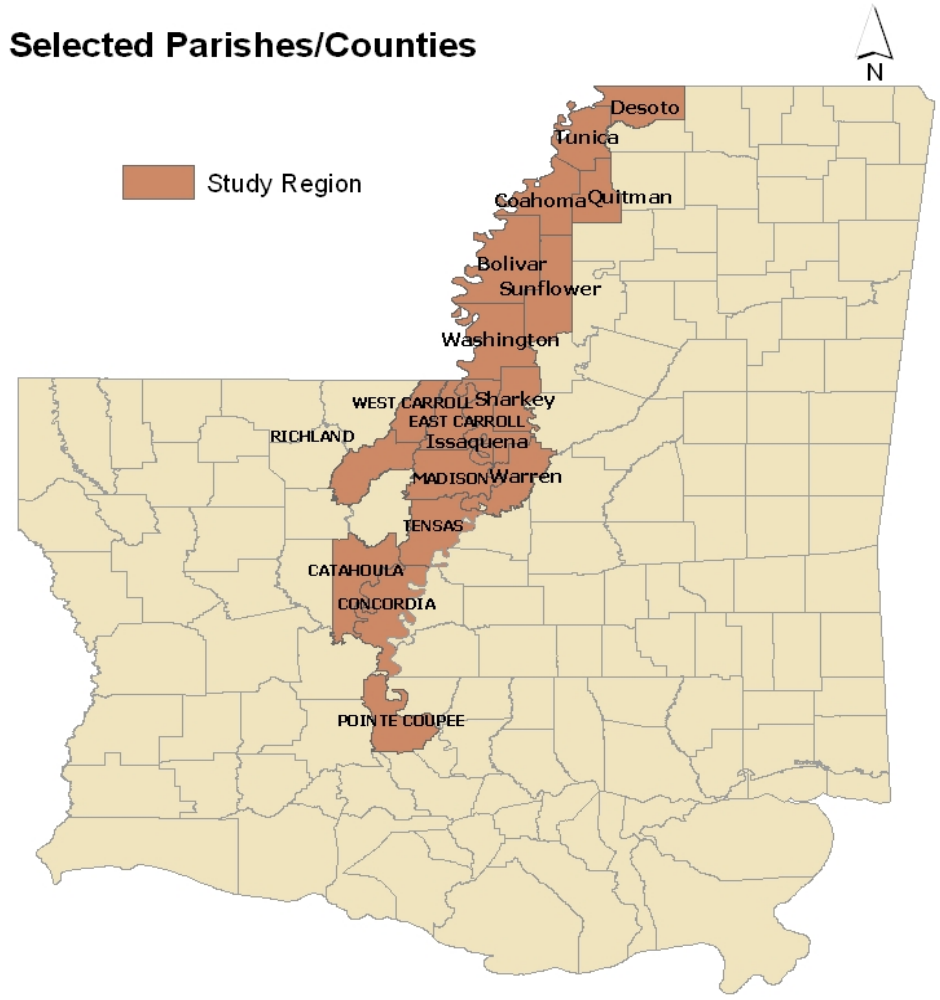
Motivations for farm management objectives can be diverse even with consistencies in ownership characteristics. Most research shows economics to be the driving factor behind farmer decision-making. However, some studies indicate that confidence levels, attitudes, farm size, and education affect the willingness of producers to adopt new technologies (Adrian et al., 2005; Cochrane, 1993). A study by Jensen (2010) on poultry farmers shows that those with college degrees and higher income are more willing to participate in biomass to bioenergy activities than those with lower education and income.

The purpose of this research was to survey small and medium agricultural producers in the U.S. Gulf South using Louisiana and Mississippi as a "test-case states" in order to identify current and potential business positions and to identify willingness to participate in new bio-based business arrangements. This study is part of a larger project designed to identify high-potential alternative bio-based revenue and profit streams for small and medium forest landowners, agricultural producers and

poultry producers (SMAPFL) with land holdings in Louisiana and Mississippi. Agriculture in Louisiana and Mississippi rank number two and one, respectively, among the top industries within the states (U.S.D.A., 2010a).

The survey encompassed the Mississippi Delta Region, which is a significant agricultural area that spans 18 counties and parishes in Louisiana and Mississippi (**Figure 2**).

Figure 2. Agricultural Producer Survey Study Region of Louisiana and Mississippi.



Agricultural Producer Survey Study Region

The study region was chosen because it represents the majority of mixed agricultural and forestry land uses in Louisiana and Mississippi as well as in other Gulf Coast states. The Delta region was selected to explore the potential for land-use driven, utilitarian agricultural producers to become involved in dedicated bio-based based options that could diversify traditional agricultural production and

contribute to rural development. Our intentions were also to develop methods that could be utilized throughout most of the U.S. South. The specific research objectives of the agricultural producer survey in Louisiana and Mississippi were to:

1. Develop a baseline understanding of the role that current agricultural products play in the supply chains from producers to consumers within the focal region.

2. Identify prerequisites and willingness to shift existing production to potentially higher value bio-based alternatives for existing producers

3. Discern the willingness to plant bio-based forest species dedicated to producing bio-based products for producers with fallow land or non-productive land.

Methods

A survey was conducted on small to medium size producers in Louisiana and Mississippi to get their views and opinions on an array of scenarios for different cellulosic bio-based products and business strategies. The Delta region survey consisted of 2,964 agricultural producers chosen by a random sample. The study samples were obtained from tax roll information and professional directory database companies provided within Louisiana and Mississippi. Small agricultural producers were defined as those having between 10-139 acres, and medium producers were identified as having 140-999 acres.

The main topics of the survey for agricultural producers were covered in four sections. Each of the four sections contained questions involving issues relevant to ownership, biomass knowledge, biomass market and policy implications, and socio-demographics. All surveys contained a cover letter, the survey, and a return envelope. Survey procedures, follow up efforts, and data analysis were conducted in accordance with Tailored Design Method (Dillman, 2000). The surveys contained fixed-response, scale, and open-ended questions to measure the major concepts. The scale questions were based upon Likert scale types (Bruner et al., 2001). The open-ended questions were designed to give questionnaires the opportunity to express their opinions not covered in other questions.

The data from the two mailings were entered into three Microsoft Excel databases. When required, returns were codified according to return responses, request to remove from list, undeliverables, non-applicable, and change of name or address. Adjusted response rate was calculated as follows.

Adjusted Response Rate = Usable Surveys / [Total Sample – (Undeliverables + Unusables)] %

The categorized data were analyzed using SPSS, SAS, and/or STATA; statistical software commonly used and accepted in human dimension sciences. The majority of the analysis utilized descriptive statistics such as simple frequencies, mean responses, as well as correlation and t-tests.

Results

Of the 2,964 surveys mailed, 299 were either undeliverable, inappropriate due to respondent being deceased, non-agricultural landowner, or unwilling to participate in the survey. They were a total of 50 unusable surveys and 771 usable surveys. The overall adjusted response rate for this survey was 26.6 percent.

Non-response bias was assessed between respondents from the first and second mailings. Due to the fact that the respondents from the second mailing required a reminder postcard, they can be

perceived as less eager to respond (Adams, 1986). Also, the respondents from the second mailing are considered likely to be a fair representation of non-respondents (Armstrong and Overton, 1977).

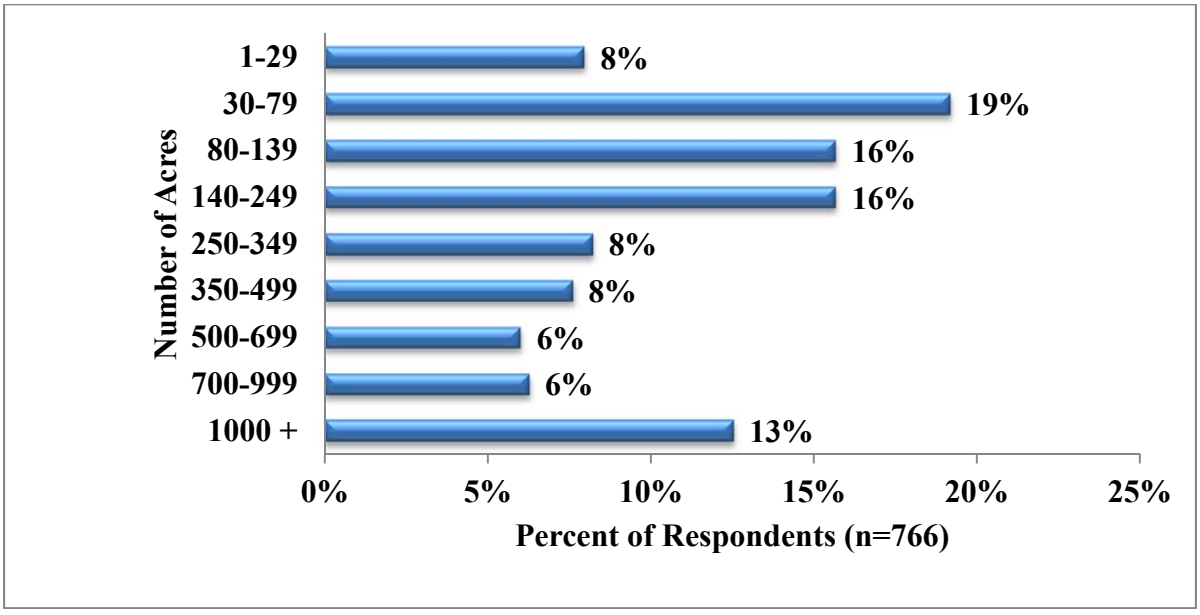
To investigate non-response bias, the groups from the first and second mailings were compared across all applicable survey questions. T-test statistics were used to compare continuous variables, and chi-square tests were used to compare categorical data. Approximately 82 percent of the questions did not differ at $\alpha<0.05$; therefore, most of the research results can be considered a fair representation of the sample frame. However, all nine questions that were statistically significant came from the biomass market section of the survey that pertained to the viability of biomass as a feedstock for bioenergy and to the value of biomass for bioenergy relative to traditional agricultural products. Therefore, the results from this section should be considered to be representative of the respondent group only.

Over 81 percent of respondents were male (n=735) and approximately 80 percent were 55 years or older (n=773). The respondents were predominately Caucasian, at 98 percent (n=698). Almost 8 percent of respondents were in the lowest income category of under $20,000, and 21 percent were in the highest income category of over $150,000 (n=626). Just over 68 percent of respondents had some college education, and over 45 percent earned an undergraduate or graduate degree (MS or PhD) (n=730). Approximately 61 percent claimed ownership of agricultural land in LA, 37 percent claimed ownership in MS, and 2 percent in both (n=766).

During the last 10 years, about 66 percent of respondents acquired agricultural property, with 41 percent acquiring less than 100 acres (n=766). In addition, 50 percent of respondents sold no property, and 40 percent disposed of less than 100 acres of agricultural land (n=766). During this timeframe, the general tendency of respondent producers was to acquire land rather than to dispose or sell their lands.

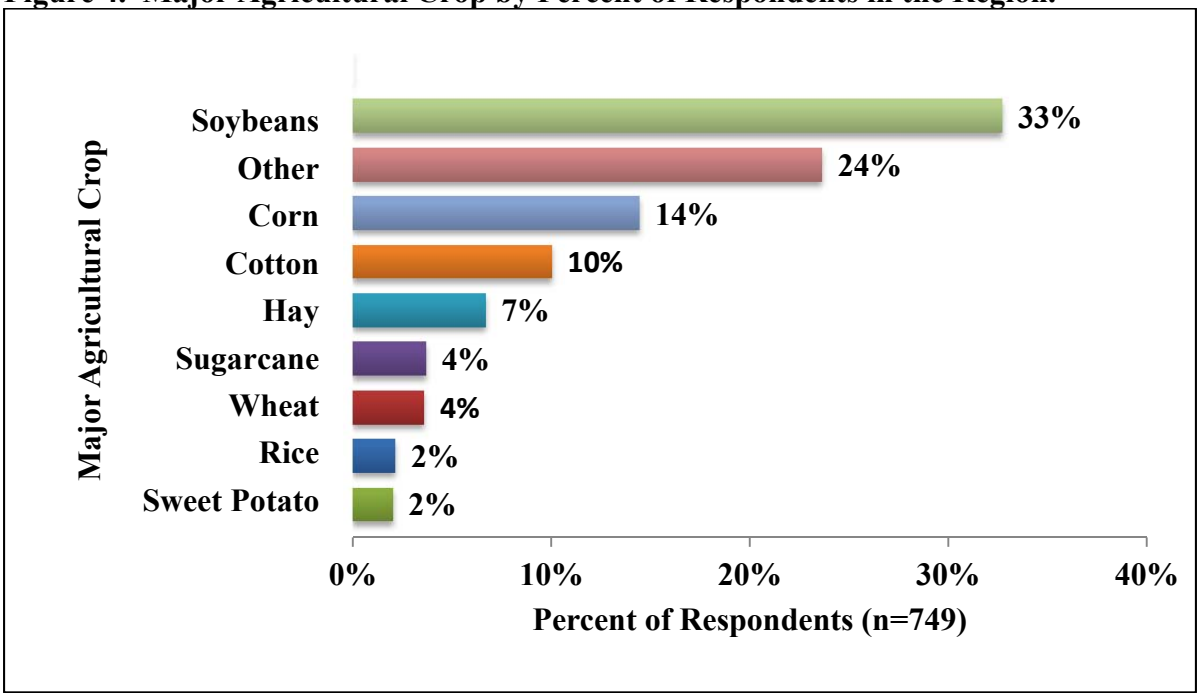
Over 59 percent of respondents owned less than 250 acres of land, with the highest percentage (19 percent) in the 30-79 range (**Figure 3**). The majority of respondents (82 percent) chose the individual ownership category that included joint husband, wife, and family ownerships other than family corporations (n=771).

Figure 3. Number of Acres Owned by Percent of Respondents in the Region.



The questionnaire included questions intended to identify the current management activities of agricultural landowners within the study region. Soybeans (33 percent), other (24 percent), corn (12 percent), and cotton (10 percent) were chosen, respectively, as the top agricultural crops under which the majority of respondents' landholdings fall (**Figure 4**). Together they represented 55 percent of all responses. Some of the "other" responses included trees, grain sorghum, and fruits. Over 89 percent of respondents believe they practiced sustainable agriculture (n=709). When asked if part of their management costs involve burning and/or removing residues associated with harvesting activities, 37 percent of respondents answered "yes" (n=711). Approximately 87 percent of respondents reported no business or other organization associated with their ownership (n=673).

Figure 4. Major Agricultural Crop by Percent of Respondents in the Region.



Questions were asked to identify agricultural producer management activity levels. The majority of respondents were neutral (44 percent) when asked if they believe bio-based activities will improve the health of their land, while over 31 percent agreed (n=729). Almost 52 percent believed biomass harvesting will help diversify the management activities of their agricultural land (n=731). When asked if respondents believe agricultural residues from harvesting activities should be used for bioenergy production, a little over 63 percent agreed while only 12 percent disagreed (n=729). More exacting, one question asked respondents if they would be willing to participate in management activities specifically geared toward biomass production such as short-rotation energy crops. A narrow majority (51 percent) of agricultural producers were willing to participate in activities specifically geared towards biomass production such as dedicated energy crops (n=694).

The questionnaire attempted to discover agricultural producers' knowledge and perceptions on biomass concepts and utilization. The majority of respondents (56 percent) agreed that economically viable technologies exist for converting agricultural biomass to bioenergy (**Table 1**). TA larger percentage of respondents (43 percent) disagreed that agricultural biomass harvesting/collection does

not require extra labor and equipment. The larger percentage of respondents (49 percent) agreed when asked if agricultural biomass transportation can be done with traditional agricultural equipment. Approximately 41 percent of respondents were neutral when asked if the conversion of agricultural biomass is a simple process that can be done at most agricultural processing facilities.

Table 1. Agricultural Producers' Knowledge of Biomass Concepts, 2011.

Biomass Issues	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
Economically viable technologies exist for converting biomass to bioenergy (n=732).	4%	10%	30%	38%	18%
Agricultural biomass harvesting and collection will not require extra men and equipment (n=729).	13%	30%	32%	19%	6%
Agricultural biomass transportation can be done with traditional agricultural equipment (n=725).	4%	17%	30%	36%	13%
Converting agricultural biomass to bioenergy is a simple process that can be done at most agricultural processing facilities (n=728).	12%	23%	41%	18%	6%
Agricultural biomass requires utilizing entire crop as well as residual feedstock (n=730).	11%	22%	31%	27%	9%

Research suggests that harvesting biomass will require use of dedicated energy crops, extra labor, and some modified equipment among other things (Jackson et al., 2010, Walsh, 2003). Also, research suggests production of energy from biomass feedstock will require either add-ons to conventional mills or construction of new bio-facilities (Jackson et al., 2010).

The high number of neutral responses indicates agricultural producers' uncertainty towards the state of technological advancements in the conversion of agricultural biomass to bioenergy. Such responses could be considered an indicator of a low-level of familiarity agricultural producers have on the emerging bio-based markets.

Statistical tests were performed based on normality of variables in order to determine the relationship between socio-demographic characteristics and respondents' knowledge and opinion of key biomass issues. For Likert scale questions, one-sample t-tests and median tests were employed for either normal or non-normal variables to determine if their mean value was significantly different from "3" or neutral. Only the question "I believe agricultural biomass requires utilizing entire crop as well as residual feedstock" was not statistically significant below the α=.05 level, or failure to reject the null hypothesis that the mean of the variable was equal to "3" (t=-0.326, p=0.745, n=728).

The Spearman correlation test was used to compare socio-demographic variables and producers' perceptions on key biomass issues (**Table 2**). All three values for rho were positive; indicating that as age increases for respondents so did their beliefs that harvesting agricultural biomass negatively impacts

the stated environmental issues. Respondents' ages were significantly related to whether or not they would supply agricultural biomass to bio-refineries capable of producing energy at the local level (Spearman rho=-0.116, p=0.002, n=707), the state level (Spearman rho=-0.106, p=0.002, n=707), and the national level (Spearman rho=-0.114, p=0.001, n=707). The negative rho values associated with responses to whether producers would supply biomass to bio-refineries indicated that as age increases respondents were less likely to supply agricultural biomass at the local, state, and national levels.

Table 2. Agricultural Producers Perceptions and Age, 2011.

	Age		
Environmental Issues	**n**	**p(rho)**	**p-value**
I believe harvesting agricultural biomass negatively impacts wildlife habitat	709	0.109	0.003
I believe harvesting agricultural biomass negatively impacts air and water quality	710	0.107	0.004
I believe harvesting agricultural biomass negatively impacts soil quality	704	0.094	0.012
Policy Issues			
Tax credits should be given to landowners, harvesters, and companies that utilize biomass for bioenergy	703	-0.116	0.001
Subsidies should be provided as an incentive to companies for selling biomass residues from agricultural operations	704	-0.112	0.001
Incentive programs should be provided to defray the costs of establishing biomass crop species	704	-0.104	0.002
Market Issues			
I would supply agricultural biomass to bio-refineries capable of producing energy for rural/local needs.	708	-0.144	0.000
Secured loans should be provided to develop and construct commercial scale bio-refineries.	704	-0.146	0.000
I believe agricultural biomass is a low value product compared to traditional commodity crops.	708	0.069	0.031

Respondents' ages were also related to a series of market and policy issues. Age was related to the belief that agricultural biomass is a low-value product compared to traditional crops. The positive rho value indicates as age increased agricultural respondents were more likely to believe that biomass was a low value product (Table 2). It was also related to whether or not respondents believed: (1) tax credits should be given to landowners, harvesters, and companies that utilize biomass, (2) government subsidies should be provided to companies for selling biomass residues, and (3) government incentive

programs should be provided to defray the costs of establishing biomass crop species (Table 2). Age was also related to respondents' perceptions as to whether or not grants should be awarded for research and development of biomass technologies (Spearman rho=-0.137, p=0.000, n=704) and secured loans should be provided to develop and construct commercial scale bio-refineries (Spearman rho=-0.146, p=0.000, n=704). The negative rho values for these issues indicated that as age increases agricultural respondents were less likely to agree with providing government programs or incentives for the research, establishment, sale, or use of agricultural biomass intended for energy production. , Age was significantly related (Spearman rho=-0.107, p=0.002, n=712) to perceptions about the viability of using biomass for bioenergy. The negative rho value indicated that as age increases respondents were more likely to have negative opinions on the viability of biomass for bioenergy.

Utilizing the same test, respondents' incomes were significantly related to questions concerning respondents' opinion or knowledge of concepts of agricultural biomass utilization. Income was significantly related to whether or not respondents agreed with the concept that their state can achieve governmental mandates requiring a percentage of total energy production come from renewable resources (Spearman rho=-0.071, p=0.035, n=609). Income was significantly related to whether or not respondents agreed that economically viable technologies exist for converting biomass to bioenergy (**Table 3**). Negative rho values associated with this issue indicated that as income increased respondents were less likely to agree that viable technologies exist for conversion of biomass to biofuels and that their state could achieve mandates for the requirements of renewable energies. Income was also related to respondents' beliefs that harvesting agricultural biomass would not require extra men and equipment, can be easily stored for long periods of time using traditional agricultural storing methods, and converting biomass to energy is a simple process that can be done at most agricultural processing facilities. Negative rho values indicate as income increased respondents had a higher propensity to disagree with these biomass concept issues. Income was not significantly related to environmental, market, and policy issues.

Table 3. Agricultural Producers' Perceptions of Biomass Concepts and the Relationship with Income and Education, 2011.

		Income			Education	
Biomass Concepts	**n**	**ρ (rho)**	**p-value**	**n**	**ρ (rho)**	**p-value**
In my opinion, economically viable technologies exist for converting biomass to bioenergy	609	-0.071	0.035	706	-0.096	0.005
I believe agricultural biomass harvesting and collection will not require extra men and equipment	608	-0.178	0.000	704	-0.098	0.004
I believe agricultural biomass can be easily stored for long periods using traditional storage methods	608	-0.085	0.015	704	-0.078	0.038
I believe converting agricultural biomass to bioenergy is a simple process that can be done at most agricultural processing facilities	610	-0.174	0.000	705	-0.192	0.000

Respondents' education levels were significantly related to questions concerning their opinions or knowledge of concepts of agricultural biomass utilization. Education level was significantly related to whether or not respondents agreed with the existence of economically viable technologies for converting biomass to bioenergy. As
education levels increased respondents were less likely to agree that viable conversion technologies exist, as revealed by negative rho values associated with this issue. Education level was related to respondents' beliefs that harvesting agricultural biomass would not require extra men and equipment, can be easily stored for long periods of time using traditional agricultural storing methods, and converting biomass to energy is a simple process that can be done at most agricultural processing facilities. Negative rho values showed that as education levels increased respondents had a higher propensity to disagree with these biomass concept issues. Education was not significantly related to market and policy issues.

Respondents were asked if they would participate in a biomass to bioenergy market with an option of "No", "Yes", or "Not Sure". Over 17 percent said they would not participate and 26 percent said they would participate (n=729). However, the majority of respondents (57 percent) were unsure if they would participate in a bio-based market.

Discussion

According to the U.S.D.A. (2009), most farmers were older males who reside in the state where they own their farms. Respondent demographics from this study similarly showed that the majority of agricultural producers were males over 55 years with higher-than-average education and income levels. The overwhelming majority of these agricultural producers reside in the state where they own their farm (95 percent) and claim individual ownership (82 percent). Knowing these key demographic factors can help identify target markets in which to provide valuable information about future biomass endeavors.

This study showed that well over half (59 percent) of agricultural producers who responded own less than 250 acres, and they (58 percent) have owned these farms for more than 30 years. The general trend of these agricultural producers was to acquire rather than dispose of their lands. The long-term commitment of bio-based facilities will depend upon the availability of supply within the area. It is important they stay abreast of ownership trends since agricultural producers are ultimately the ones making decisions for their property.

A portion of the results from this study shows agricultural producers' knowledge, attitudes, and perceptions of biomass concepts and utilization. Results indicate the majority of producers (56 percent) believe that economically viable technoligies exist for converting agricultural biomass to bioenergy. Also, the larger percentage of respondents (43 percent) disagreed that agricultural biomass harvesting/collection does not require extra men and equipment. The larger percentage of respondents (49 percent) agreed when asked if agricultural biomass transportation can be done with traditional agricultural equipment. A large portion of producers (41 percent) remain neutral about whether or not converting biomass is a simple process which can be done at most agricultural facilities. Research suggests that harvesting biomass will require use of dedicated energy crops, extra labor, and some modified equipment among other things (Jackson et al., 2010, Walsh, 2003). Previous studies have also shown that production of energy from biomass feedstock will require either add-ons to conventional mills or construction of new bio-facilities (Jackson et al., 2010). The high numbers of neutral responses to these issues in this study indicate producers' ineptitude toward the state of technological advancements in the conversion of agricultural biomass to bioenergy. Such responses could be considered an indicator of a low level of familiarity agricultural producers have on the emerging bio-

based markets. These individuals should be looked at as an ideal base for administering information as well as involvement in future discussions from the biomass industry.

In general, a rather large amount of respondent producers (63 percent) believe agricultural residues from harvesting activities should be used for bioenergy production. Despite this percieved affinity, only about half are willing to supply biomass feedstock, participate in bio-based activities, and believe a bioenergy market will be comparatively competitive to conventional energy markets. Therefore, a clear gap exists between the desire to utilize agricultural biomass and the viability of bio-based markets.

Confidence levels, attitudes, farm size, and education are factors that have been shown to affect the intentions of producers to adopt new technologies (Adrian et al., 2005; Cochrane, 1993). Results from this study indicate that agricultural producers' perceptions of environmental, market, policy, and concept issues were influenced by several socio-demographic variables. This study shows older producers have a higher propensity to agree that harvesting biomass will negatively impact wildlife habitat, air, water, and soil quality. They are more likely to agree that tax credits, subsidies, and incentive programs should not be provided for biomass establishment, selling, and utilization. Agricultural respondents were less likely to agree that secured loans should be provided to develop commmercial scale bio-refineries. Some of the observed antagonistic attitudes continue with education and income levels of producers. Agricultural producers with higher education and income levels were less likely to agree that economically viable technologies exist for biomass or that biomass can be easily converted at local agricultural facilities. Most of the agricultural producers surveyed were older individuals with higher-than-average income and education levels. These perceptions could belie state and local officials' incentives needed to attract developers and energy producers. This is an important note for policy makers, legislators, and local officials to take forward when creating policies intended to foster the development of bio-based markets.

One important part of the study was to discern the willingness of agricultural producers to participate in bio-based activities. Over a third of these agricultural producers' costs involve burning or removing residues associated with harvesting activities. However, despite the seemingly large amount of current production and the costs accrued from disposing of harvest residues, only 26 percent were willing to participate in a biomass-to-bioenergy market. The majority of producers were unsure (57 percent) if they would participate in bio-based markets. The lack of clarity for agricultural producers to participate in bio-based markets should be of concern for developers, producers, and investors of bio-based facilities. Thus, there is an inherent need for increased educational services about any advancements in bio-based technologies and potential profits associated with the bioenergy market in order to help bridge the gap between suppliers and producers.

Another inference could be made about their unwillingness to participate. It's possible that some have searched for advancements and/or potential profits and haven't found any due to the market being in its infancy.

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