The Impact of Biofuel Production on Crop Production in the Southern Plains

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Future Ethanol Production

Year	RFS	Capacity
2006	4.0	5.1
2007	4.7	6.6
2008	5.4	7.9
2009	6.1	8.6
2010	6.8	9.3
2011	7.4	9.9
2012	7.5	10.3

Biofuel Production is Expanding from the Grain Belt to (grain deficit) Regions in the Southern Plains

- Lower natural gas prices, reduced transportation costs for co-products and ethanol
- Oklahoma: 3 ethanol plants (150 M gallons total capacity) in construction- feed stock exceeds total OK feed grain production

Cellulosic-based Ethanol

- Greatly expands ethanol potential
- Higher infrastructure costs but potentially lower production costs
- Projecting cropping shifts into cellulosic feed stocks has critical implications for infrastructure development and agricultural impacts
- Many projections about cellulosic ethanol ignore economic or market forces

A New OPEC Nation

- *"Oklahoma could become another OPEC nation by converting crop land to switchgrass production" New York Times*
- *First speaker at the Oklahoma Governors Conference on Biofuels stated that Oklahoma had the potential to produce 12B gallons of ethanol*

Study Projected Oklahoma's Biofuel Crop Production

- Multi Disciplinary study funded by the Oklahoma Secretary of Energy
- Determine current biofuel crop potential
- Determine potential land shifts into grain-based biofuel feed stocks
- Determine potential land shifts into cellulosic-based biofuel feed stocks
- Results have general implications for other feed grain deficit regions

Data and Methods

- County level crop budgets developed for every major crop
- Conversion rates and costs estimated for grain-based ethanol, cellulosic-based ethanol and biodiesel
- Biofuel production costs included all variable and fixed costs plus a 15% return on invested capital
- Residual value of biofuel product assumed to accrue to the crop producer

Data and Methods (continued)

- For each crop and county land was allowed to shift from the current crop to the biofuel crop when the net returns for the biofuel feed stock exceeded the net returns for the current crop
- First considered grain-based ethanol and biodiesel then expanded to consider cellulosic-based ethanol

Data and Assumptions

- OSU Enterprise budgets (cost adjust with yield)
- 5 year time series of yields and prices
- 2.8 gallons/bu of ethanol for corn, 75 gallons per ton for switchgrass
- Ethanol variable production costs: $.50/gallon for grain based and $.75/gallon for cellulosic
- $1.5/gallon capital cost for grain based, $3.00/gallon for cellulosic

Assumptions (continued)

- Canola yields based on wheat yields
- County CRP rental rates used to represent current income from CRP land
- Switchgrass production assumed to equal alfalfa yield (4/ton acre average) with separate estimates for CRP land.
- Hay budgets used to estimate harvest costs
- Transportation costs not considered

Summer Crops Allowed to Shift to Corn or Sorghum. Winter Crops to Barley

- Corn & Sorghum
- Cotton → corn, sorghum
- Soybeans → corn or sorghum
- Alfalfa → corn or sorghum
- Hay → corn or sorghum
- Oats → corn or sorghum
- Peanuts → corn or sorghum
- Wheat → barley
- Rye → barley

Summer Crops also Allowed to Shift to Soybeans, Winter Crops to Canola

- Soybeans
- Cotton ➔soybeans
- Alfalfa ➔soybeans
- Hay ➔soybeans
- Oats ➔soybeans
- Peanuts ➔soybeans
- Wheat ➔ canola
- Rye ➔ canola

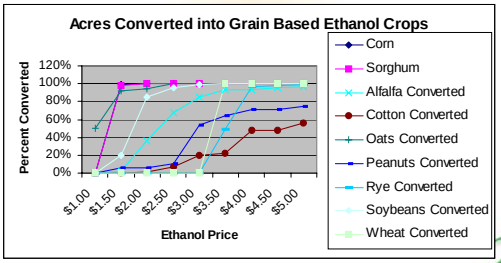
Cellulosic Ethanol Crops

- Wheat straw
- Corn Stover
- CRP acres ➔switchgrass
- Crop and hay acreage ➔switchgrass

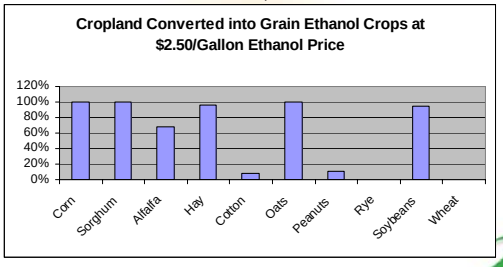
Current Biofuel Crop Production

- Corn
  - 200,000 acres
  - 26M bushels
  - 75M gallons ethanol potential
- Sorghum
  - 310,000 acres
  - 13M bushels
  - 37M gallons ethanol potential
- Soybeans
  - 238,000 acres
  - 9M bushels
  - 16M gallon biodiesel potential

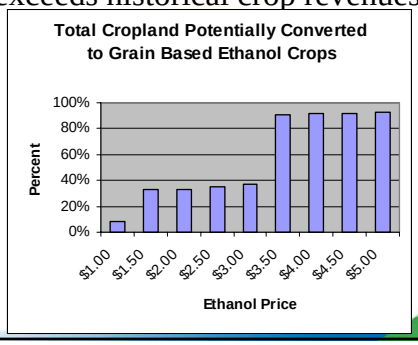
Price Sensitivity of Ethanol Crop Conversion

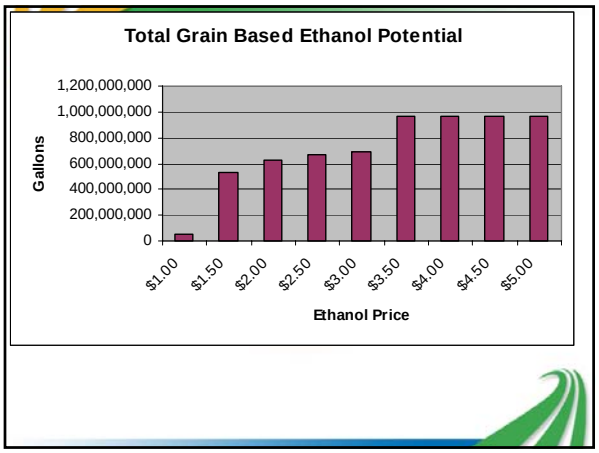


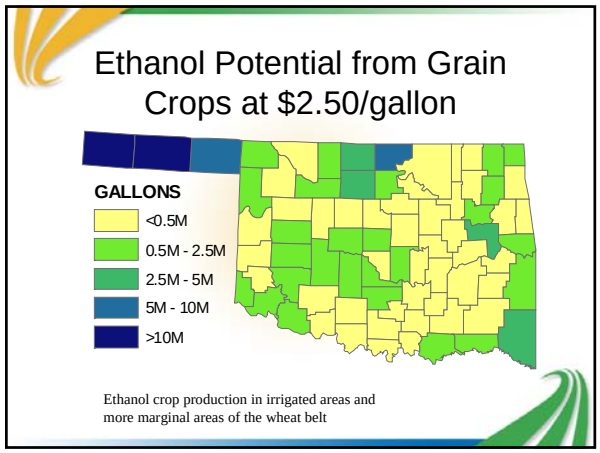
Land will not shift out of wheat, cotton or peanut at ethanol prices below $3.00

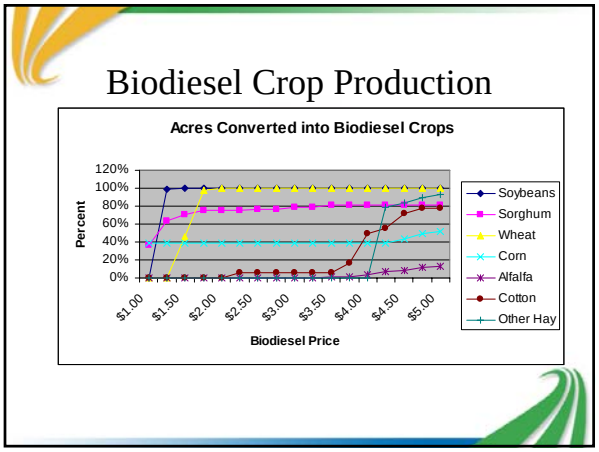


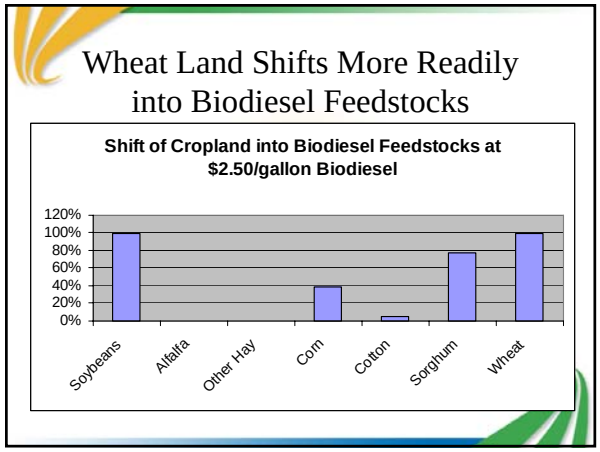
At $3.75/gallon ethanol revenues exceeds historical crop revenues

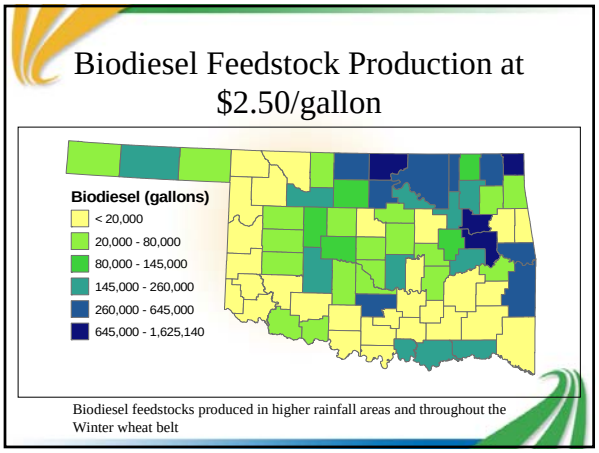


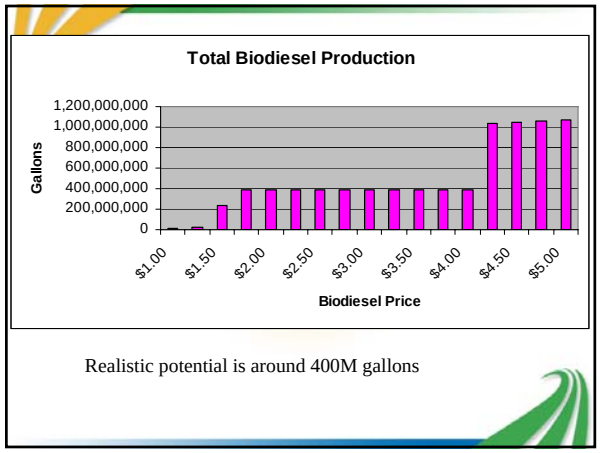

Total Grain Based Ethanol Potential
Gallons
1,200,000,000
1,000,000,000
800,000,000
600,000,000
400,000,000
200,000,000
0
$1.00
$1.50
$2.00
$2.50
$3.00
$3.50
$4.00
$4.50
$5.00
Ethanol Price

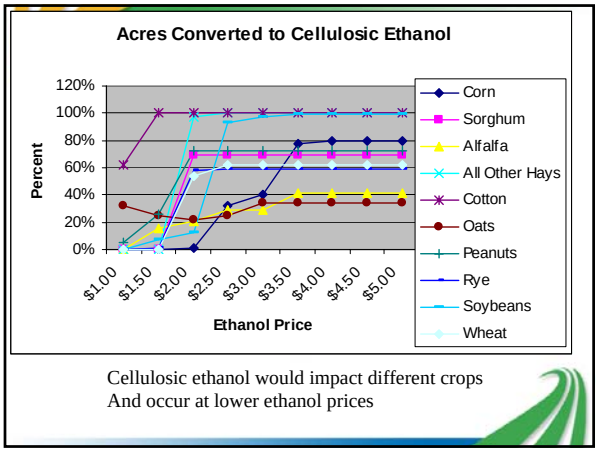

Ethanol Potential from Grain Crops at $2.50/gallon
GALLONS
<0.5M
0.5M - 2.5M
2.5M - 5M
5M - 10M
>10M
Ethanol crop production in irrigated areas and more marginal areas of the wheat belt


Biodiesel Crop Production
Acres Converted into Biodiesel Crops
Percent
120%
100%
80%
60%
40%
20%
0%
$1.00
$1.50
$2.00
$2.50
$3.00
$3.50
$4.00
$4.50
$5.00
Biodiesel Price
Soybeans
Sorghum
Wheat
Corn
Alfalfa
Cotton
Other Hay


Wheat Land Shifts More Readily into Biodiesel Feedstocks
Shift of Cropland into Biodiesel Feedstocks at $2.50/gallon Biodiesel
120%
100%
80%
60%
40%
20%
0%
Soybeans
Alfalfa
Other Hay
Corn
Cotton
Sorghum
Wheat

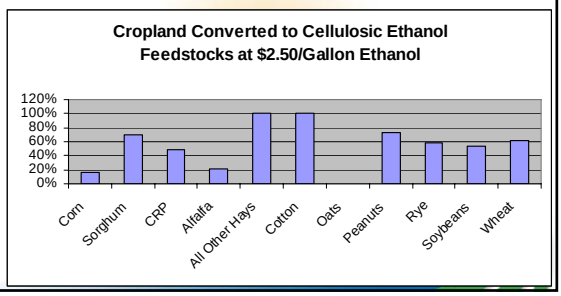

Biodiesel Feedstock Production at $2.50/gallon
Biodiesel (gallons)
< 20,000
20,000 - 80,000
80,000 - 145,000
145,000 - 260,000
260,000 - 645,000
645,000 - 1,625,140
Biodiesel feedstocks produced in higher rainfall areas and throughout the Winter wheat belt


Total Biodiesel Production
Gallons
1,200,000,000
1,000,000,000
800,000,000
600,000,000
400,000,000
200,000,000
0
$1.00
$1.50
$2.00
$2.50
$3.00
$3.50
$4.00
$4.50
$5.00
Biodiesel Price
Realistic potential is around 400M gallons

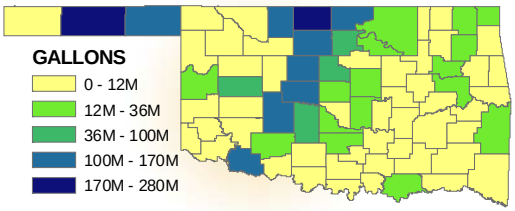


Cellulosic ethanol would impact different crops
And occur at lower ethanol prices

Cellolosic Ethanol Technology Could Shift a Higher Portion of Land into Ethanol Feedstocks

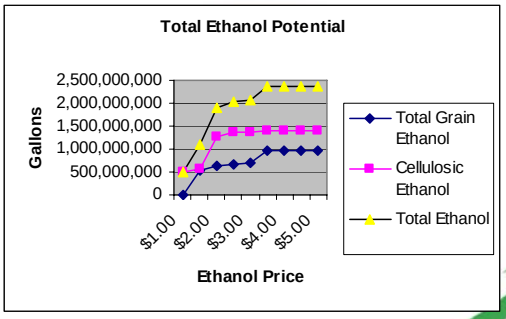


Cellulosic Ethanol Production Potential at $2.50/gallon



Cellolosic feedstock production would center in the wheat belt

Grain Based plus Cellulosic Ethanol



Maximum Economically Efficient Potential (gallons)

	$2.50 Ethanol and Biodiesel	$5.00 Ethanol and Biodiesel
Grain based ethanol	666M	970M
Grain and Cellulosic ethanol	2 B	2.4B
Biodiesel	388 M	1 B

Conclusions

- Biofuel prices above $3.5/gallon required to shift majority of acreage to biofuel feedstocks
- Marginal wheat land will be the first to shift to grain-based ethanol feed stocks
- Land shifts to biodiesel feed stocks at lower biofuel prices
- Cellulosic feed stock may center on crop land, not marginal land

Implications

- Biofuels may have major impacts on land use
- Changes will impact food, feed and livestock
- Predictions on land use, regional location and total production must consider economics