Irrigation Efficiency in Chihuahua, Mexico

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Based on work done by Aaron Hobbs, unpublished paper “The U.S./Mexico Water Dispute: Impacts of Increased Irrigation in Chihuahua, Mexico” May 2003
U.S./Mexico Water

• Allocations of Rio Bravo/Rio Grande Under 1944 Treaty

• Mexico Water Deficit
  – 726,153 acre-feet
  – Lost LRGV Business Activity from Withheld Minimum
    Annual Inflows: $135 Million (John Robinson)

• Issues/Problems
  – Drought Conditions and Greater Water Demand
  – Low Irrigation Efficiency (40%)
  – Population & Trade Growth Along Border
  – Ground Water Depletion
Objectives

• Overview of Water Treaty Provisions

• Review Cropping Patterns in Chihuahua, MX

• Estimation of Irrigation Water Use in Chihuahua & Savings from Improved Irrigation Efficiency

• Discuss Potential Policy Options to Mitigate Impacts of Water Debt with Mexico
1944 Water Treaty

Administered by International Boundary & Water Commission (IBWC-El Paso)

Delimits Rights to International Waters of Tijuana, Colorado, and *Rio Grande (Rio Bravo)* Rivers from Fort Quitman, Texas to the Gulf of Mexico

U.S. Receives 1/3 of Total Flows or **Minimum of 350,000** Acre Feet (af)/Year from Rio Grande River Below Fort Quitman

Mexico Receives 1.5 million af/Year from the Colorado

Mexico Receives 2/3 of Rio Grande, ALL of Waters from San Juan & Alamo Rivers & Half of the Flow from Rio Grande Below Falcon Dam
1944 Water Treaty
Contingencies for Drought

• Extraordinary Drought - What is it?
  – When Mexico has Difficulty Delivering Run-off of 350,000 af/Year

• Any Deficiencies at the End of 5 Year Cycle SHALL Be Made Up in Following Cycle

• Whenever Conservation Capacities of U.S. in Two International Reservoirs Are Filled, a Cycle SHALL Be Terminated & All Debits Fully Paid
Chihuahua
Nuevo
Leon
Tamaulipas
LRGV
Rio Conchos
Coahuila
• Amistad Reservoir
• Falcon Reservoir

65% of Inflows
80% Capacity
100% Capacity

Rio Bravo del Norte
Rio Grande
Ft. Quitman
Presidio
Amistad Reservoir
LRGV
Falcon Reservoir
Rio San Juan Basin
Pecos River

Río Bravo del Norte
Chihuahua
Rio Conchos
Chihuahua
Delicias
Coahuila
Nuevo
Leon
Tamaulipas
Study Area

Francisco I. Madero Reservoir, Delicias
282,000 acre-feet capacity, 134,000 acre-feet on
July 20, 2004
Present level: 1,002,480 acre-feet (2/14/05)
Irrigated Crop Production, Chihuahua, Mexico, 1980-2003

Area (Million H. Acres) and Production (Million Metric Tons)
Irrigation Crop Acreage in Chihuahua, MX 2003

Total Acreage: 797,289

Top 5 Crops, 66.7%

- Alfalfa: 18.6%
- Corn: 19.6%
- Others: 15.3%
- Cotton: 10.9%
- Pecans: 8.1%

Estimates: CNAS; Total of 27 crops included in study.
Penman-Monteith Irrigation Water Use Example

• Alfalfa ETo: 56.45 inches
• Crop Coefficient: 0.8833
• Seasonal ETo: 56.45 * 0.8833 = 49.86
• Annual Rainfall: 13.78 inches
• Estimated Irrigation Water Use:
  49.86 – 13.78 = 36.08 acre-inches
• Estimated Irrigation Water Use in Acre-Feet for Year: 36.08 / 12 = 3.01 acre-feet
Irrigation Water Use in Chihuahua, MX

Million Acre-Feet

Author's Estimates, CNAS
Estimated Irrigated Water Use in Chihuahua, MX 2003 (1,000 acre foot)

- Alfalfa 1116
- Corn 612
- Apples 404
- Pecans 360
- Veg/Melons 337
- Cotton 333
- Wheat 83
- Others 386

Estimates: CNAS; Total of 27 crops included in study.
### Apparent Irrigation Efficiency

- Delicias Irrigation District

<table>
<thead>
<tr>
<th>Crop</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Alfalfa</td>
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<tr>
<td>Pecans</td>
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<td>Peanuts</td>
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<tr>
<td>Corn</td>
<td>32</td>
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<tr>
<td>Wheat</td>
<td>58</td>
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</tbody>
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**Furrow & Flood Irrigation Dominant, Some Center Pivot, Sprinkler Systems in Use**
What is Value of Chihuahua Irrigation Water?

• $424/acre-foot ($652/ac in LRGV)
  – Total Value of Irrigated Production/Total Water Used Net of Rainfall

• Improving Irrigation Efficiency from 40 to 60% in Chihuahua
  – Saves 1.1 million acre-feet/year
  – Valued at $472 million/year
Policy Options

• Retaliatory Duties on Mexican Agricultural Products
• Direct Compensation for Texas Producers
• Divert Flows from Colorado River
• Construct New Water Delivery System
• Improve Existing Water Delivery Systems & Adopt More Efficient Irrigation Technology in U.S. and Mexico
Conclusions

- Irrigation Water Use Has Increased
- Switch from Surface Water to Aquifer
- Switch to More Water Intensive Crops & Higher Yields
- Antiquated Institutional Framework?
- *Extraordinary Drought* Needs Rigorous Definition
- Stakeholder Input Crucial to Future
- Environmental Consequences of Population & Trade Growth Are Important