Tools for Transboundary Water Resources Management

- Database Development
- Basin Modeling
  - Modeling Management Scenarios
- Information Sources
- Participant’s Experience in Transboundary Information and Modeling

Daene C. McKinney, University of Texas at Austin
Acknowledgement: Samuel Sandoval-Solis and Rebecca L. Teasley, UT Austin

Physical Assessment of Transboundary Basins

- Develop Basin-Wide, Multi-National Tools
  - Database
  - Model to Evaluate Scenarios
- Develop Scenarios
  - Stakeholder Driven
  - Improved Water Management Opportunities
- Evaluate Scenarios
  - Physical Feasibility
  - Economic and Institutional Feasibility
- Generate Recommendations
  - Water Management Improvement Options
Physical Assessment Project

Examine opportunities to improve water management in Rio Bravo basin

Construct model to simulate Rio Bravo Basin and evaluate effects of alternative policies (“Scenarios”)

Define scenarios by interviews with: stakeholders from both sides of the Border

Bi-National Collaboration

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Mexico</th>
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<tbody>
<tr>
<td>University of Texas at Austin</td>
<td>Instituto Tecnológico y de Estudios Superiores de Monterrey</td>
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<tr>
<td>University of Arizona</td>
<td>Universidad Autónoma de Ciudad Juárez</td>
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Environmental NGO

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<tr>
<th>Natural Heritage Institute</th>
<th>US Geological Survey</th>
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Governmental Research

| WWF World Wildlife Fund | Instituto Mexicano de Tecnología del Agua |

Scenarios for Improved Water Management

Scenario Development

• Developed through extensive consultations with stakeholders from both sides of the border
• Evaluating physical feasibility of scenarios using model
• Survivors analyzed for economic, legal and institutional feasibility

Stakeholder Groups (MX & US)

Water Users

Irrigators
Municipalities
Environmental groups

Government Representatives

Mex: CNA, DLA, SEMARNAT
US: DOD, EPA, USDA, DOI, FWS, FOS

Planners & Policy Makers
Scientists and Experts
Scenarios for Improved Water Management

Stakeholder Suggested Improvements

- Objectives
  - Increase Whole System Benefits
  - Improve Ag. Supply Reliability
  - Increase Muni. Water Supply
  - Restore Environmental Flows

- Methods
  - Water Right Buybacks & Transfers
  - Groundwater Banking & Conjunctive Management
  - Non-treaty Tributary Flows
  - Water Conservation & Reuse
  - Facility Reconfiguration & Reoperation
  - Brackish Water Desalination

Scenario Analysis

- Which scenarios are physically feasible?
- How do scenarios improve the water management in basin?

Existing Policies:
- PADUA: Water Rights Buy-Back
- Minute 309: Improvement in Infrastructure

Proposed Policies:
- GW Bank: Change in water allocation policy
- Environmental Flows: Hydrological Feasibility
- Etc.

Database of the Rio Grande/Bravo Basin
Scenario Analysis

- Performance Criteria
  - Reliability – How often does system satisfy users
  - Resilience – How fast to recover from failure
  - Vulnerability – How bad is a failure
- Criteria used to measure scenario performance for different users
  - Whole Basin
  - Treaty
  - United States
  - Mexico
  - Irrigation Districts
  - Environment

Scenario: Water Rights Buyback
Scenario: Water Rights Buyback

DR-005 Delicias

Treaty Obligations

WMS 8-13

DR-025 Bajo Rio Bravo

Baseline Run
Scenario I.A

Scenario: Groundwater Banking

Surface Water Source

Groundwater Source

Surface Water Source

Groundwater Source

(A) Sufficient Surface Water Supply

(B) Surface Water Supply Shortage

Scenario I.B
Scenario: Water Conservation - Minute 309

Water Conservation Measures implemented in the Rio Conchos Basin

Increase Global Efficiency of DR-005 Delicias from 33% to 55%

<table>
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<th>Item</th>
<th>Conveyance Efficiency (%)</th>
<th>Aplication Efficiency (%)</th>
<th>Global Efficiency (%)</th>
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<tbody>
<tr>
<td>Old system</td>
<td>61</td>
<td>54</td>
<td>33</td>
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<tr>
<td>New system</td>
<td>69</td>
<td>80</td>
<td>55</td>
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</table>
Scenario: Environmental Flows in Conchos Basin

- Building Block Method to Determine Environmental Flows

- Enough dam storage to supply water users?
  - Yes: deliver normal year environmental flows
  - No: deliver dry years environmental flows

Rio Conchos Basin

Env Flow Location ('07)
Env Flow Location ('08)
Summary

- **Water Rights Buyback**
  - Increased local benefits, no decrease in global benefits, or treaty deliveries

- **Groundwater Banking**
  - Improved basin water supply, and no decrease treaty deliveries
  - Water Conservation & Saved Water Delivered to Treaty
  - Improved treaty deliveries, and decreased benefits for DR-005

- **Environmental Flows in Conchos Basin**
  - Unsustainable under current conditions
  - Increase in treaty deliveries and smaller treaty deficits
  - Decrease in benefits to DR-005 Delicias
**Water Quality Modeling**

- Create a Water Quality model in WEAP using Geodatabase
- Simulate main WQ parameters
  - BOD, DO, TSS, TDS, Temperature
- Simulate impacts of wastewater from demand sites and treatment plants
- Explore WEAP – QUAL2K linkage

**Main River Segments in GIS Rio Bravo Basin**

**Sources:**
- Geodatabase, CRWR Water Management Project, IBWC, TCEQ, CNA, IMTA

**Main data:**
- Cross sections, Measured data: BOD, DO, TSS, TDS, Temperature, Wastewater treatment plants, Other discharges

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**Water Quality Data**

- **Sources:**
  - Geodatabase, CRWR Water Management Project, IBWC, TCEQ, CNA, IMTA
- **Main data:**
  - Cross sections, Measured data: BOD, DO, TSS, TDS, Temperature, Wastewater treatment plants, Other discharges

- Monthly variation of DO in the headwaters of the river
- Variation of BOD below the La Amistad Dam
- Changes in water temperature downstream of Falcon Dam

Water quality model for the reach from Falcon Dam to the Gulf of Mexico
Water Quality Model Results

- Calibration of the model from Falcon Dam to Gulf of Mexico
- Model reproduces the dynamics of water quality constituents
- Comparisons made with measured data, average error < 10%

![Water quality stations used in the calibration](image)

Effects of Climate Change on Treaty

- Model the hydrological behavior of the Rio Conchos basin (rainfall – runoff)
- Simulate climate change scenarios
- Assess climate change impacts on water resources in basin and effect on 1944 Treaty
- What will happen with the available water resources in the next 100 years taking into account climate change impacts in the basin?
- What will happen with US – Mexican agreements?
- What water policies may need to be implemented in order to face drought periods?
Rio Conchos Hydrologic Model

- Hydrologic model
  - calibrated for 20 years (1980-2000)
- La Boquilla:
  - Monthly error < 10%
  - Annual error < 6%
- Ojinaga:
  - Monthly error < 7.5%
  - Annual < 3.2%

- Results indicate a strong agreement between observed and simulated flows

Methodological Diagram
Materials

- [www.crew.utexas.edu/riogrande.shtml](http://www.crew.utexas.edu/riogrande.shtml)
- [arcims.crew.utexas.edu/website/riogrande/](http://arcims.crew.utexas.edu/website/riogrande/)
- [http://www.crew.utexas.edu/reports/2006/rpt06-B.shtml](http://www.crew.utexas.edu/reports/2006/rpt06-B.shtml)