

**Producer Willingness and Ability to Supply Biomass**

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## **Abstract**

Producer willingness and ability to supply could be a key barrier to bioenergy and bioprocessing industries. In this paper we investigate and compare the willingness to supply biomass in two areas in the U.S. Midwest: mid Missouri and southern Illinois. In addition we take into consideration their ability and capabilities to provide biomass to bioenergy processors by comparing their existing assets and their willingness to provide critical services such as transport and storage. Results indicate that mid Missouri producers had higher willingness to supply at relevant price levels; although under ideal theoretical conditions such as higher prices, southern Illinois producers had a higher willingness to supply.

## **Introduction**

Interest in renewable energy from biomass has increased in recent years. This interest has been driven by local and global environmental concerns, domestic energy security, land use tradeoffs between food and energy as well as potential rural development benefits from biomass production and processing. All these areas, as well as the basic financial feasibility of bioenergy production, are influenced by the producers' willingness and ability to supply biomass at prices that make it profitable for processors to utilize nascent technologies to convert biomass to energy for markets such as transportation fuels and power sectors.

In this paper we compare survey results from two potential biomass areas in the U.S. Midwest: mid Missouri and southern Illinois. The focus is on producer willingness to supply existing biomass products: cereal straw, corn stover and surplus hay; although

results also include producers' ability to supply biomass by investigating the existing assets producers own that could support bioprocessing industries as well as the services producers may be willing to provide such as transportation and storage.

More specifically, the survey attempts to reveal answers to the following questions. Do producers have the assets to support a biomass based energy industry or will producers be required to make new investments? Are producers willing to provide the necessary services to support a local bioenergy industry such as transportation and storage services or will processors be better served by utilizing the services of non-local custom contractors for services? Overall, what proportion of their current biomass products will biomass producers be willing to sell to bioenergy processors and are there differences between regions?

The results show that the willingness to supply services in the different geographic areas to be fairly similar while the current asset ownership to be somewhat different with mid Missouri having more capabilities when it comes to baling and southern Illinois producers having more capabilities considering transport equipment. Willingness to supply variables show more statistical differences when considering straw and stover while their willingness to supply hay is not statistically different under ideal conditions. Results also indicate that mid Missouri producers have a higher willingness to supply at relevant price levels; although under ideal theoretical conditions such as optimal agronomic factors like soil and weather conditions as well higher prices, southern Illinois producers had a higher willingness to supply.

## Literature

The biomass a bioenergy literature includes techno-economic feasibility studies that include variations in process technology. The pathways to process biomass include biological, chemical, thermal and physical (Brown, 2003). Since the mid 1990s biological pathways such as enzymatic hydrolysis have been shown to be cost competitive with corn ethanol and more environmentally sustainable than leading chemical path ways using acidic hydrolysis (Lynd, 1996 and Wyman, 1994). Physical processes have been shown to be most effective in pretreatment stages, while thermal processes tend to be more mature and the basis of the current biopower industry (Altman and Johnson, 2008 and Altman and Johnson, 2009).

Even though some feasibility studies show cellulosic ethanol could be feasible, the empirical evidence suggests that the growth of the industry has been limited. Growth beyond the pilot plant stage has not occurred and the long term potential for maturity and to emerge from premature commercial development seems to always be 5 years in the future. To this point in the development of cellulosic ethanol, no commercial production has occurred beyond pilot plants. Thus the relevant economic research turns toward the various barriers to economic feasibility.

Technical barriers to cellulosic ethanol include the process technology. Various commercial, government and academic institutions have developed intensive research agendas to identify and solve the various technology based questions.

Non-technical barriers are less well understood. Among these logistics, organization and producer willingness to supply questions are paramount. Altman and Johnson (2009) investigate organizational structure of current and future biomass

industries and consider the impact of scale on organizational decisions in the current biopower industry (Altman, Klein and Johnson, 2007). Supply chain development, an oft-overlooked aspect of the biopower industry--is considered by Altman, Sanders, and Boessen (2007), who also find that the nature of supplier contracts may also impact the development of the industry (Altman, Boessen, and Sanders, 2008).

In the area of willingness to supply various approaches have developed. Indirect approaches include modeling producer's costs of production in various areas and estimate prices to cover their opportunity costs (Gallagher et al., 2003). Other indirect approaches model the profitability of producers for typical farms if they convert to biomass production under various assumptions such as risk and contract type (Larson, et al. 2008). More direct approaches include the surveying of producers in order to estimate the willingness of producers to convert land to intentionally grown energy crops such as fast growth trees such as hybrid willow and poplar or perennial grasses such as switch grass and miscanthus (Jensen et al., 2007).

In this research paper we investigate the willingness of producers in two Midwestern States, Missouri and Illinois, to supply existing biomass products, cereal straw, corn stover and hay to hypothetical biomass to energy processors. We take a direct approach by surveying producers' willingness to supply at 3 price levels with various producer characteristics. In addition we investigate the producers' willingness to provide services by investigating their current assets. The two geographic areas are compared to determine whether there are meaningful differences across alternate production areas.

## **Survey Data**

The data set for this paper rely on two separate surveys of producers in mid Missouri and southern Illinois conducted by the Southern Illinois University and the University of Missouri. In January and February of 2007 the Missouri survey was conducted and then in January and February 2009 the Illinois survey was conducted. Both surveys were similar in structure breaking questions down into production, assets and activities, marketing and demographics.

The surveys were mailed out to 2,500 producers in Missouri and 3,000 producers in Illinois based on a sample from a list provided by the National Agricultural Statistics Services. About 600 producers responded to the Missouri survey and about 960 to the Illinois survey for a response rate of 24% and 32%, respectively. Some producers who responded to the survey did not answer every question so most of the analysis relies on responses less than the 558 and 940 totals.

## **Results**

In this paper results are presented using summary statistics as well as standard t-tests to determine if the two areas are statistically different. The objectives of this paper were to identify the producers' willingness to supply, their assets available, and their overall willingness to provide services in support of the bioenergy industry. First, simple summary statistics are presented and discussed, then a comparison between the two geographic areas is made.

## Missouri Survey

For the mid Missouri area the assets and services were found to be adequate with 89 percent of producers having a tractor capable of operating a round baler and 61 percent having a round baler. Although, fewer producers, at 10 percent, had a square baler. This may be a weakness if the processor wanted biomass in this form. The percentage of producers with baling experience was 86 percent and two thirds or 66 percent had a truck and trailer capable of hauling bales for transportation services. Table 1 presents these data.

**Table 1: Producer Assets-Missouri**

Variable	Observations	Frequency of Affirmative Response	Percent
Round baler ownership	551	340	61.71
Tractor ownership	548	493	89.96
Square baler ownership	545	59	10.83
Baling experience	545	471	86.42
Truck and trailer ownership	547	362	66.18

For the mid Missouri producers, the services they were willing to provide were not as high as the assets they owned. Table 2 presents these data. Results indicate between 33 percent to 43 percent were willing to provide the various services such as windrowing, baling, stacking, long term storage and delivery. Perhaps not all producers that provide biomass would have to engage in these services thus having 60 or 70 percent of producers not wanting to participate could be reasonable for the processor. Although, if the processor wanted most producers to delivery their own biomass this may be an indicator that there may not be enough interest in this area.

**Table 2: Producer Services-Missouri**

Variable	Observations	Frequency of Affirmative Response	Percent
Windrowing	558	187	33.51
Baling	558	244	43.73
Storing	558	201	36.02
Delivering	558	212	37.99

Willingness to supply was measured in two ways. First, the general willingness to supply biomass was measured by asking the producers under ideal conditions “what is the maximum portion of your annual cereal straw, corn stover and hay that you could make available for market?”. For mid Missouri producers the range was 21 to 38 percent depending on the biomass product. Therefore, on average the maximum biomass mid Missouri producers would make available for bioenergy processors would be 38 percent of their straw, 32 percent of their stover and 21 percent of their hay. Table 3 summarizes these data.

**Table 3: General Willingness to Supply-Missouri**

Variable	Observations	Mean	Std. Dev.	Min	Max
Straw	416	38.09	41.35	0	100
Stover	400	32.52	39.87	0	100
Hay	431	21.45	33.35	0	100

The second method to measure producers’ willingness to supply was to ask them their willingness to supply under 3 pricing scenarios, \$10, \$15 and \$20 per ton priced in the field (not bailed). On average mid Missouri producers’ willingness to supply ranged from 12 percent to 35 percent for straw, 12 percent to 33 percent for stover and 4 percent to 14 percent for hay.



**Table 4: Price and Willingness to Supply-Missouri**

Willingness to Supply			
Price	Cereal Straw	Corn Stover	Hay
\$10/ton	12.68%	12.43%	4.44%
\$15/ton	15.88%	16.35%	6.15%
\$20/ton	35.59%	33.16%	14.86%

**Illinois Survey**

For southern Illinois producers the assets in place to serve the industry were also adequate ranging between 89.9 percent for tractor ownership to 57.6 percent for round baler ownership. Again, only 10 percent of producers reported having a square baler in southern Illinois. This may also be a drawback for this areas if a processor wanted biomass in this form. For producers in southern Illinois 77 percent responded that they had baling experience while 74 percent reported having the assets in place to participate in transportation services (truck and trailer ownership). Having three quarters of the producers in this area with transportation capabilities would be a strength. Table 5 below presents the southern Illinois results for producer assets.

**Table 5: Producer Assets-Illinois**

Variable	Observations	Frequency of Affirmative Response	Percent
Round baler ownership	940	541	57.6
Tractor ownership	940	845	89.9
Square baler ownership	940	100	10.6
Baling experience	940	724	77.0
Truck and trailer ownership	940	699	74.4

In terms of services the Illinois producers would be willing to provide, these results ranged between 35 to 40 percent willingness to participate. Table 6 below presents the Illinois results for producer services. Processors may consider this rate to be low if they were expecting a producer delivery system.

**Table 6: Producer Services-Illinois**

Variable	Observations	Frequency of Affirmative Response	Percent
Windrowing	940	380	40.4
Baling	940	370	39.4
Storing	940	329	35.0
Delivering	940	346	36.8

For southern Illinois producers, the general willingness to supply range was from 22 to 46 percent depending on the biomass product. On average the maximum biomass southern Illinois producers would make available for bioprocessors would be 46 percent of their straw, 40 percent of their stover and 22 percent of their hay. Table 7 summarizes these data for the general willingness to supply.

**Table 7: General Willingness to Supply-Illinois**

Variable	Observations	Mean	Std. Dev.	Min	Max
Straw	595	46.47	39.70	0	100
Stover	610	40.89	37.62	0	100
Hay	508	22.19	34.94	0	100

Under the 3 pricing scenarios, \$10, \$15 and \$20 per ton priced in the field (not bailed), Illinois producers willingness to supply ranged from 8 percent to 25 percent for

straw, 8 percent to 26 percent for stover and 2 percent to 9 percent for hay. Table 8 below presents these data for the southern Illinois producers.

**Table 8: Price and Willingness to Supply-Illinois**

Willingness to Supply			
Price	Cereal Straw	Corn Stover	Hay
\$10/ton	8.24%	8.15%	2.05%
\$15/ton	10.04%	10.99%	2.91%
\$20/ton	25.27%	26.86%	9.35%

The next section of the paper provides a comparison between these two areas. Mid Missouri and southern Illinois are similar from a general perspective in that they are in the U.S. Midwest with a strong agricultural base. Both areas are also near higher corn producing areas of northern Missouri and Iowa and central and northern Illinois. The following discussion compares the assets, services and willingness to supply of mid Missouri and southern Illinois.

### **A Comparison Between Areas**

In comparing these two areas first the assets will be compared followed by the services they may be willing to provide as well as their willingness to supply the three existing biomass crops: straw, stover and hay. The existing assets in the areas are somewhat different. Round baler ownership, baling experience and truck and trailer were statistically different however the economic difference may not be significant enough for potential bioenergy processors to differentiate based on existing assets. Round baler ownership was 4 percent higher in Missouri, and 9 percent more Missouri producers stated they had baling experience. While truck and trailer ownership was 8 percent higher

in Illinois, indicating they have more of the assets to participate in the transport of biomass. Tractor ownership and square baler ownership were not statistically different between these two areas at around 90 percent and 10 percent respectively. Based on these data, Missouri has slightly higher baling assets while Illinois has more capability in transportation. Table 9 presents these data along with significance tests.

**Table 9: Producer Assets-Comparison**

Variable	Missouri Percent	Illinois Percent	T-value	P-value
Round baler ownership	61.71	57.6	-7.316	0.001
Tractor ownership	89.96	89.9	0.523	0.601
Square baler ownership	10.83	10.6	-0.076	0.939
Baling experience	86.42	77	-3.937	0.001
Truck and trailer ownership	66.18	74.4	3.583	0.001

The services the producers are willing to provide are also similar. In fact, 3 of the 4 service variables are not statistically different. Table 10 presents the producer service comparison. The producers willingness to provide baling, storing and delivery services are not statistically different in these areas, all ranging in the upper 30 and lower 40 percents. The willingness to provide windrowing was the only variable that had a significant difference with Illinois having about 7 percent more producers willing to provide windrowing. The economic significance here is uncertain. Potential bioenergy processors may or may not be sensitive to these differences. Still, they may be able to use this information to compare and contrast with other potential production areas.

**Table 10: Producer Services-Comparison**

Variable	Missouri Percent	Illinois Percent	T-value	P-value
Windrowing	33.51	40.4	3.269	0.001
Baling	43.73	39.4	-1.254	0.210
Storing	36.02	35	-0.050	0.960
Delivering	37.99	36.8	0.016	0.987

The willingness to supply variables may show more meaningful differences between the two areas. For the general willingness to supply variable Illinois has an 8 percentage point higher willingness to supply than the Missouri producers for straw and stover, and the hay difference is not statistically significant. Table 11 displays this comparison. These results may be more economically significant than the asset and services variables. Again, this will hinge on the bioenergy processor's willingness to supply or participation requirement needed to support a processing facility. Importantly, the question posed is the maximum under "ideal circumstances." The questions must be further refined by examining willingness to supply under alternative price scenarios?

**Table 11: General Willingness to Supply-Comparison**

Variable	Missouri Mean	Illinois Mean	T-value	P-value
Straw	38.09	46.47	3.257	0.001
Stover	32.52	40.89	3.481	0.001
Hay	21.45	22.19	0.289	0.773

Tables 12,13, and 14 present the comparison at the 3 price levels for the 3 biomass crops. At the price levels of \$10, \$15 and \$20 per ton priced in the field (not baled) the mid Missouri producers tended to have higher willingness to supply. For straw, the mid Missouri producer's willingness to supply was 4 per cent, 5 percent and about 10

percent higher at the \$10, \$15 and \$20 price levels. Similarly for stover mid Missouri producers had a 4, 5 and 6 percent higher willingness to supply at the respective price levels. The difference for willingness to supply hay was less pronounced at 2,4 and 5 percent at the different price levels and were also statistically different. Given these results mid Missouri may have the advantage in terms of having a higher willingness to supply at lower price levels.

**Table 12: Price and Willingness to Supply (WTS) Cereal Straw - Comparison**

Price	Missouri WTS	Illinois WTS	T-value	P-value
\$10/ton	12.68%	8.24%	-2.478	0.013
\$15/ton	15.88%	10.04%	-2.579	0.010
\$20/ton	35.59%	25.27%	-2.479	0.013

**Table 13: Price and Willingness to Supply (WTS) Corn Stover - Comparison**

Price	Missouri WTS	Illinois WTS	T-value	P-value
\$10/ton	12.43%	8.15%	-3.095	0.002
\$15/ton	16.35%	10.99%	-2.818	0.005
\$20/ton	33.16%	26.86%	-2.900	0.004

**Table 14: Price and Willingness to Supply (WTS) Hay - Comparison**

Price	Missouri WTS	Illinois WTS	T-value	P-value
\$10/ton	4.44%	2.05%	-4.167	0.001
\$15/ton	6.15%	2.91%	-2.503	0.012
\$20/ton	14.86%	9.35%	-3.041	0.002

## Conclusions

The conclusions to this paper are that mid Missouri and southern Illinois have fairly similar willingness to provide services to support a bioenergy processing industry and somewhat different assets and capabilities. The mid Missouri area had a higher percentage of producers owning balers and more baling experience, while southern Illinois producers had a higher percentage of producers owning trucks and trailers. Although, both areas tended to have higher percentages of asset ownership compared to services, except for square baler ownership. Ownership of a tractor capable of pulling a baler and ownership of square balers showed no statistical difference between the areas.

In addition, 3 of 4 service variables were not statistically different across the regions and were all about 33 percent to 40 percent participation. These were all considerably lower compared to asset ownership variables, except square baler ownership at around 10 percent ownership. These factors, services and square baler ownership, could be a drawback to both regions if the processor considers these critical.

The results for willingness to supply may have more significant differences compared to assets and services, although the indicators are conflicted. If the overall willingness to supply under ideal circumstances is considered paramount, southern Illinois producers had a higher willingness to supply. However, at price scenarios realistic for bioprocessors, mid Missouri had statistically higher willingness to supply indicators compared to southern Illinois. Thus if processors had some flexibility to price increases in exchange for higher willingness to supply they could consider southern Illinois over mid Missouri, however, if the price range is more rigid mid Missouri had a higher willingness to supply at the lower price range.

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