Energy Sorghum as A Biofuel Feedstock: Effects On GHG Offsets and Sector Performance

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INTRODUCTION

The biofuel industry in the U.S. has experienced a rapid expansion during the past decade. This growth has largely involved the 1st generation biofuels mainly from corn and has contributed to higher food prices in domestic and international markets (Boddiger, 2007, Headey and Fan, 2008).

The effect on export markets has been argued as a force fueling overseas deforestation that can result in considerable carbon emissions and carbon debts (Searchinger et al., 2008).

These factors undermine the legitimacy of adopting biofuels as a strategy for reducing greenhouse gases (GHG) emissions and perhaps as a strategy for enhancing U.S. energy security. In response, the 2nd generation biofuels that utilize cellulosic, non-food feedstocks are suggested as replacements (EPA, 2010). The recent crop - energy sorghum - has been posed as a high yielding energy crop that can help alleviate the induced land use change issue and export implications.

This study aims to investigate the implications of various aspects regarding energy sorghum's participation in the renewable fuel standards (RFS2) provisions of the Energy Independence and Security Act of 2007 (EISA).

EISA mandates that 36 billion gallons of renewable fuel to be produced by 2022 and 21 billion must be from cellulosic and other advanced sources.

METHOD

The agricultural component of the Forest and Agricultural Sector Optimization Model – Greenhouse Gases Version (FASOMGHG) was used for this study. FASOMGHG is a dynamic, nonlinear and price endogenous programming model for the forest and agricultural sectors in the U.S. plus export markets. It simulates the allocation of land over time to competing activities in the forestry and agricultural sectors, suggesting resultant consequences for the markets of commodities supplied by these lands with welfare evaluation (Adams et al., 2005).

The use of energy sorghum as ethanol feedstock was simulated under a variety of scenarios. See Scenario Definition for more information.

ACKNOWLEDGEMENTS

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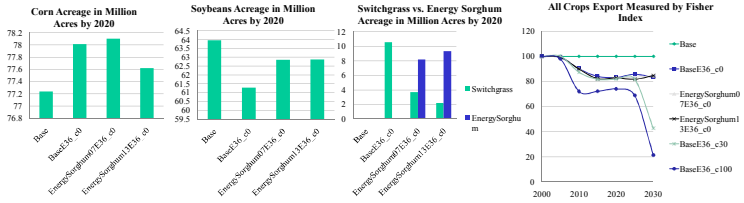
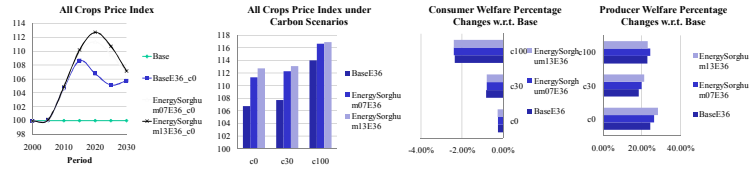
RESULTS

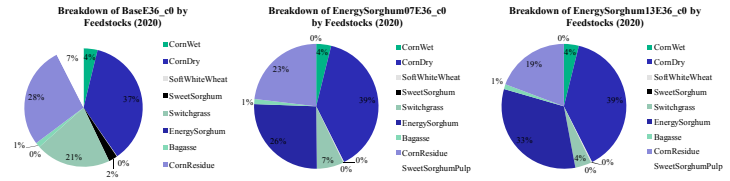
Crop Acreages & Export Implications



Crop Prices & Welfare Changes

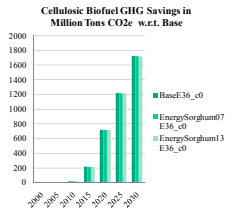


Ethanol Production & GHG Offsets



Percentage Changes in Feedstock Uses under Carbon Scenarios (2020)

	BaseE36		EnergySorghum07E36		EnergySorghum13E36	
	c30	c100	c30	c100	c30	c100
CornWet	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
CornDry	-1.11%	-2.53%	-0.15%	-0.74%	-0.11%	-0.61%
SoftWhiteWheat	0.13%	-100.00%	25.96%	-29.13%	14.63%	-44.90%
SweetSorghum	17.02%	43.49%	N/A	N/A	N/A	N/A
Switchgrass	-30.79%	-21.98%	-36.25%	-78.27%	-9.96%	-85.32%
EnergySorghum	N/A	N/A	5.39%	14.91%	2.60%	5.72%
Bagasse	-0.49%	-1.23%	-5.08%	-99.03%	-4.56%	-99.02%
CornResidue	18.20%	4.60%	5.32%	12.78%	-1.92%	15.30%
SweetSorghumPulp	17.02%	43.49%	N/A	N/A	N/A	N/A



SCENARIO DEFINITION

	RFS2	Yield Growth Rate 0.7%	Yield Growth Rate 1.3%	Carbon Price $0	Carbon Price $30	Carbon Price $100
Base				√		
BaseE36_c0	√			√		
BaseE36_c30	√				√	
BaseE36_c100	√					√
EnergySorghum07E36_c0	√	√		√		
EnergySorghum07E36_c30	√	√			√	
EnergySorghum07E36_c100	√	√				√
EnergySorghum13E36_c0	√		√	√		
EnergySorghum13E36_c30	√		√		√	
EnergySorghum13E36_c100	√		√			√

CONCLUSIONS & DISCUSSIONS

- Energy sorghum plays a significant role in cellulosic ethanol production under RFS2. Its competitiveness improves under higher yield growth rate scenarios. The introduction of carbon prices ($ per ton) would further increase energy sorghum's share in the ethanol industry. Energy sorghum displaces switchgrass in providing cellulosic ethanol.
- Acreages of major crops are affected by RFS2. Overall, the presence of energy sorghum would alleviate the induced land use change issue. Besides, export activities are negatively influenced by RFS2. The introduction of carbon prices may aggravate the situation.
- The presence of RFS2 increases agricultural commodity prices. Producers would see significant increases in gains and consumers may experience slight losses. Energy sorghum brings even more benefits to producers.
- Caveats: climate change effects on agriculture were not considered in this study. Results were obtained from FASOMGHG with 11 supply regions.

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