Problems with corn grain ethanol

Economics

In 2011, 40% of US corn grain was converted to ethanol displacing ~5% of our oil use.

If we convert every corn kernel grown today in the U.S. to ethanol we offset just 12 percent of our gasoline use (Jason Hill, U Minn).

Environmental

… from a climate perspective, ethanol from corn grain is basically a way to make cars run on coal and natural gas. (from Field et al. 2007)

Soil erosion, nutrient pollution, greenhouse gases…
Promise of cellulosic ethanol

15-billion gallon goal

- 70 gal EtOH per ton dry matter (Sheehan et al. 2003)...[not yet produced at industrial scale]
- Translates to ~214 million tons dry biomass

Milbrandt et al. (2005) estimate that 423 million tons of excess dry biomass is available each year in the US.

Tremendous amount of variability in production, but let’s use a value of 6.6 Mg/ha (2.7 tons/ac)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Location and description</th>
<th>Biomass yield</th>
<th>N (min)</th>
<th>Range</th>
<th>Mean</th>
<th>Source</th>
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</thead>
<tbody>
<tr>
<td>Staples</td>
<td>Field-scale plots (0 to 61 ha) on 10 farms in Nebraska, South Dakota, and South Dakota USAs harvested for 7 yr</td>
<td>0.212</td>
<td>5.2-11.1</td>
<td>4.9</td>
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<tr>
<td>Miscanthus</td>
<td>Experimental plots harvested for 3 yr in Wisconsin</td>
<td>8.0</td>
<td>1.0-18.2</td>
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<tr>
<td>Miscanthus</td>
<td>Experimental plots harvested for 3 yr in Wisconsin</td>
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<td>Belding grass</td>
<td>Experimental plots in Iowa USA harvested for 3 yr</td>
<td>0.109</td>
<td>3.0-10.1</td>
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<td>Belding grass</td>
<td>Experimental plots at two sites in Iowa USA harvested for 3 yr</td>
<td>0.140</td>
<td>3.0-10.1</td>
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<td>Experimental plots at two sites in Illinois USA harvested for 3 yr</td>
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<td>Belding grass</td>
<td>Three experimental plots at 2 sites in Illinois USA, USA, harvested for 3 yr</td>
<td>0.00</td>
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<td>Sugarcane</td>
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<td>0.1-0.5</td>
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<td>Tobacco</td>
<td>Summary of studies from 6 sites in the southern USA</td>
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<td>9.4</td>
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<td>Experimental plots in South Dakota USA harvested for 2 yr</td>
<td>0</td>
<td>6.8-6.8</td>
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<tr>
<td>Prairie coneflower</td>
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<tr>
<td>Cane rice</td>
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<td>6.8-6.8</td>
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<tr>
<td>Live canopy high diversity plots</td>
<td>10 plots on 5 plant species in small plots grown for 1 yr in Cedar Creek, Wisconsin USA</td>
<td>0</td>
<td>3.7</td>
<td>3.7</td>
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</table>

from Sanderson & Adler 2008 Int J Mol Sci
Promise of cellulosic ethanol

214 million dry tons excess biomass goal

- Assume 2.7 tons dry matter per acre
- Translates to 80 million acres
  - WI is 42 million acres
  - Currently 34 million acres in CRP in US
  - Remainder would be crop residue or cropland converted to biomass production
  - Currently 448 million acres in cropland in US

Is food v. fuel a red herring?

- Appears to be enough land in US to produce cellulosic biofuels without displacing food production
- We currently produce enough food for 10 billion people (FAO UN 2009)...distribution/political will/social justice is the problem
- Food quality is not considered...are we talking about soda?
- Real problems for environment if cellulosic crops are managed intensively.
“As Biofuel Demand Grows, So Do Guatemala’s Hunger Pangs”

Opening quote from NY Times Article

In the tiny tortillerias of this city, people complain ceaselessly about the high price of corn. Just three years ago, one quetzal — about 15 cents — bought eight tortillas; today it buys only four. And eggs have tripled in price because chickens eat corn feed.

The basic argument goes something like this:
- US has policies promoting biofuels as substitute for oil for national security and environmental reasons;
- Those policies increase demand for corn and soy which increases global grain prices which cuts into the purchasing power of poor people and makes them hungry.

Possible & True This Year But Not Always...

- When would it be true?
  - When grain supplies are tight, and when demand for grains as biofuels and other uses are strong.
  - Supply side tight now because of weather shocks
  - Demand side robust because of US policy and very rapid economic growth in Asia...

- When would it not be true?
  - When grain supplies are loose, and when demand from biofuels is ‘not making the market’ or driving it.
  - Was true until 2007 and again somewhat before 2011.

Lots of Research on This...

- See work by Babcock; Just and de Gorter

- Basic story goes like this:
  - Ethanol mandate and ‘blend wall’ lead to less elastic demand which makes prices more variable when supply is short.

- We are in one of those times when Renewable Fuel Standards (RFS) raises prices.
Teaser:
Other US ethanol policy critiques

- Combination of mandate and ‘tax credit’ actually increases demand for oil by making gas cheaper...
- So, we are making more greenhouse gas, driving more miles on more congested roads than we would if government policies for ethanol promotion were dropped...
- See Just and de Gorter’s research...

What to do about biofuels & hunger?

- Make RFS flexible in tight supply eras to take pressure off of grain demand and prices...
- Recognize bigger truth, too!
- Hunger is more about ‘income’ than it is about prices. High prices exacerbate situation but are not the core cause of hunger.
- Low incomes from low assets, low education, poor access to credit and technology, and weak social policy are more fundamental than prices. Lots can be done and is being done there.