The Future of Irrigated Agriculture in the Central and Southern High Plains

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Groundwater Use By Aquifer

(USGS, 2000)
Expansion of irrigation began after WWII.

The aquifer is very heterogeneous.

Recharge is minimal in much of the central and southern parts of the aquifer.

Is recognized as a local and regional issue.

Common pool resource.

Some areas/farmers have already stopped irrigating. Many areas have experienced great declines in well capacity.
Saturated Thickness
Background

- Additional regulations at the state level to reduce water withdrawals will be difficult.
- Rural economies are dependent upon the aquifer.
- Improvements in irrigation efficiency have not decreased groundwater withdrawals.
- Beneficial use or right to capture.
Figure 14. Saturated thickness of the High Plains aquifer, 2000. (Modified from Weeks and Guttenberg, 1981.)
Water Level Trends 1996 to 2011

Average Depth to Water, 1996 to 2011,
Kansas High Plains Aquifer

Depth in Feet

Year

Estimated Usable Lifetime for the High Plains Aquifer in Kansas (Based on ground-water trends from 2001-2003 to 2011-2013 and the minimum saturated thickness required to support well yields at 400 gpm under a scenario of 90 days of pumping with wells on 1/4 section)

Years Until the Average 2011-2013 Saturated Thickness (ST) Reaches Minimum Thresholds

- ST Already Below Minimum Threshold
- Water Table Above 2001-2003 Levels
- Under 25
- 25 - 50
- 50 - 100
- 100 - 250
- Over 250

Based on average water-level changes from 2001-2003 to 2011-2013

Extent of the Saturated Portion of the High Plains Aquifer
Ogallala Aquifer Use Versus Recharge Rate (Kansas)

2007 Estimate:
Use: 2.4 million acre feet

Recharge: 0.72 million acre feet

Source: Kansas Geological Survey
What Will Groundwater Be Worth in the Future?

Gross returns to groundwater for corn: 0.4% for 1975-1999; 9.7% for 2000-2011; 3.5% for 1975 - 2011
Options for Kansas

- Keep pumping until gone.
- Reduce withdrawal rates to extend the useful life of the aquifer.
- Increase irrigation efficiency to maintain and/or increase productivity to minimize effects.
- Go to a sustainable yield.
Recent Changes/Thoughts (for Kansas)

- All wells are metered.
- Legislative changes.
  - Repealed use it or loose it rules.
  - Waterbanks.
  - Voluntary 5-year flex plan offered.
  - Increased fines for over pumping/altering water meters.
  - New opportunity to locally, voluntarily regulate, “Local Enhanced Management Areas.”
- New technology development and implementation.
- Looking at the opportunity to transfer water (as much as 3 million acre feet annually) from the Missouri River to western Kansas.
- Kansas Governor developing 50-year vision for water.
Predictions for the Future of Ogallala Aquifer in Kansas
Corn is by far the primary irrigated crop in Kansas.
Irrigated Yields are Increasing 2.4X Faster Than Dryland and have Much Less Variability

Kansas Corn Yield Trend

Kansas Farm Facts

Irrigated Yields are Increasing 2.4X Faster Than Dryland and have Much Less Variability

Irrigated Yield Regression: $y = 2.5753x + 105.9$

Dryland Yield Regression: $y = 1.0792x + 59.315$
Estimated and Predicted Water Storage in Kansas Portion of Ogallala Aquifer

<table>
<thead>
<tr>
<th>District</th>
<th>Predevelopment Storage ($10^9$m$^3$)</th>
<th>Groundwater in Storage Through Years $10^9$m$^3$ (% of predevelopment)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1960</td>
</tr>
<tr>
<td>Northwest</td>
<td>93.1</td>
<td>90.6 (97%)</td>
</tr>
<tr>
<td>West Central</td>
<td>31.1</td>
<td>28.4 (91%)</td>
</tr>
<tr>
<td>Southwest</td>
<td>267.4</td>
<td>260.6 (97%)</td>
</tr>
<tr>
<td>Total</td>
<td>391.6</td>
<td>379.6 (97%)</td>
</tr>
</tbody>
</table>

## Impact of Water Reduction Scenarios on Estimated and Predicted Water Storage in the Kansas Portion of Ogallala Aquifer, 2110

<table>
<thead>
<tr>
<th>District</th>
<th>Groundwater in Storage With Different Water Reduction Strategies (% reduction from current use)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>Northwest</td>
<td>27%</td>
</tr>
<tr>
<td>West Central</td>
<td>12%</td>
</tr>
<tr>
<td>Southwest</td>
<td>8%</td>
</tr>
</tbody>
</table>

(% in storage compared to predevelopment)

Saturated Thickness of the High Plains Aquifer in Kansas from Early Development through Recent to Future Projections
Options for Kansas

- Keep pumping until gone.
- Reduce withdrawal rates to extend the useful life of the aquifer.
- Increase irrigation efficiency to maintain and/or increase productivity to minimize effects.
- Go to a sustainable yield.
Sustaining Rural Economies Through New Water Management Technologies

David Brauer, Dan Devlin and Terry Howell