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Assessing Small and Medium-Sized Farmers' Willingness to Produce Alternative Biofuel Feedstocks

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ASSESSING SMALL AND MEDIUM-SIZED FARMERS' WILLINGNESS TO PRODUCE ALTERNATIVE BIOFUEL FEEDSTOCKS

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Abstract

The study assessed the willingness of small and medium-sized farmers to produce alternative biofuel crops in Louisiana and Mississippi. Data were collected from a random sample of 304 participants. The results revealed that the majority of the respondents were males, African Americans, over 50 years, part-time farmers, and a third earned less than $1,000 per year from farming. Most of the respondents (75%) indicated an interest in alternative fuel development, and 72% do not use alternative fuels in their operations. Also, a majority of respondents (83%) indicated that they would like to learn more about opportunities for alternative fuel development; 90% were in favor of alternative fuel development, and 87% were in favor of using alternative fuel on-farm. These results will be used to develop outreach programs to increase adoption of alternative crops in Louisiana and Mississippi; thus, increasing the potential for profitability for small and medium-sized farmers.

Keywords: Biofuel, Alternative Energy, Small and Medium-Sized Farmers

Introduction

The adoption of biofuel crops and associated technologies on-farm is complex and risky. In considering adopting biofuel crops, agricultural producers are faced with the uncertainty of unfamiliar crops, impacts on farm labor, availability of equipment and soil resources, new crop markets, and incorporating new technologies into their production systems. Furthermore, there exists a need to understand the socioeconomic factors that lead to the adoption of biofuel feedstock enterprises, which has been ignored in many regional studies of bio-energy crop supply. According to the USDA (2007), 78% of all farms in the United States are defined as small to medium-sized farms. However, minimal research exists examining factors that affect small to medium-sized farmers' willingness to produce cellulosic sources of biofuel feedstocks either by growing perennial crops or harvesting crop residues. This is compounded by the lack of information on socioeconomic factors such as perceptions about biofuels, environmental attitudes, farm characteristics, labor and machinery dynamics, government policy, and contractual arrangements. This obviously will affect both the extent of adoption and the price farmers are willing to accept for their biofuel feedstocks.

The lack of established markets for bio-energy crops and crop residues, and contractual arrangements with individuals or groups of producers is likely to affect an adequate supply of feedstock in the long-term. These shortcomings are pre-requisites for a processor or bio-refinery to enter the market. In addition, the lack of knowledge concerning the potential adoption of cellulosic biofuel feedstock production by farmers, and the necessary contractual arrangements to ensure an adequate long-term supply for processors necessitates the need for research into these areas. Extensive, in-depth communication between scientists and farmers about the farmers' willingness to produce cellulosic biofuels feedstock are sparse or nonexistent.

The purpose of this study, therefore, was to assess small and medium-sized farmers' willingness to produce alternative biofuel feedstocks, such as corn stover, wheat straw, switchgrass, and other perennial crops, in Louisiana and Mississippi. The objectives were to (1) identify and describe operator characteristics, and (2) ascertain farmers' views on and willingness to participate in biofuel development.

Literature Review

Production of alternate fuels from biomass-based energy sources is expected to increase in the near future in the quest to reduce both excessive dependence on fossil fuels and net emissions of greenhouse gases (GHGs), such as carbon dioxide (CO_2), methane (CH_4) and nitrogen dioxide (NO_2) (Blanco-Canqui and Lal, 2009). The Congressionally mandated RFS2 goal is to use at least 36 billion gallons of bio-based transportation fuels by 2022 (U.S. Department of Energy, 2007). The Environmental Protection Agency's (EPA) analysis projects that 15 billion gallons of conventional biofuels could come from current or planned production capacity of corn starch ethanol by 2022; however, there still exists a need to achieve the remaining shortfall of 21 billion gallons of advanced biofuels, such as cellulosic ethanol (USDA, 2010). Indeed, cellulosic ethanol production will soon become a reality as technologies for the conversion of biomass into liquid fuels are refined, and cellulosic ethanol plants are being installed. At present, corn (*Zea mays* L.) stover is being considered as one of the main feedstock sources for producing ethanol, because sustainability information on other alternative feedstock sources is not yet readily available (Graham et al., 2007). Indiscriminate crop residue removal can, however, adversely impact soil and environment as well as crop production (Whilhelm et al., 2007; Robertson et al., 2008; Blanco-Canqui and Lal, 2009).

Growing herbaceous energy crops such as perennial warm season grasses may be a sustainable option over crop residue removal for biofuel production. Perennial grasses provide many ecosystem services, including water and wind erosion control, soil organic carbon sequestration, and improvement of soil properties (Schilling et al., 2008). Large amounts of biomass will be, however, required to meet the high demands for biofuel feedstocks. Thus, the continuing questions here are where and how to grow energy crops. The USDA estimates that nearly 50% of the 21 billion gallons can come from the Southeast Region of the country with the feedstock representing (perennial grasses, soy oil, energy cane, biomass [sweet] sorghum, and logging residues) (U.S. Department of Energy, 2007).

Louisiana and Mississippi are two of the seven states that make up the Mississippi River Valley, which is a broad floodplain that extends from Illinois to the Gulf of Mexico (Guffey et al., 2006). The soils of the Valley are very fertile and support an agricultural economy of cotton, rice, and soybeans. A large portion of the area has been converted to row crops. However, some 2.1 million acres or 23% is still available for potential use. Therefore, a tremendous opportunity exists for small and medium-sized farms to capitalize on the growing biofuel market to grow energy crops. Cellulosic biomass production in the United States is still in its infancy, and many uncertainties exist, including where biomass crops will be grown and in what quantities. Fargione et al. (2008) stated that energy crops should not be grown in forest and prime agricultural lands if a sustainable renewable energy source is sought. Conversion of forestlands to energy crops could accelerate net GHG emissions and increase risks of projected global

climate change (Tilman et al., 2006). Similarly, conversion of prime agricultural lands into energy crops may increase risks of food insecurity (Campbell et. al., 2008).

Blanco-Canqui and Lal (2009) indicated that the most viable option for growing energy crops is the use of marginal, degraded, and abandoned lands. These lands can be used by small and medium-sized farmers with limited acreage to grow energy crops. Gedikoglu (2015) reported that younger farmers were more likely to take a risk and be more willing to grow energy crops than older farmers. However, the author also reported that smaller farmers were willing to grow energy crops despite the many constraints that they face. In addition, Gedikoglu (2015) argued that larger farmers might not be willing to grow energy crops due to yield and price uncertainty, and already high commodity prices.

Lignocellulosic biomass is expected to become a key feedstock for renewable energy production. However, the potential supply strongly depends on farmers' willingness to grow new perennial energy crops (Bocquého and Jacquet, 2010). It is estimated that there are approximately 30,000 farms in Louisiana averaging 370 acres in size. Of these, less than 4% gross more than $250,000 annually (Mishra and Khanal, 2012). Also, Mississippi is estimated to have 41,959 farms averaging 273 acres in size. Of these, less than 11% gross more than $100,000 annually (Meter, and Goldenberg, 2014). Therefore, in understanding the viability of energy crop production in Louisiana and Mississippi, it is necessary to first understand the willingness of small and medium-sized farmers to participate in feedstock production. This study is a step towards gaining an understanding of the future of alternative energy production in Louisiana and Mississippi for small and medium-sized farmers.

Methodology

A previous focus group conducted in St. Martinville, Louisiana in January 2011 indicated that the majority of the farmers were unwilling to produce alternative biofuel crops; however, this was a very small sample of 10 participants. Hence, the survey in this study to cover a larger sample size, from 12 rural parishes of Louisiana (Table 1) and 12 rural counties of Mississippi (Table 2). The parishes in Louisiana were selected based on the presence of Southern University Agricultural Research and Extension Center county agents in those parishes, and also, the proportion of farms less than 179 acres in relation to the total number of farms. The counties in Mississippi were selected based on the proportion of farms less than 179 acres in relation to the total number of farms. A stratified random sampling approach was used select 50 participants from each parish and county for a total sample size of 1,200 (600 each from Louisiana and Mississippi) out of a total of 15,754.

Students were recruited from Southern University, Baton Rouge, Louisiana campus to assist in collecting data for the study. A contingent valuation (CV) survey that queries landowners about their willingness to plant energy crops was developed. The most commonly used mechanisms for administering CV surveys are in-person interviews and mail surveys. Mail surveys reduce the likelihood of sample selection bias, while in-person interviews do not exclude people with reading difficulties (Carson, et. al., 2001). Therefore, a combination of in-person interviews, phone interviews, and mail surveys was used to determine small and medium-sized farmers' willingness to produce cellulosic biofuel feedstocks as well as on their ownership characteristics. A total of 305 surveys with usable data were ultimately used with an overall response rate of

approximately 25% after taking into account bad addresses, farmer retirements, and missing data. Due to similar circumstances, Caldas et. al. (2014) also utilized a 25% response rate.

Table 1. Twelve Parishes in Louisiana Selected for the Study

Parish	Total Farms in Parish	Farms with < 179 Acres
Avoyelles	947	676
East Feliciana	439	282
Evangeline	806	642
Iberia	345	273
Madison	355	145
Morehouse	473	235
Point Coupee	441	311
St. Helena	364	276
St. Landry	1,401	1,146
St. Martin	355	290
Tangipahoa	1,188	961
Vermillion	1,182	892

Source: USDA NASS (2007) Census of Agriculture

Table 2. Twelve Counties in Mississippi Selected for the Study

County	Total Farms in County	Farms with < 179 Acres
Amite	599	386
Clay	505	313
Hinds	1,071	764
Holmes	556	313
Jefferson	356	236
Kemper	455	287
Madison	747	500
Marshall	577	359
Noxubee	606	341
Oktibbeha	451	317
Panola	767	432
Walthall	768	572

Source: USDA NASS (2007) Census of Agriculture

Results and Discussion

Table 3 shows the responses on operator characteristics. Most of the respondents were males (74%); 90% were African Americans; 73% were over the age of 50 years, and about half (52%) earned less than $5,000 per year from farming. Respondents indicated that the majority of their on-farm costs were associated with feed purchases (40%), followed by fuel costs (18%), livestock purchases, and fertilizer (13% each). The average number of years farming was 19 years, with over 57% indicating that farming was their second occupation; the average sized farm was 69 acres, and the total acreage farmed was 21,191 acres. The types of farming enterprises for the majority of the respondents were livestock, field crops, and vegetables. The main livestock enterprise was beef cattle (80%) and the main crop enterprise was vegetables (67%).

The results from this study show that African American farmers were the predominate farmers, with small farm acreages, and earned less than $5,000 annually. This suggests an opportunity to increase on-farm income in this demographic, such as adoption of alternative feedstocks for biofuels. The results also indicated that the majority of on-farm costs were associated with feed purchases for livestock; this may be reduced or even eliminated given if farmers adopt alternative feedstock for fuel production.

Table 3. Operator Characteristics (N = 305)

Variable	Frequency	Percent
Gender		
Male	225	74.0
Female	80	26.0
Race		
White	28	9.2
Black	275	90.2
Hispanic	1	0.3
Other	1	0.3
Age		
<30	6	2.0
30-39	31	10.2
40-49	46	15.1
50-59	90	29.6
60-69	96	31.6
<=70	35	11.5

Table 3. Continued

Variable	Frequency	Percent
Income		
<$1,000	96	31.5
$1,000-$4,999	63	20.7
$5,000-$9,999	62	20.3
$10,000-$14,999	30	9.8
$15,000-$19,999	19	6.2
$20,000-$24,999	7	2.3
$25,000-$29,999	7	2.3
$30,000-$70,000	18	5.9
>$70,000	3	1.0
Expenses		
Feed Purchases	122	40.1
Livestock Purchases	40	13.2
Fertilizer	40	13.2
Chemicals	18	5.9
Gasoline	54	17.8
Hired Farm Labor	19	6.3
Interest Expenses	4	1.3
Other	8	2.6
Years of Farming	**19***	
Farming as Second Occupation		
Yes	176	58.0
No	129	42.0
Acreage	**69***	**21,191****
Types of Livestock		
Cattle	163	79.5
Hogs	17	8.3
Goats	43	21.0
Sheep	8	3.9
Horses	33	16.1
Rabbits	8	3.9
Fish	18	18.0
Types of Crops		
Corn	28	13.6
Soybeans	20	9.7
Hay	56	27.2
Sugar Cane	6	2.9
Vegetables	137	66.5
Sweet Potatoes	34	16.5
Strawberries	12	5.8

Note: *Average number of years of farming; average acreage farmed; **Respresents total acreage farmed

Table 4 presents the responses on alternative energy development. The majority of the respondents (75%) indicated an interest in alternative fuels, with 72% indicating that they currently do not use alternative fuels in their farm operations. Also, most of the respondents (83%) were interested in learning more about alternative fuels, and (90%) were in favor of alternative fuel development production plants in their respective areas. In addition, a majority (87%) was in favor of using alternative fuel in their farming operations, and 85% were in favor of having an alternative fuel production plant in their community.

The results show that there is willingness for small and medium-sized farmers to grow energy crops despite the fact that the majority of these farmers were over the age of 50 and had been farming on average for 19 years. Previous research by Gedikoglu (2015) suggests that younger farmers are more likely to take a risk and be more willing to grow energy crops than older farmers. However, the results support another finding by Gedikoglu (2015) that smaller farmers were willing to grow energy crops irrespective of their challenges. Larger farmers might not be willing to grow energy crops because of uncertainty in yield and price, as well as other better alternatives. It could be that small farmers, especially the ones that have pasture, may be willing to grow energy crops and that off-farm employment may be an incentive.

Table 4. Participants' Responses on Alternative Energy Development (N = 305)

Variable	Frequency	Percent
Interest in Alternative Fuel		
Yes	228	75.0
No	40	13.0
Do not know	37	12.0
Current Use of Alternative Fuel		
Yes	56	18.0
No	220	72.0
Do not know	29	10.0
Interested in Learning More About Alternative Fuels		
Yes	252	83.0
No	27	9.0
Do not know	26	8.0
In Favor of Alternative Fuel Development		
Yes	273	90.0
No	32	10.0
In Favor of using Alternative Fuel on Farm		
Yes	265	87.0
No	40	13.0
In Favor of Having an Alternative Fuel Production Plant in Community		
Yes	258	85.0
No	47	15.0

Conclusion

The study assessed small and medium-sized farmers' willingness to produce alternative biofuel feedstocks in Louisiana and Mississippi. It identified operator characteristics, and analyzed farmers' willingness to participate in biofuel development. A majority of the respondents were males; African Americans; over the age of 50 years, and earned less than $5,000 per year. The highest on-farm costs were feed and fuel costs. The majority raised livestock, and cultivated vegetables. Moreover, a majority was interested in alternative fuels; wanted to learn more about alternative fuels, and was in favor of having an alternative fuel production plant in their community.

The results of the study suggest that the potential for production in the study area is high; however, these exists the lack of knowledge associated with growing alternative crops. This highlights the potential importance of education and outreach programs regarding alternative fuels. Different strategies might be needed to promote the adoption of different energy crops. One such strategy is the development of educational materials in association with outreach programs for small and medium-sized farmers. These programs could have the potential to ultimately increase adoption of alternative feedstocks in Louisiana and Mississippi; thus, increasing on-farm profitability for small and medium-sized farmers.

A limitation of this study is that a larger proportion of the sample did not respond to the survey, and this may have implications for the results. Future studies are suggested to confirm the results of the study.

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