Markets for Ecosystem Services: Water Leasing Applications

December 10th 2008
ACES, Naples FL

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What are Markets and Ecosystem Services?

“A market is the collection of buyers and sellers that, through their actual or potential interactions, determine the price of a product or set of products.”

Pindyck & Rubinfeld
Microeconomics 6th edition pg. 7

“Ecosystem Services are components of nature, directly enjoyed, consumed, or used to yield human well-being”

Boyd & Banzhaf
RFF Jan 2006 pg. 8
Water Rights Markets
- Permanent transfer of a water right between two users
  - Owens Valley and Los Angeles, CA

Water Leasing Markets
- Temporary transfer of a water right between two users
  - Snake River Rental Pool, ID
  - Arkansas River Basin, CO

“can be an attractive option for both parties because it maintains continuity, preserves ownership by the holder of the right for future use, and accommodates an intermediate use.”

Shupe et al. 1989
Critical Issue: Natural Resource Markets Require all Components to Function properly Including Ecosystem Services

Market Model
(e.g. Double Oral Auction)

Behavioral / Institutional Model
(e.g. Urban / Industrial / Ecosystem Demand / Property Rights / 3rd Party Effects)

Engineering Model
(e.g. Water Distribution System / Gage Points / Storage)

Physical Science Models
(e.g. GW and SW / Veg. / Avian/ Riparian / Wildlife)

Bids and Offers

Price

Demand

Supply

Addition

Extraction
## Development of a Prototype Water Leasing Model

<table>
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<tr>
<th>Stage</th>
<th>Description</th>
<th>General Results</th>
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| 1     | **Stylized Proof of Concept**  
(Completed 2005) | - Efficient prices (convergence to expected price) |
| 2     | **Enhanced Farming Decisions**  
(Completed 2006) | - Economic welfare gains from reallocating water |
| 3     | **Futures and Climatic Uncertainty**  
(Completed 2008) | - Endogenous Market Equilibrium  
(expected price is derived from participant crop choices) |
| 4     | **Third Party Effects**  
(Completed 2008) | - Hedging and Opportunity (inter-temporal trading and managing risk) |
| 5     | **Café Style – Real Time Market in the Upper Mimbres Basin**  
(Experiments Conducted 2008) | - Minimal 3rd Party Effects  
- Understanding “Stacking” pre and post call incentives (change in current institutional rules) |
Experimental Economics

- Movement began in the 1940’s and 1950’s using laboratory methods to predict:
  - Neoclassical price theory
  - Non-cooperative game theory
  - Individual decision making

- Induce demand and cost structure and test these induced values to the observed outcomes
  - Saliency (realistic to participants)
  - Parallelism (replicates the true decision making process)
General Results of a Prototype Market

- **Price Efficiency**
  - Weighted average price paths for three decreasing climatic scenarios
  - Expectation is that the treatments weighted average prices will convergence in the second and third growing season

- **Welfare Gains**
  - Total market income gains / losses
  - Gains / losses realized from market participation

- **Water Movement**
  - First trading month of the third growing season for a dry climatic scenario
  - Net effect change from the initial allocations to all users per reach
Moving Towards More Robust Natural Resource Markets

- Two methods of including Ecosystem Services:
  1. Design the market to include ecosystem goals as constraints. (Physical – No Behavioral Component)
  2. Allocate water rights to ecosystem trustees and allow them to participate in market transactions
     - Public Trust for a Public Good (e.g. Nature Conservancy Plus)
     - Trustee has the same role as a municipal use

- Need Ecosystem Values
  - How do we obtain Ecosystem Values?
How to Inform the Valuation Process with Science?

Characterization of An Ecosystem
1. Components
2. Processes
3. Outputs

Develop Scenarios Anthropogenic Climatic

Survey (Education)

Ecosystem Valuation Component (Attributes)
1. Surface Water
2. Veg.
3. Cost

Ecosystem Services Demand Curves

DSS (current conditions)

Changes Hydrology Component

Changes Riparian Component

Changes Avian Component

Feedback??
Science Plays a Critical Role in Designing and Driving Non-Market Values

- (e.g. robust coupling of GW and SW models)
- (e.g. veg. / avian / riparian / wildlife)
  - Informs valuation process; values are only as good as the science
  - Entered as a behavioral relationship into the market

Integrate Non-Market Values into Natural Resource Markets

- Ecosystem Services
- Traditional Uses
Thank You