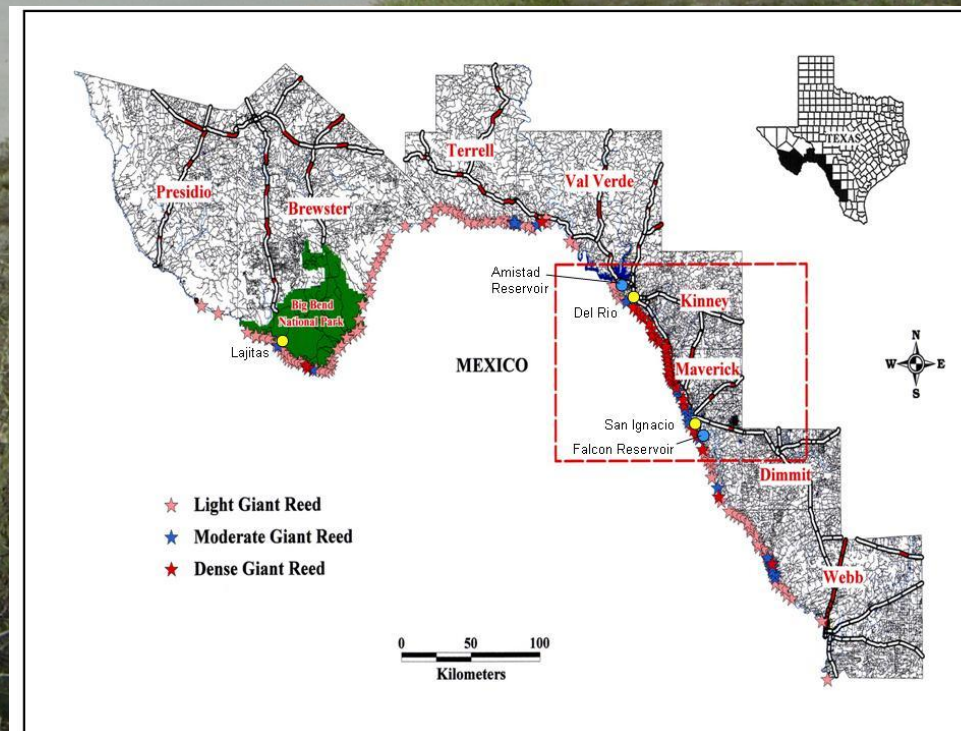
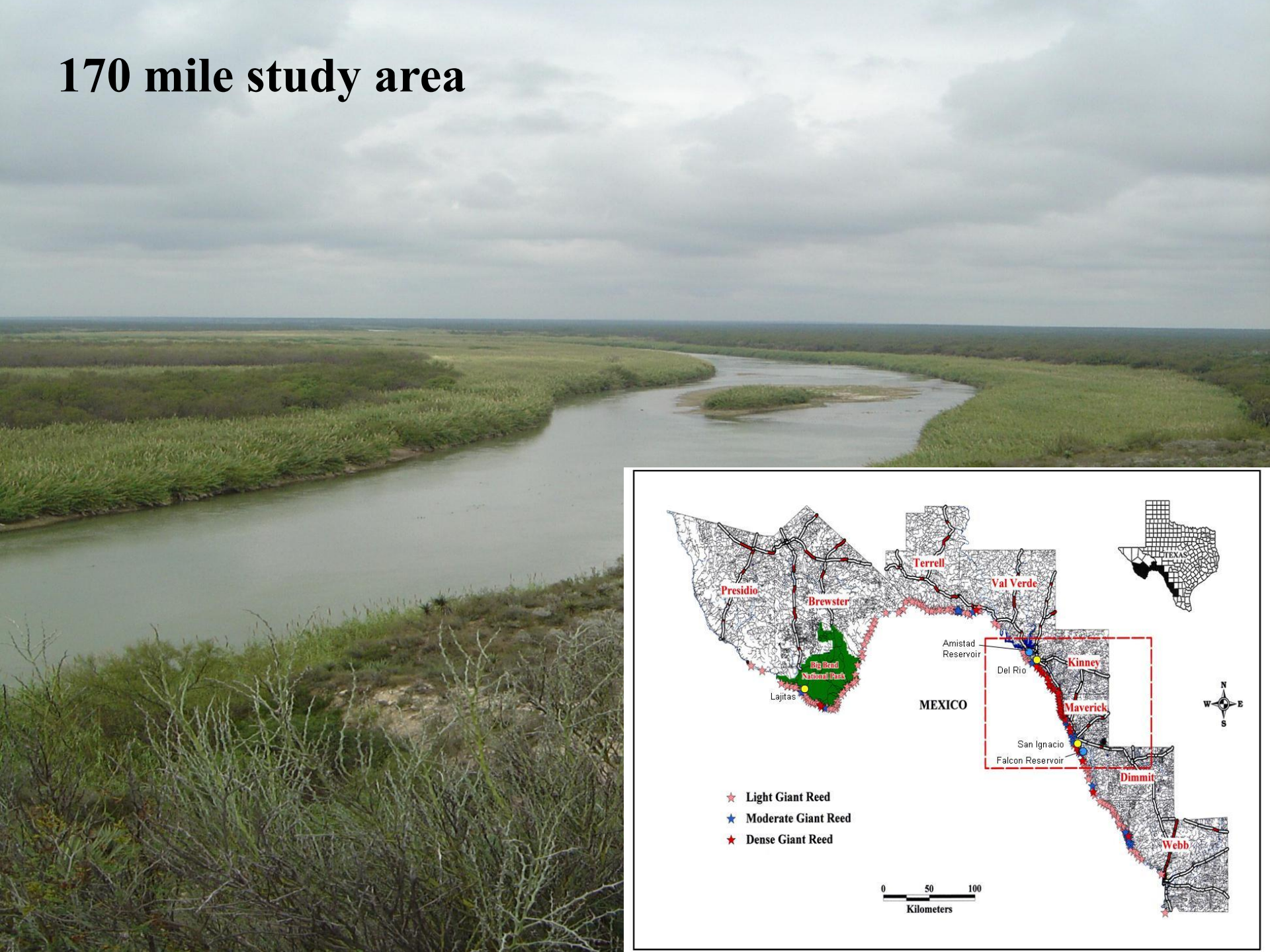


Benefit-Cost, Per-Unit Cost, and Impact Analysis of Potential Water Saved from the Biological Control of *Arundo donax* along the Rio Grande [River]

Emily K. Seawright, M. Edward Rister, Ronald D. Lacewell,
Dean A. McCorkle, Allen W. Sturdivant, John A. Goolsby, and
Chenghai Yang

June 5, 2010

170 mile study area





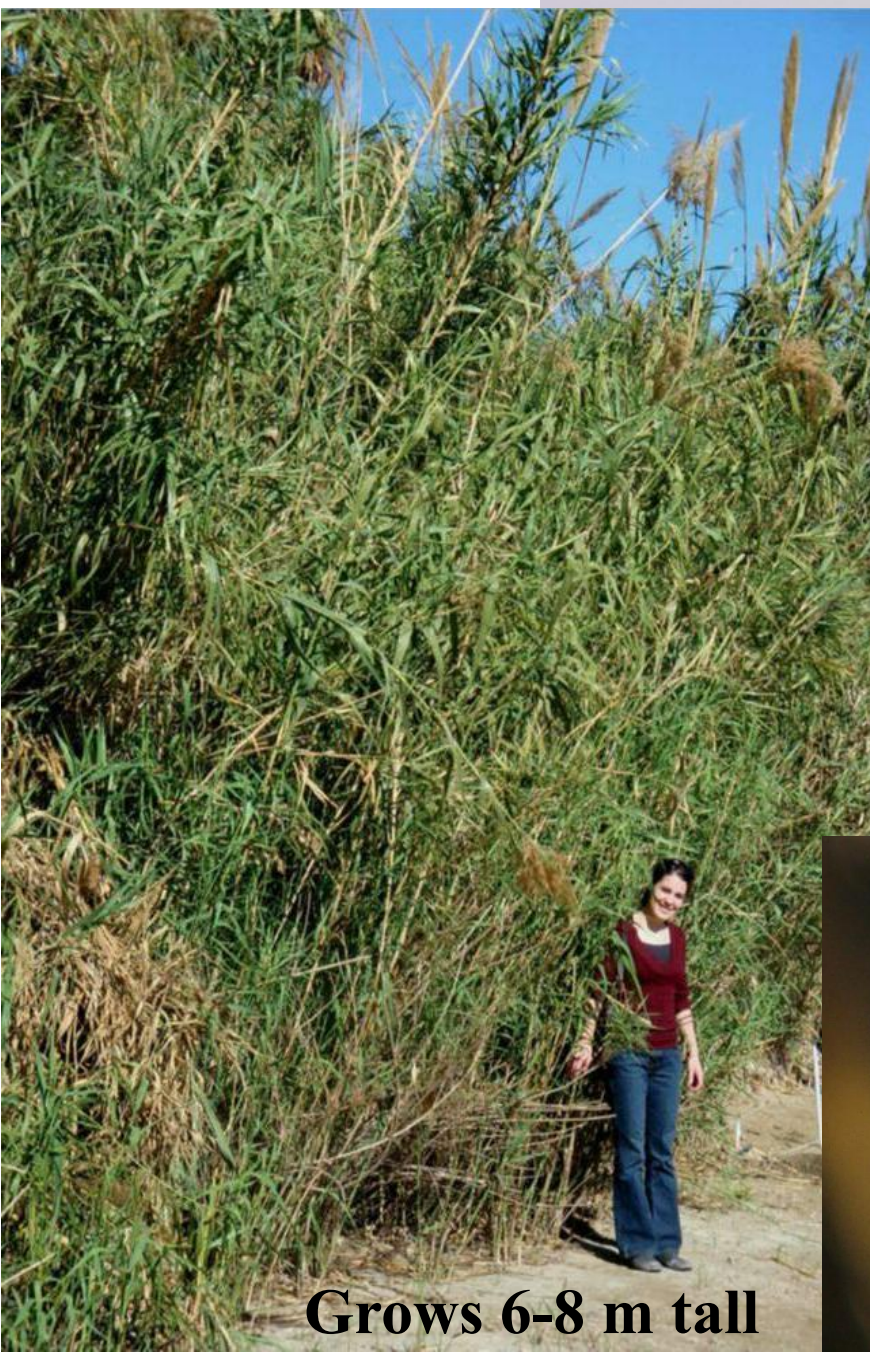
Data

Arundo donax Infestation

- Focusing on Rio Grande River Basin
- 15,715 acres in 2002 (Goolsby)
- 18,072 acres in 2008 (Goolsby)
- Assume Growth
 - 2.36% per year
 - Meets 15% growth between 2002 and 2008

Water

- 4.37 acre-feet per acre annually



Grows 6-8 m tall



4 Bio Control Insects

- wasp*
- fly
- scale*
- leafminer

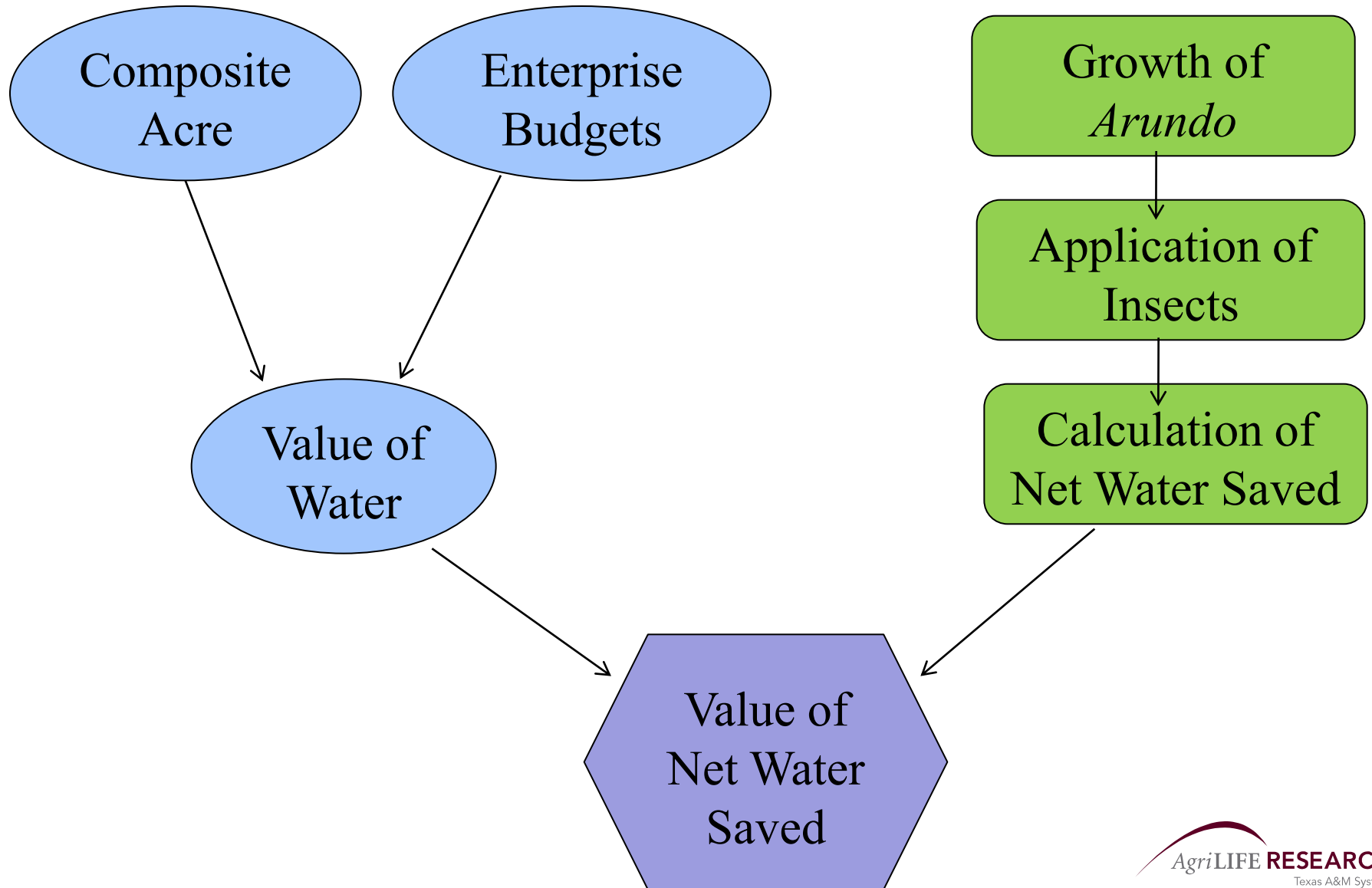




Objective

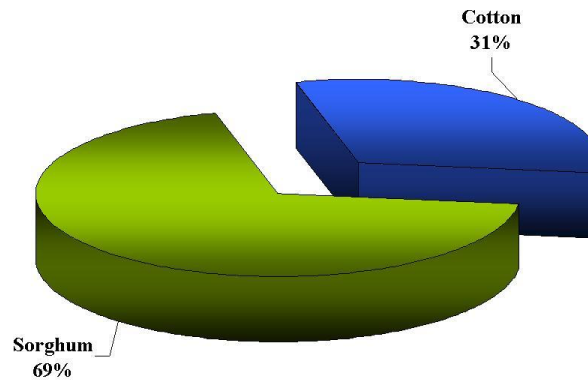
- Scope of research area
 - Texas Lower Rio Grande Valley to Amistad Reservoir
- Determine direct economic impact (value to irrigation) of water saved from biological control of *Arundo donax*
- Perform benefit-cost analysis of the project
- Determine per-unit cost of water saved
- Conduct sensitivity analyses
- Formulate impact analysis and implications of saved water to economy

Objective-Model Overview

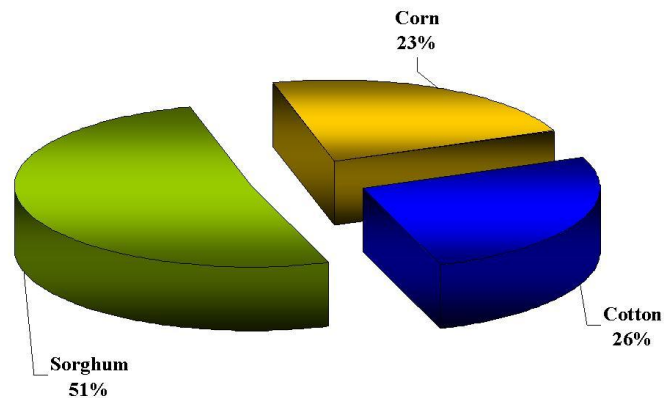


Composite Acre

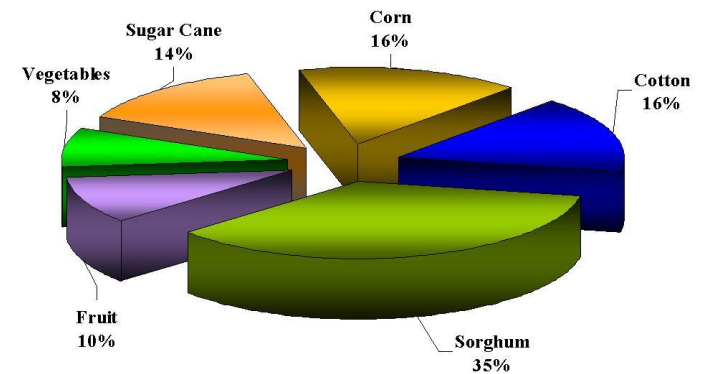
Dryland Composite Crop Acre



Low-Marginal-Value Irrigated Composite Crop Acre



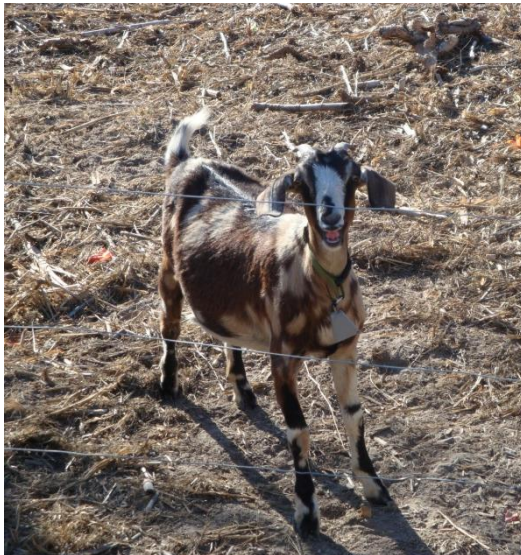
High-Marginal-Value Irrigated Composite Crop Acre



Returns to Water per Acre-Foot

Returns to Water per Acre-Foot for Irrigated Crop Composite Acres for the Texas Lower Rio Grande Valley

| | Value of Water (Market) | Value of Water (Normalized) |
|------------------|----------------------------|--------------------------------|
| Irrigated (Low) | \$ 187.98 | \$ 139.22 |
| Irrigated (High) | \$ 307.29 | \$ 279.99 |

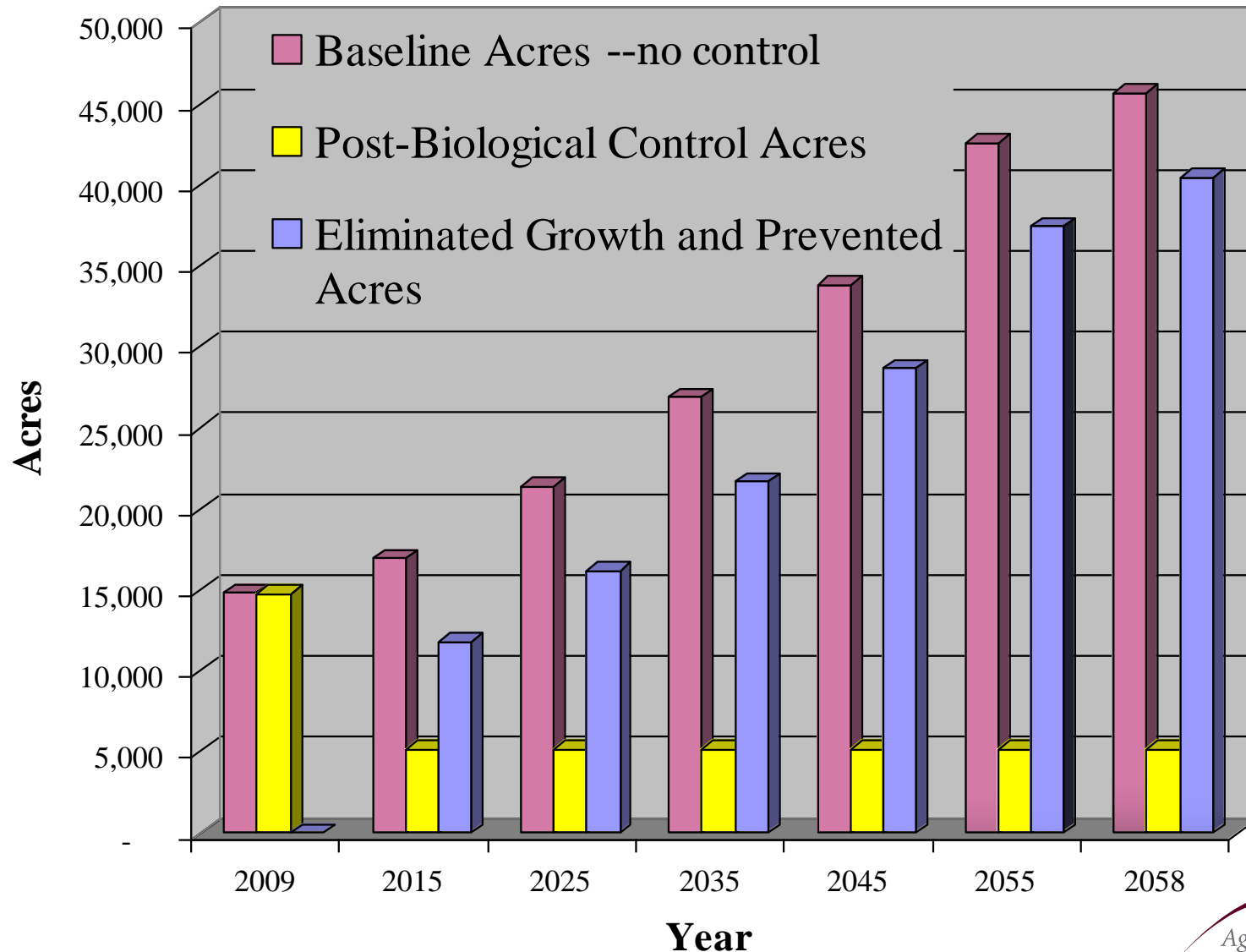


Control Applied

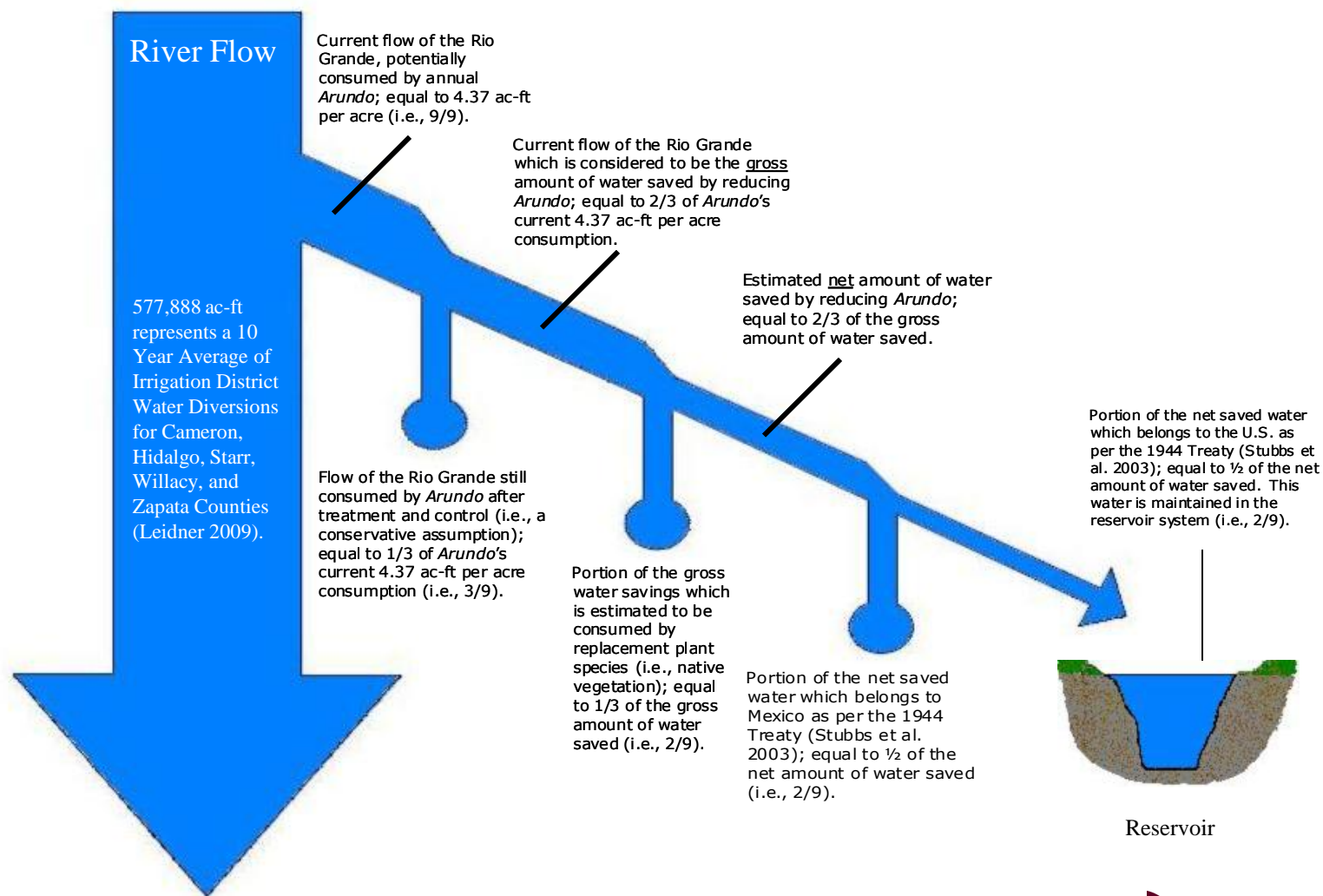
- 67% control in 2 years on miles treated
 - 45% control of area treated in first year
 - 22% control of area treated in subsequent year
- Once treated, acreage controlled assumed constant



Projected Acreage of *Arundo* , with and without the USDA-ARS, Weslaco, Texas Biological Control Program



Water Use in the Rio Grande



Results: Water Saved and Value

Annual Water Saved and Present Value of Water Saved on Low- and High-Marginal Value Crops, Texas Lower Rio Grande Valley, 2009

| Year | Acre-Feet of Water Saved due to Insects | Returns to Water Low-Value ^a (\$ Million) | Returns to Water High-Value ^b (\$ Million) |
|------|---|--|---|
| 2009 | 59 | \$0.011 | \$0.018 |
| 2015 | 17,173 | \$3.2 | \$5.3 |
| 2025 | 23,567 | \$4.4 | \$7.2 |
| 2035 | 31,615 | \$5.9 | \$9.7 |
| 2045 | 41,744 | \$7.8 | \$12.8 |
| 2055 | 54,492 | \$10.2 | \$16.7 |
| 2058 | 58,924 | \$11.1 | \$18.1 |

Present Value^c

\$97.8

\$159.9

^a Low marginal value composite crop acre returns to water (cotton, corn, and sorghum) value of \$188.

^b High Marginal Value composite crop acre returns to water (cotton, corn, sorghum, fruits, vegetables, sugarcane) value of \$307.

^c Present Value is discounted over 50 years (i.e., 2009 through 2058) at a discount rate of 6.125%.

Benefit-Cost Results

Expected Benefit-Cost Implications and Economic Cost of Water Saved for the USDA-ARS, Weslaco, Texas *Arundo donax* Biological Control Program between San Ignacio and Del Rio, Texas 2009.^a

| Result Item | Social Benefits (Using Normalized Prices) | | Costs |
|---|--|----------------------------------|---------------|
| | Low Value of Water ^a | High Value of Water ^b | |
| Present Value Over 50 Years (\$ Million) | \$72.4 | \$145.7 | \$16.5 |
| Annualized Benefits (\$ Million) | \$4.7 | \$9.4 | --- |
| Benefit-Cost Ratio | 4.38 | 8.81 | --- |

Annuity Equivalent-- Economic Cost of Water Saved (\$/ac-ft)

\$44.08

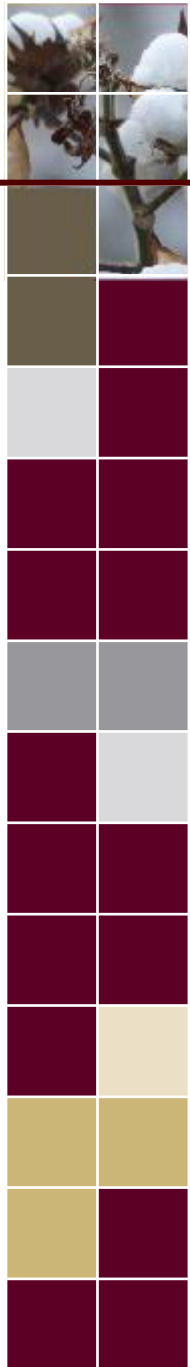
^a. Low Value of Water refers to the low marginal returns for water calculated using the composite acre for low value crops (i.e., corn, cotton, sorghum), a value of \$139.22 per acre-foot. The values calculated with the low value of water represent the lower bound of the social benefits to be realized over the 50-year planning horizon.

^b. High Value of Water refers to the high marginal returns for water calculated using the composite acre for high value crops (i.e., fruits, vegetables, sugar cane, corn, cotton, sorghum), a value of \$279.99 per acre-foot. The values calculated with the high value of water represent the upper bound of the social benefits to be realized over the 50-year planning horizon.

Sensitivity Analysis-Low

Sensitivity Analyses Summary, Benefit-Cost Ratios of Benefits Varying *Arundo* Water Use with Listed Variables for Low-Marginal-Crops in the Texas Lower Rio Grande Valley, 2009

| Variable | Annual Water Consumption of <i>Arundo</i> (acre-feet) | | | | |
|---|---|------|------|------|-------|
| | Variations | 2.00 | 3.00 | 4.37 | 7.00 |
| Efficacy of Insects | 40.00% | 1.56 | 2.34 | 3.41 | 5.47 |
| | 67.00% | 2.00 | 3.01 | 4.38 | 7.02 |
| | 80.00% | 2.22 | 3.33 | 4.85 | 7.76 |
| <i>Arundo</i> Acreage Expansion (post control) | 0.00% | 2.00 | 3.01 | 4.38 | 7.02 |
| | 1.50% | 2.00 | 3.00 | 4.36 | 6.99 |
| Native Vegetation Water Use | 20.00% | 2.41 | 3.61 | 5.26 | 8.42 |
| | 33.33% | 2.00 | 3.01 | 4.38 | 7.02 |
| | 50.00% | 1.50 | 2.26 | 3.28 | 5.26 |
| Value of Water | \$50.00 | 0.72 | 1.08 | 1.57 | 2.52 |
| | \$139.99 | 2.00 | 3.01 | 4.38 | 7.02 |
| | \$200.00 | 3.24 | 4.86 | 7.08 | 11.34 |
| Costs of Program (NPV=\$16.5 million) | -30.00% | 2.86 | 4.30 | 6.26 | 10.02 |
| | 0.00% | 2.00 | 3.01 | 4.38 | 7.02 |
| | 30.00% | 1.54 | 2.31 | 3.37 | 5.40 |



Impact Analysis

- IMPLAN model
 - Multipliers for increased economic activity on a county level up to the state and national level
- Estimate change in gross returns by year
- Calculation of Impact for Texas Lower Rio Grande Valley Region
 - Economic output
 - Value added
 - Employment

➤ Up to the farm-gate



Change in Acres and Gross Revenues

2007 Current Condition -- all crops being considered

| Crop | Irrigated or Dryland | Acres (00-07 avg) | Gross Revenue/Acre (07 crop budgets) | Total Gross Revenue |
|-----------------|----------------------|----------------------|---|-----------------------|
| Corn | Irrigated | 47,300 | \$ 325 | \$ 15,372,500 |
| Cotton | Irrigated | 52,213 | \$ 531 | \$ 27,743,697 |
| Sorghum | Irrigated | ↓ | ↓ | ↓ |
| Cotton | Dryland | ↓ | ↓ | ↓ |
| Sorghum | Dryland | ↓ | ↓ | ↓ |
| Total | | 701,411 | \$ 499.90 | \$ 350,633,672 |
| Irrigated Acres | | 301,261 | Irr. GR | \$ 282,287,578 |
| Dryland Acres | | 400,150 | Dry. GR | \$ 68,346,093 |

Converted Acres, assuming converted to low value crops

| 2009 Total | Converted Acres | 108 |
|------------|----------------------|------|
| Crop | Irrigated or Dryland | |
| Corn | Irrigated | 25 |
| Cotton | Irrigated | 28 |
| Sorghum | Irrigated | 55 |
| Cotton | Dryland | (33) |
| Sorghum | Dryland | (75) |

NEW ACREAGES AND REVENUES USING LOW VALUE CROPS

| 2009 | | | | |
|-----------------|----------------------|----------------|--------------------|-----------------------|
| Crop | Irrigated or Dryland | Acres | Gross Revenue/Acre | Total Gross Revenue |
| Corn | Irrigated | 47,325 | \$ 325 | \$ 15,380,659 |
| Cotton | Irrigated | 52,240 | \$ 531 | \$ 27,758,422 |
| Sorghum | Irrigated | ↓ | ↓ | ↓ |
| Cotton | Dryland | ↓ | ↓ | ↓ |
| Sorghum | Dryland | ↓ | ↓ | ↓ |
| Total | | 701,411 | \$ 499.92 | \$ 350,649,484 |
| | | | Change in GR | \$ 15,812 |
| Irrigated Acres | | 301,368 | Irr. GR | \$ 282,321,763 |
| Dryland Acres | | 400,042 | Dry. GR | \$ 68,327,721 |

Counties

Cameron
Hidalgo
Starr
Willacy

Impact for the Rio Grande Valley

2009-First Year

- **0-1 jobs** are associated with the biological control program;
- Projected increase in **value-added** ranges between **\$11,000-\$29,000**;
- Projected increases in economic output ranges from **\$22,000-\$45,000**.



Future Impact for the Valley

- Employment, value-added, and economic output continue to increase in association with the benefits from the biological control program
- Rough estimates for employment range from
 - 254-471 jobs 25 years into the future and
 - 492-878 jobs 50 years into the future;
- Rough increases for value-added range from
 - \$5.9-\$15.8 million 25 years into the future
 - \$11.1-\$29.5 million 50 years into the future;
- Rough increases for economic output range from
 - \$11.9-\$24.1 million 25 years into the future
 - \$22.3-\$44.9 million 50 years into the future.



Recognizing the structure of the economy is constant in the model



Implications

Biological control of *Arundo* appears economic

- Life-Cycle Costs comparable to other water conservation methods in the Valley (e.g., lining irrigation canals)
- Positive Benefit-Cost Ratios
- Sensitivity Analyses performed with positive outcomes
- Positive Economic Impacts to the Texas Lower Rio Grande Valley

Questions

