Farmer Participation in Water Quality Trading Programs

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State of Water Quality in the U.S.

- 48% Assessed Rivers and Streams Impaired
- 60% Assessed Lakes, Reservoirs and Ponds Impaired
- 61% Assessed Estuaries Threatened or Impaired

(Selman et al 2009)

Result: Demand for Pollution Reductions to Waterways

Credit Trading at Work

- Point Sources Have High Marginal Abatement Costs
  - *Technology and Infrastructure Costly*
- Non-Point Sources Have Lower Marginal Abatement Costs
  - *Farmer Implements BMP that Generates Abatement Credit*
- Trading allows Point Sources to "Outsource" Compliance
  - *Point Sources Purchase Credits to Meet Regulatory Requirements*
- Potential for Overall Costs of Abatement to be Lower
  - *$140-235 million annually (Newburn &Woodward 2012; USEPA 2001)*

Experience To Date

PS-NPS Programs *(Ribaudo & Gottlieb 2011; Morgan & Wolverton 2008)*

- Number: 15
- Nutrient Types: P (8), N (1), Both (5), Sediment (1)
- Trades: # (1, 4, 400, 4) in Four Programs
- Success? Cost Savings Have Been Achieved….

Challenges

- Institutional Framework ← Obstacle
- Demand Side Regulatory Drivers
- Supply Side Credit Generation

} Significant Problems

WQT Necessary Conditions

- Identify Credit and Regulatory Relaxation Equivalency
- Credible Credit Certification and Duration Process
- Clearly Defined Units of Trade
- Determination of a Baseline (Quantification of Credits)
- Compliance, Monitoring and Enforcement Provisions
- Address Uncertainty (Trading Ratios)
- Public Participation and Support

(Hahn & Richards 2011; Selman et al 2009; King & Kuch 2003)

Credit Supply Challenges

- Conservation Effectiveness Dependent on

  (1) Site-Specifics, (2) Implementation, (3) Maintenance

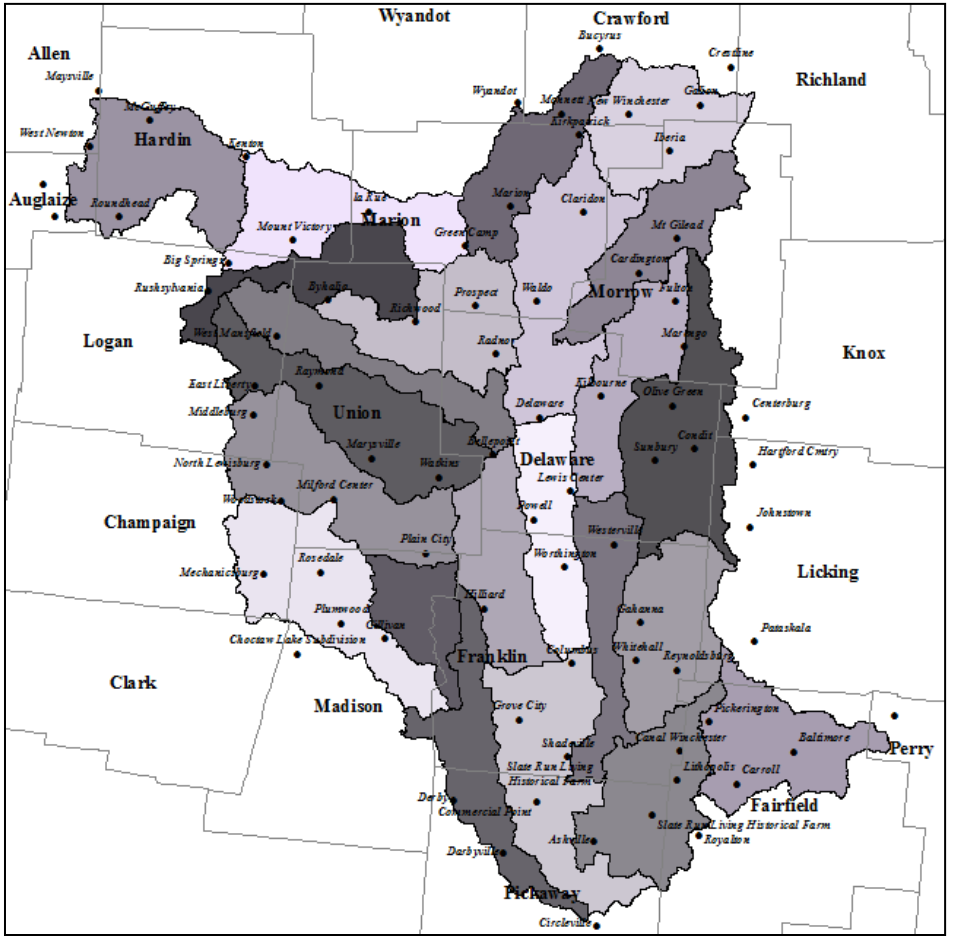
  → Leads to Offset and Financial Uncertainty
- High Transactions Costs to Finding Trade Partners
- Additional Farm Inspection/Scrutiny (Loss of Autonomy)
- Admission of Pollution (Negative Publicity)
- Not Compelled Now, But Future Regulation?
- Competition from Other Subsidies *(Ribaudo & Gottlieb 2011)*
- Mistrust of Regulators and Urban Entities *(Breetz et al 2005)*

Our Contribution

- Ex-Ante Supply Side Examination of Credit Generation
- Establish Preferences Over Major WQT Attributes
  - Role of Financial Certainty
  - Role of Administrator
  - Role of Buyer
  - Role of Contract Length
  - Conservation Practices
  - Farmer Payment Needs
- What WQT Program Would Maximize Enrollment

Upper Scioto Watershed *(USEPA 2006)*

- Total Waterways: 3,064 (mi)
  - 31% Impaired
  - 32% Unassessed
- Contaminated: 5,401 (mi)
  - 41% from NPS
  - 14% from PS
  - 17% from Development
- 300+ Point Sources
- 80% of Watershed in Crops
- 8% Developed Land
- TMDL Implementation



Survey: Administration

Administration

- Sampled 2000 Producers (18 years +)
- Obtained from USDA-NASS
- Mail Survey Design (Zip Code Based)
- 735 Responses (36.75% Response Rate)
- 343 Useable Responses

Experimental Design

- Fractional-Factorial, Generic Attribute
- 145 Choice Scenarios

Survey: Characteristics

- Gender: 96% Male
- Education: 97% High School +
- Average Age: 59 Years
- Average Income: $90,000
- Average Acreage: 567 in Upper Scioto Watershed

Crop	Total Acres (2011)	Conventional Tillage	Conservation Tillage	No-Till	Average Yield (bshl/acre)
Corn	214	15	107	90	160
Soybean	301	7	55	228	53
Wheat	36	½	11	30	63

Survey: Experimental Design

Attribute	Levels
Conservation Measure	Cover Crop Nutrient Management Plan Conservation Tillage Filter Strips None
Contract Length	5 years 10 years 15 years None
Payment	$50 per acre per year $100 per acre per year $150 per acre per year None
Administrator	Government Agency Private Agency None
Buyer	Within the county (Local) Outside of the county (Non-Local) None

Survey: Choice Scenario

Program Features	Program A	Program B
How long is the **contract length**?	15 years	10 years
Who is the **program administrator**?	Government agency	Private agency
Who is the **buyer**?	Buyer from within county	Buyer from outside county
Which **conservation practice** should I adopt?	Filter Strips 	Conservation Tillage 
How much is the **payment**?	$ 150 per acre per year	$ 50 per acre per year
I would choose	Program A ☐	Program B: ☐
I would not choose either program ☐		

Random Utility Model

$$U_{ij} = \beta_0 + x_{ij}\ \beta_l + (M_i + p_{ij}\ )\ \beta_M + \varepsilon_{ij}$$

- i indexes individual respondent
- j indexes alternative
- l indexes attribute
- x denotes attribute value
- M denotes individual respondent income
- p denotes payment

Mixed Logit Estimates

Variable		Estimate	T-Statistic
Payment		0.01**	8.26
Contract Length (Mean)		-0.16**	-6.46
Contract Length (St. Dev)		0.26**	10.35
Conservation Measure	Cover Crop	-0.21	-1.00
	Nutrient Management Plan	-0.37**	-2.20
	Conservation Tillage	0.72**	4.32
	Filter Strips	-0.81**	-5.23
Administrator	Government Entity	0.25	1.57
	Private Entity	0.03	0.22
Buyer	Within County (Local)	-0.02	-0.13
	Outside County (Nonlocal)	0.28**	2.05
ASC		-0.15	-1.18
N		**1169**	
Adjusted R^2		**.28**	
Log-Likelihood		**-1022.24**	

Conclusions

- Participation Increases with:
  - Size of Payment
  - Non-local Credit Buyer
  - Conservation Tillage
- Participation Decreases with:
  - Contract Length
  - Filter Strips ($69) (average CRP payment $47.33 *(USDA 2012)*)
  - Nutrient Management Plans ($31)
- Administrator Had No Discernible Impact
- Conservation Tillage Popular, but Additionality Likely Small
- Cost Still Most Likely Underlying Driver

Future Work

- Link with SWAT Model
- Determination of Best Program Design
  - Calculation of Changes in Probability of Participation
- Split Sample By CRP Participation

- Examination of Other Conservation Measures (Livestock)
- Choice Comparison Against CRP, CREP, EQIP, etc.

Thank You!

- Abdoul Sam and VPC Workshop
- US EPA
- USDA-NASS
- OSU Environmental Policy Initiative
- Allen Klaiber
- Brian Roe
- William McGuire

Appendix: Citations

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