Cost-Effectiveness of Reverse Auctions for Watershed Nutrient Reductions in the Presence of Climate Variability

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Introduction

- Changes in climate patterns (higher temperatures, changes in extreme precipitation events, higher level of humidity) will adversely impact water quality (IPCC) .
- The variability in the climate patterns can be more problematic than changes in the average temperatures or precipitation for agricultural decision making and nutrient management.
- Some of the major challenges in implementing watershed-based programs to control agricultural nonpoint source pollution involve a) a large number of individual landowner decision makers and b) the extant assignment of property rights in agriculture.

Background

- Current regulatory framework largely supports only voluntary approaches, designing incentives programs that are both cost-efficient and budgetary cost-effective is critical.
- A reverse auction is an incentive selection process that includes a monetary bid (the willingness to pay for adopting a conservation practice) and a ranking of the environmental benefits associated with that conservation practice.
- Competitive biddings, also referred to as “reverse auctions” or procurement auctions, have come to the attention as mechanism that can both increase the budgetary cost effectiveness and reveal the true costs of adopting different conservation.
- Competitive bidding mechanisms induce landowners to submit bids close to their opportunity costs, thus increasing the budgetary cost effectiveness and revealing the true costs of adopting different conservation practices.

Objectives

- to determine how the effectiveness of different conservation practices will be affected by climate variability
- consider and simulate the cost efficiency of a reverse auction as an incentive mechanism designed to improve water quality at the watershed level in the presence of climate change.

Methods

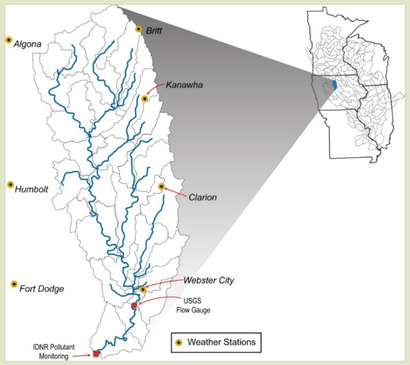
- Estimate a system of points to measure the efficiency of a set of conservation practices using Soil and Water Assessment (SWAT) model.
  - how effective an abatement practice is in reducing the edge-of-field emissions, and
  - the impact of the edge-of-field reduced emissions on the ambient (downstream) water quality (Rabotyagov, Valcu, and Kling, 2013).
- Costs for each conservation practice are drawn from several sources (in dollars per acre)
- Use the system of points together with cost data to evaluate the cost efficiency of a reverse auction. For each field,
  - construct a set of ratios defined as a ratio of point values associated with a conservation practice to the corresponding implementation cost,
  - select the ratio with the highest value.
  - rank all the winner ratios from the highest to the lowest.
- The number of fields accepted in the reverse auction can be determined in two ways:
  - given the budget,
  - given the desired level of nutrient reductions.
- Consequently, we are able to assess the cost-effectiveness of a reverse auction in the presence of climate variability.
- The estimation of the point values for each conservation practice in the as well as the simulation of the reverse auction simulations are performed given
  - points are estimated at different scale (watershed, sbbasin, field)
  - the current weather patterns,
  - the future simulated weather scenarios.

Simulation Model

- SWAT model (USDA-ARS) – simulation developed as a part of the TMDL process
- Model calibrated and validated for streamflow and nutrients using USGS data
- Watershed: Boone River Watershed, Iowa
- Conservation practices simulated:
  - Cover crops
  - No-till
  - N fertilizer reduction
  - Retirement from row crop production (perennial grass)

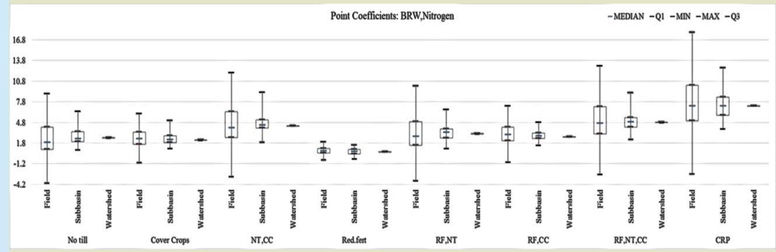
Boone River Watershed

- ~0.53 million acres
- tile drained, 90% corn and soybeans
- some of the highest nitrogen loads in Iowa
- 30 subbasins; 2,900 field units



Results

Point estimates



Reverse auction outcomes

Reverse Auction Outcomes under full enrollment

	N %	Cost ($million)
Watershed level	23.77	2.13
Subbasin level	26.74	2.38
Field level	30.21	3.17

Conclusions

- Given the implications of climate change on water and soil quality, it is important for watershed managers, stakeholders, and policymakers to understand not only the effectiveness of different conservation practices in improving water quality, but also the cost effectiveness of a watershed-level policy program designed for implementing conservation practices.
- Data collected from a typical Midwestern agricultural watershed will be used to assess the cost effectiveness of a reverse auction for nutrient reductions in the presence of climate variability.