Analysis of the Impact of Corn Stover Marketing on Farmer Planting Decisions

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Motivations of Economic Analysis of Corn Stover as Cellulosic Biofuel Feedstock

- The Renewable Fuel Standard calls for 16 billion gallons of cellulosic biofuels by 2022
- Corn stover is the most abundant crop residue available in the Mid-west
- Up-to-date corn stover production costs are available
- May have little land use change impacts on the crop production system

Research Objective

- To test whether the added corn stover revenue would be sufficient to induce farmers to plant more continuous corn

Methodology

- B-21 PCLP farm planning model
  - Solves several aspects of farming problems: labor and machinery availability, farming technology and tillage system, and crop rotation choices
  - Combines all the farming resources in the most profitable way that gives the highest return to each farm with subject to any resource limitations

Methodology Cont'd

- Anonymous data for real farms from 2008 Purdue Top Farmer Crop Workshop were used as base scenarios
- Costs of corn stover collection, corn stover price and yield were converted and incorporated into corn planting activity in the base scenarios, which generated modified scenarios including corn stover
- Impacts of corn stover on farming decisions would be revealed by comparing the PCLP results from different scenarios

Data Calculations

- Corn stover price
  - No published corn stover price is available
  - $30/ton farm gate price was chosen initially based on the information from Brechbill and Tyner, 2008
  - $$0.84\ \left(\$/_{bu}\right) = 30\ \left(\$/_{ton}\right) \div [2000\ \left(pounds/_{ton}\right) \div 56\ \left(pounds/_{bu}\right)]$$
- Combined price of corn and corn stover
  - $$combined\ price\ \left(\$/_{bu}\right) = corn\ price\ \left(\$/_{bu}\right) + stover\ removal\ rate \times \frac{stover}{corn}\ yield\ ratio \times stover\ price\ \left(\$/_{bu}\right)$$

Data Calculations Cont'd

- Corn stover yield is highly related to grain yield and corn stover removal rate
  - $$corn\ stover\ yield\ \left(\frac{bushel}{acre}\right) = 0.95 \times 38\% \times corn\ yield\ \left(\frac{bushel}{acre}\right)$$
  - $$corn\ stover\ yield\ \left(\frac{tons}{acre}\right) = 0.95 \times 38\% \times corn\ yield\ \left(\frac{bushel}{acre}\right) \times 56\left(\frac{pounds}{bushel}\right) \div 2000\left(\frac{pounds}{ton}\right)$$

Data Calculations Cont'd

- Custom-hired corn stover harvesting costs (Brechbill and Tyner, 2008)
  - Nutrient replacement cost

Description of cost	Cost per ton	Total cost per ton
Nitrogen	$6.43	
Phosphorous	$2.39	$15.63
Potassium	$6.81	

Data Calculations Cont'd

- Net wrap baling option cost

Description of cost	Cost per ton	Total cost per ton
Bale custom rate	$5.28	$11.65
Net wrap	$1.97	
Moving to field edge	$2.00	
Dry matter loss	$0.78	
Storage premium	$0.11	
Profit premium	$1.52	

Results

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- Changes of corn acreage and farmer's profitability with corn stover removal rate of 38% and price of $30/ton

	Corn production without corn stover		Corn production with corn stover
Total acres of corn planted	43459		43459
% increase in corn acres		0.0%	
Total return to resources	$61,927,083		$61,988,458
% increase in return to resources		0.1%	

Sensitivity Analyses of the Impact of Various Corn Stover Prices on Farmer Planting Decision

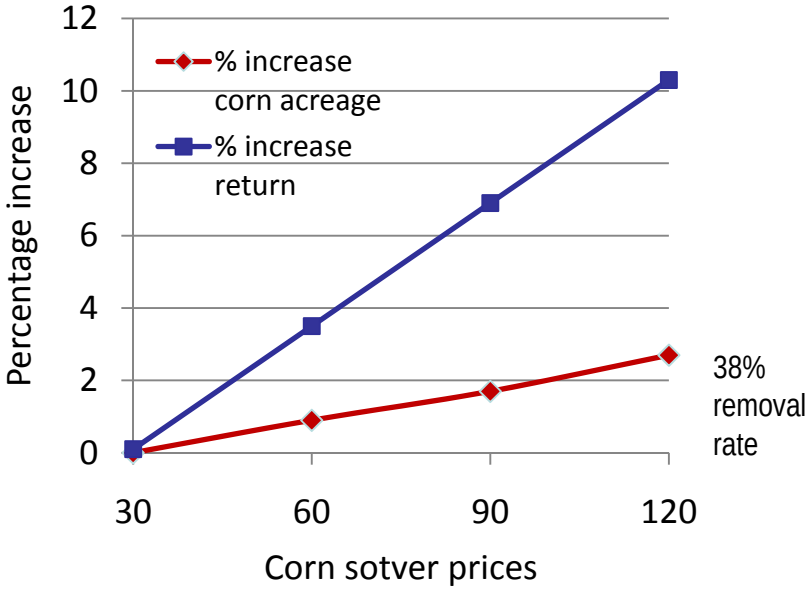
38% stover removal rate	Corn production w/o stover	Corn production w/ stover ($30/ton)	Corn production w/ stover ($60/ton)	Corn production w/ stover ($90/ton)	Corn production w/ stover ($120/ton)
Total acres of corn planted	43459	43459	43838	44205	44626
% increase in corn acres	--	0.0%	0.9%	1.7%	2.7%
Total return to resources	$61,927,083	$61,988,458	$64,119,941	$66,198,427	$68,288,863
% increase in return to resources	--	0.1%	3.5%	6.9%	10.3%

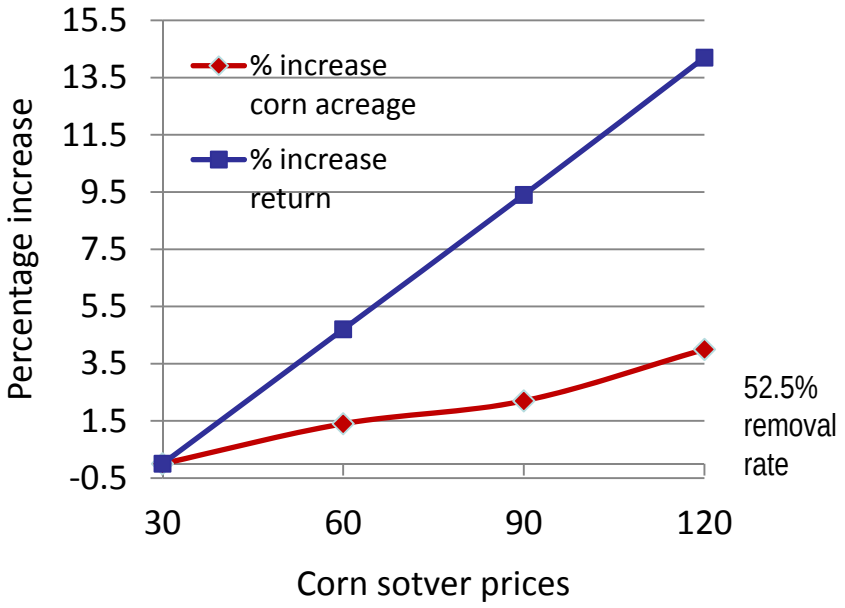
Sensitivity Analyses of the Impact of Various Corn Stover Prices on Farmer Planting Decision

52.5% stover removal rate	Corn production w/o stover	Corn production w/ stover ($30/ton)	Corn production w/ stover ($60/ton)	Corn production w/ stover ($90/ton)	Corn production w/ stover ($120/ton)
Total acres of corn planted	43459	43459	44077	44396	45203
% increase in corn acres	--	0.0%	1.4%	2.2%	4.0%
Total return to resources	$61,927,083	$61,928,460	$64,818,195	$67,737,671	$70,698,404
% increase in return to resources	--	0.0%	4.7%	9.4%	14.2%

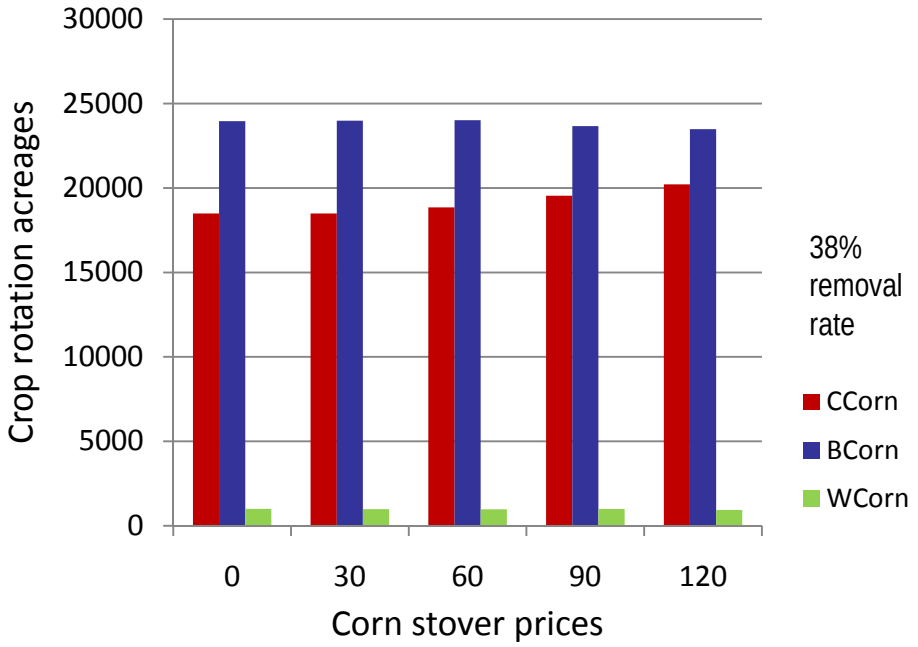
Result Summary

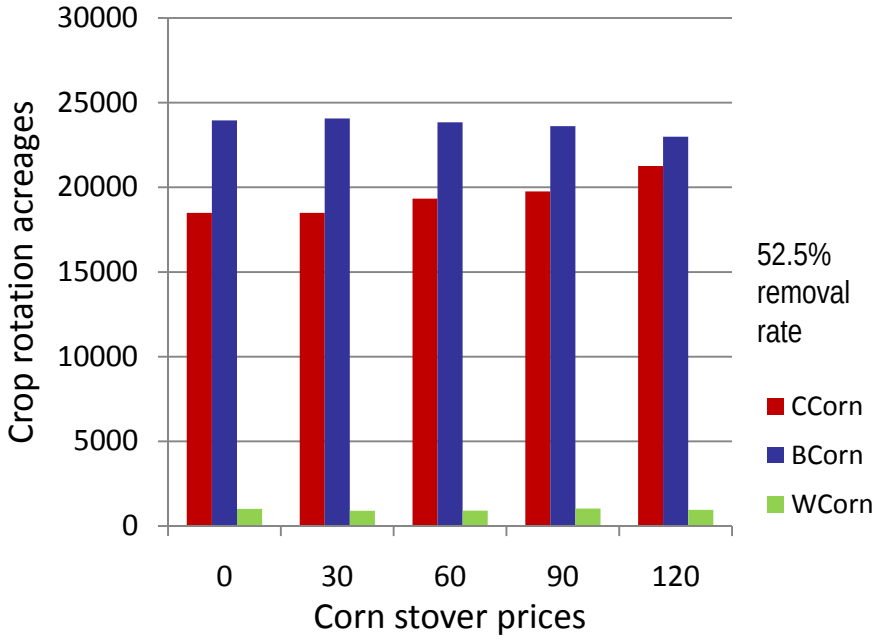
- With 38% and 52.5% removal rates and current corn stover production cost levels, corn acreage impacts at most corn stover prices are low:





Changes in Crop Rotations as Corn Stover Price Increases





- Note: there is no corn stover activity when its price is 0

Conclusions

- Corn stover price higher than $30/ton would induce farmers to grow somewhat more corn, although the change is quite small even at stover prices that would render biofuels uneconomic.
- The additional corn stover revenue is not sufficient to induce farmers to plant more continuous corn instead of corn-soybean rotation.
- Using corn stover as cellulosic biofuel feedstock could increase land use change for corn production only at very high corn stover prices, not likely to prevail.