Evaluating the Shadow Price of Water for Irrigation – A Case of the High Plains

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Selected Poster prepared for presentation at the Agricultural & Applied Economics Association’s

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1 Background and problem setting
- About 27% of US irrigated land depends on the Ogallala Aquifer – High Plains (HP) is a key region for livestock, corn, wheat & soy
- The Ogallala’s volume is predicted to fall by 52% between 2010 and 2060
- Irrigation makes 61% of total water use in TX, 85% in Kansas and 94% in Nebraska
- Actual water rates for irrigation do not reflect the real value of water (water is underpriced)
- Appropriate water pricing crucial for economic efficiency & natural resource conservation
- Recent research on shadow prices limited

2 Research objective
The objective is to evaluate economic value of water for irrigation in High Plains (Texas, Kansas, Nebraska) in 2010 and 2011. The main focus is on:

a) Shadow price of water on regional level ($/af)
- Shadow price of water for irrigation = ratio of total production net returns to the total amount of water used for irrigation
b) Shadow price of water in actual (drought) conditions compared to expected production conditions – example from TX HP

3 Methods and data
- Farm-budget residual valuation - inputs and outputs in the crop production process (Comparative-statics analysis)
- A profit-maximizing firm will use water up to the level where the net revenue gained from one additional unit of water is equal to the marginal cost of obtaining this water (Lange, 2006)
- Crops included in the analysis: corn, cotton, wheat, soybeans, sorghum
- Data from: National Agricultural Statistics Service (NASS), Texas Water Development Board (TWDB), Texas AgriLife Extension Agricultural Economics Station, Kansas Department of Agriculture, Kansas AgManager.info, University of Nebraska-Lincoln
- Subsidies averaged for all crops in KS ($30/ac). Subsidies not available in TX and NE
- Irrigation in Nebraska estimated based on the actual water demand due to missing data

4 Shadow price of water for irrigation

<table>
<thead>
<tr>
<th>2010</th>
<th>Crop</th>
<th>Net returns (million $)</th>
<th>Irrigation water (af)</th>
<th>Shadow price of water ($/af)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TX Northern HP</td>
<td>Corn</td>
<td>89.4</td>
<td>971,853</td>
<td>92.82</td>
</tr>
<tr>
<td></td>
<td>Cotton</td>
<td>95.8</td>
<td>110,663</td>
<td>865.99</td>
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<tr>
<td></td>
<td>Wheat</td>
<td>-52.8</td>
<td>309,361</td>
<td>-170.71</td>
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<tr>
<td></td>
<td>Soybeans</td>
<td>0.38</td>
<td>20,486</td>
<td>18.61</td>
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<tr>
<td></td>
<td>Sorghum</td>
<td>-10.3</td>
<td>61,906</td>
<td>-160.85</td>
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<tr>
<td>KS HP</td>
<td>Corn</td>
<td>1.4</td>
<td>656,335</td>
<td>5.13</td>
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<td></td>
<td>Cotton</td>
<td>81.5</td>
<td>1,253,028</td>
<td>66.10</td>
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<td>Wheat</td>
<td>-27.6</td>
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<td>Soybeans</td>
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<td>Sorghum</td>
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<tr>
<td>NE HP</td>
<td>Corn</td>
<td>103.9</td>
<td>1,339,319</td>
<td>77.64</td>
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<td>Cotton</td>
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<td>Wheat</td>
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<tr>
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<td>Sorghum</td>
<td>-12.5</td>
<td>16,372</td>
<td>-765.10</td>
</tr>
</tbody>
</table>

5 Conclusions
- Unprofitable production in 2010: wheat and sorghum in TX NHP & NE HP + wheat, soybeans and sorghum in TX SHP & KS HP
- Lowest positive net production returns: soybeans in TX NHP ($0.38/ml), cotton in KS ($1.4/ml) and corn in TX SHP ($3.4/ml)
- Lowest positive shadow price of water: corn in TX SHP ($5.13/af) and soybeans in TX NHP ($18.61/af)
- Variations in net returns and shadow price of water for irrigation regardless of the wet and dry production year (2010 and 2011) in TX
- Challenge: higher water prices for irrigation beneficial for conserving water resources; but severe economic impacts on farms’ productivity possible & higher governmental subsidies necessary
- Increase in water rates possible, but due to water scarcity (i.e. persistent drought) rather than to a politically or environmentally driven approach

6 References

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Presented at the 2014 AAEA Annual Meeting
Minneapolis, MN
July 27-29, 2014