National Water Use Implications of Biofuel Feedstock Production

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Goal of presentation

- Provide a National perspective on irrigated agriculture
  - Acres
  - Water use
  - Crops
- What do trends and current conditions tell us about the water currently used for biofuel production?
- What does tell us about the potential water use for biofuel production?
U.S. irrigated acres & water applications

Year
0 10 20 30
Million acres


Irrigated Acres
Water Applied

Inches water applied
0 5 10 15 20 25 30

Source: NRCS, based Census of Agriculture Data and Farm and Ranch Irrigation Survey Data
Total and agricultural water withdrawals (1960-2005) and consumptive use estimates (1960-1995)

Source: USDA, NRCS, based on Kenny, et al, 2009

* Data limitations do not allow estimation of consumptive use in 2000.
U.S. Irrigation water withdrawals, 2005

Acre-feet (1,000)

Source: NRCS analysis of USGS Water Use data
What is all that irrigation water used for?
Irrigation overview: Acres location, 2007

Source: USDA, 2007 Census of Agriculture
U.S. irrigated acreage, 2007

Source: NRCS analysis of Census of Agriculture Data
Southeast irrigated acreage, 2007

Source: NRCS analysis of Census of Agriculture Data

Percent of 2007 irrigated area

- Other crops: 13%
- Orchard & vegetables: 9%
- Hay: 21%
- Other grains: 13%
- Soybeans: 7%
- Corn: 23%
- Cotton: 14%

Source: NRCS analysis of Census of Agriculture Data
Regional Irrigated cropping patterns, 2007

Source: NRCS analysis of Census of Agriculture Data
How does biofuel feedstock production impact irrigation water demands?
Irrigated corn share and current ethanol plant locations

Source: ERS based on 2007 Census of Agriculture data and 2010 Renewable Fuels Association data.
How much water for an “average” corn field?

- 130 acre center-pivot field
- 12 inch application in 2008 (reduction from 14 in 2003)
- 42,357,120 gallons applied per year per field (27,152 * 12 * 130)
- States with >100,000 acres range from 21 to 85 million gallons per field
- 1,800 gallons /bu (based on average irrigated corn yield in 2008 of 181 bu/acre)

Source: USDA, NASS, Farm and Ranch Irrigation Survey
Gallons of irrigation water per bushel of irrigated corn, 2008

Source: NRCS based on Farm and Ranch Irrigation Survey Data
Gallons of irrigation water per gallon of corn-based ethanol, 2008

Assuming all feedstock irrigated converting at 2.7 gallons per bushel.

Source: NRCS based on Farm and Ranch Irrigation Survey Data
Average irrigation water applications levels for selected crops, U.S., 2008

Source: ERS based on 2008 Farm and Ranch Irrigation Survey data.
Average irrigation water applications levels for selected crops, Nebraska, 2008

**Source:** ERS based on 2008 Farm and Ranch Irrigation Survey data
Average irrigation water applications levels for selected crops, Kansas, 2008

<table>
<thead>
<tr>
<th>Crop Type</th>
<th>Irrigation Application (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orchards</td>
<td>17</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>16</td>
</tr>
<tr>
<td>Silage corn</td>
<td>15</td>
</tr>
<tr>
<td>Corn</td>
<td>14</td>
</tr>
<tr>
<td>Pasture</td>
<td>13</td>
</tr>
<tr>
<td>Other Hay</td>
<td>12</td>
</tr>
<tr>
<td>Soybeans</td>
<td>11</td>
</tr>
<tr>
<td>Grain Sorghum</td>
<td>11</td>
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<tr>
<td>Veggies</td>
<td>11</td>
</tr>
<tr>
<td>Dry Beans</td>
<td>11</td>
</tr>
<tr>
<td>Wheat</td>
<td>11</td>
</tr>
<tr>
<td>Other Crops</td>
<td>11</td>
</tr>
<tr>
<td>Cotton</td>
<td>9</td>
</tr>
<tr>
<td>Other Crops</td>
<td>8</td>
</tr>
</tbody>
</table>

Source: ERS based on 2008 Farm and Ranch Irrigation Survey data
Average irrigation water applications levels for selected crops, Georgia, 2008

Source: ERS based on 2008 Farm and Ranch Irrigation Survey data
Did irrigation water use change with the growth in biofuel feedstock production?
Corn for Grain 2002 to 2007

- Corn harvested for grain peaked in 2007, when compared to 2002:
  - Planted corn acres increased by 19 million acres (about 25%);
  - Harvested corn acres increased by 17 million acres (about 25%);
  - Irrigated corn acres harvested increased by 3.4 million acres (about 35%);
  - Corn production increased by 3 billion bushels (about 33%);
  - Corn exported increased by 1 billion bushels (about 50%);
  - Corn used as an ethanol feedstock increased by 2 billion bushels (about 200%); and
  - Corn prices per bushel increased by $1.88 (about 80%).
Regional irrigated crop acreage changes from 2002 to 2007, selected crops

Source: NRCS, based on Census of Agriculture data
Change in Irrigation Water Applications, 2002-07

Percent change

Source: NRCS analysis of USGS Water Use data
Resource requirements for Biofuel production

- **Shifting** irrigated acres to biofuel production
  - Land—one for one primary shift (secondary impacts are likely as crop prices rise)
    - Nitrogen fertilizer needs.
    - Pesticide needs.
    - Erosion levels.
  - Irrigation water—depends on the specific crop shift and where it occurs
    - Soybeans to corn Northern Plains: ▲ irrigation water application
    - Potatoes to corn in Pacific: ▼ irrigation water application
Resource requirements for Biofuel production

• **Develop** new irrigated acres for biofuel production?
  - Land—irrigable acres available, but …
  - Irrigation water—location specific availability
    • Water use is controlled by State laws
    • Many States are now using a local planning process to establish management goals
    • Declines in water availability in some locations to meet environmental and water quality concerns
    • Irrigated field-crop returns relative to non-irrigated
Summary

• Short run: increased agricultural production for biofuels will not alter the national water use picture

• Longer run: Feedstocks for the next generation of biofuels could have a more significant regional and local impact
  ▪ In some cases an increase in water use
  ▪ In other cases a decrease, depending on the crops being grown now and the biofuel crops produced
  ▪ New irrigation will depend on the profitability of irrigation
    • Yield response to applied water
    • Risk considerations
    • How important is a stable feedstock supply?
Thank you!

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