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Evaluating the Efficiency-Participation Tradeoff in Agricultural Conservation Programs

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The authors gratefully acknowledge the funding support by Iowa Nutrient Research Center project 2017-07 GS-140136, USDA National Institute of Food and Agriculture Hatch Project IOW04099.

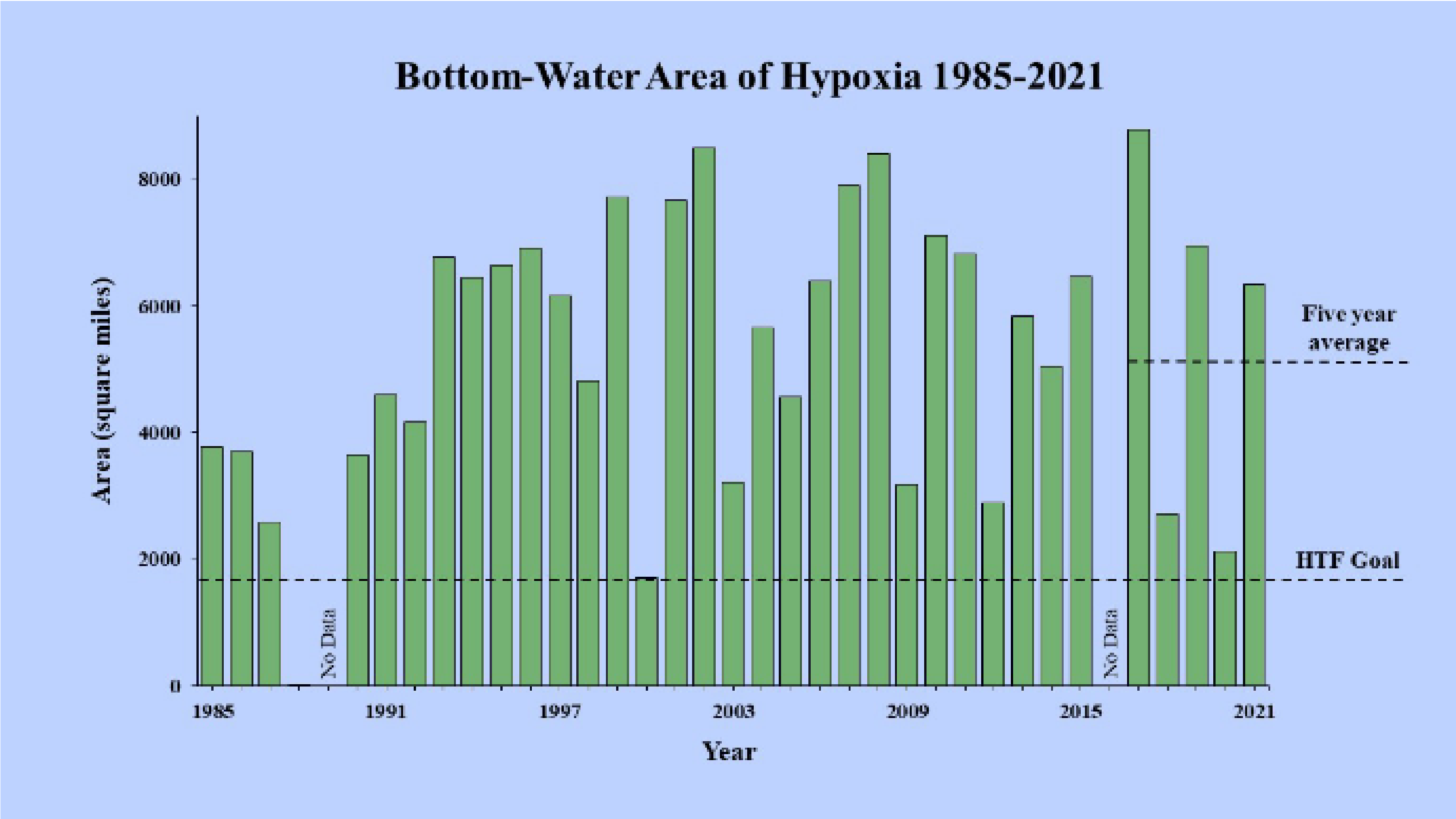
*Author Valcu-Lisman was employed by ISU when this research was conducted. The findings and conclusions in this presentation are those of the authors and should not be construed to represent any official USDA or U.S. Government determination or policy.

Introduction: Ag Nutrient Runoff

N and P loadings in Mississippi River Basin have led to increasingly large hypoxic zones in Gulf of Mexico

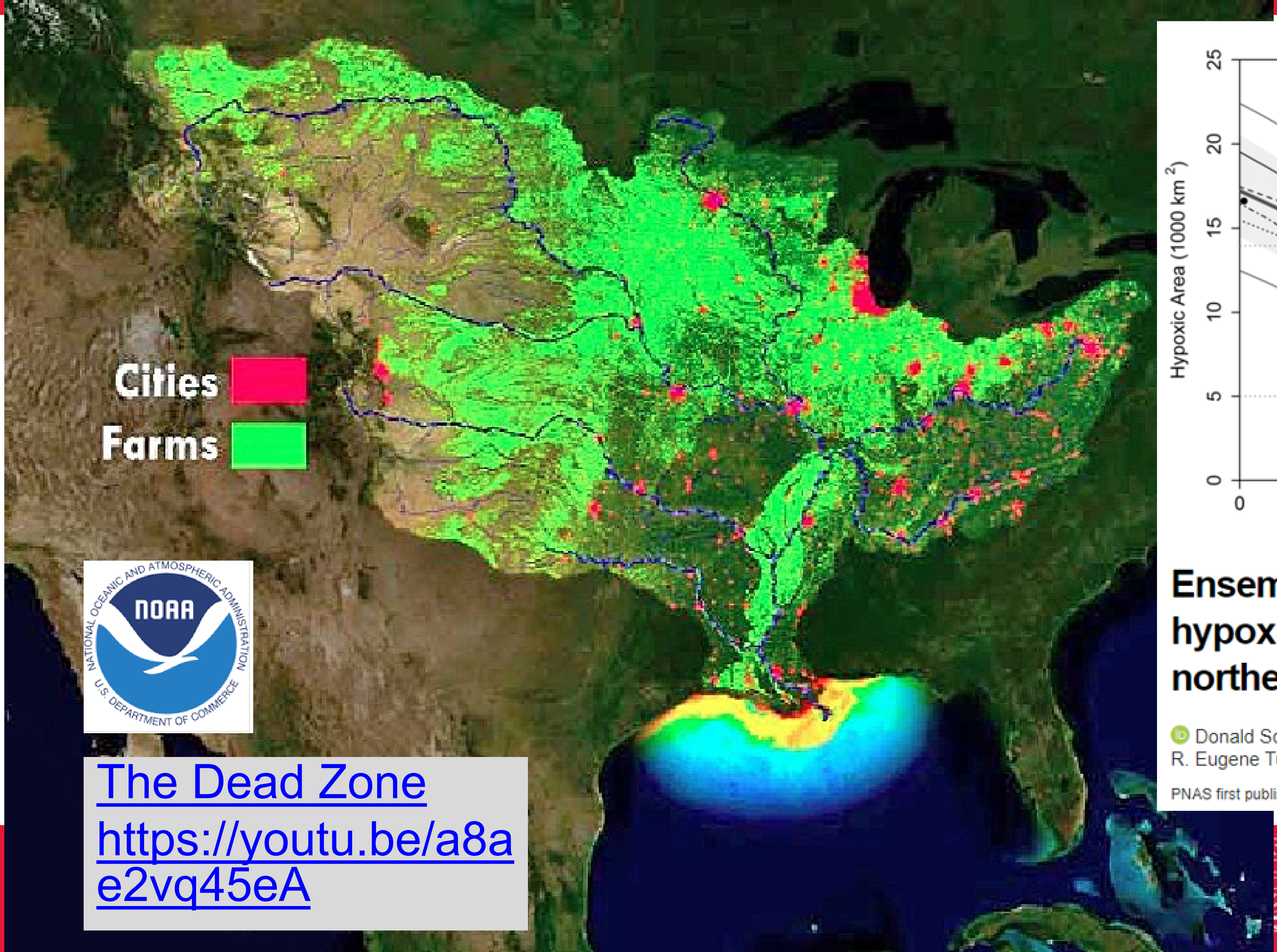
Majority of loadings originate from upstream agricultural runoff

Many other upstream surface waters (rivers, lakes, etc.) also compromised



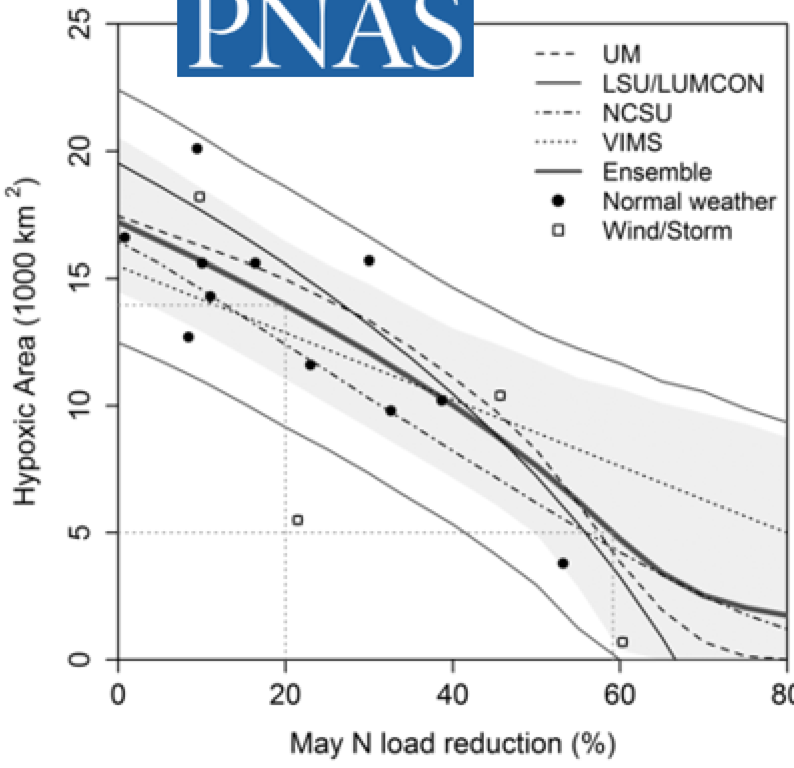
Long-term measured size of the hypoxic zone (green bars) measured during the ship surveys since 1985, including the target goal established by the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force and the 5-year average measured size (black dashed lines). (LUMCON/NOAA)

https://www.noaa.gov/news-release/larger-than-average-gulf-of-mexico-dead-zone-measured



[The Dead Zone](https://youtu.be/a8ae2vq45eA)
https://youtu.be/a8ae2vq45eA

PNAS



Ensemble modeling informs hypoxia management in the northern Gulf of Mexico

Donald Scavia, Isabella Bertani, Daniel R. Obenour, R. Eugene Turner, David R. Forrest, and Alexey Katin

PNAS first published July 31, 2017 https://doi.org/10.1073/pnas.1705293114

CARD
Agricultural and Rural Development

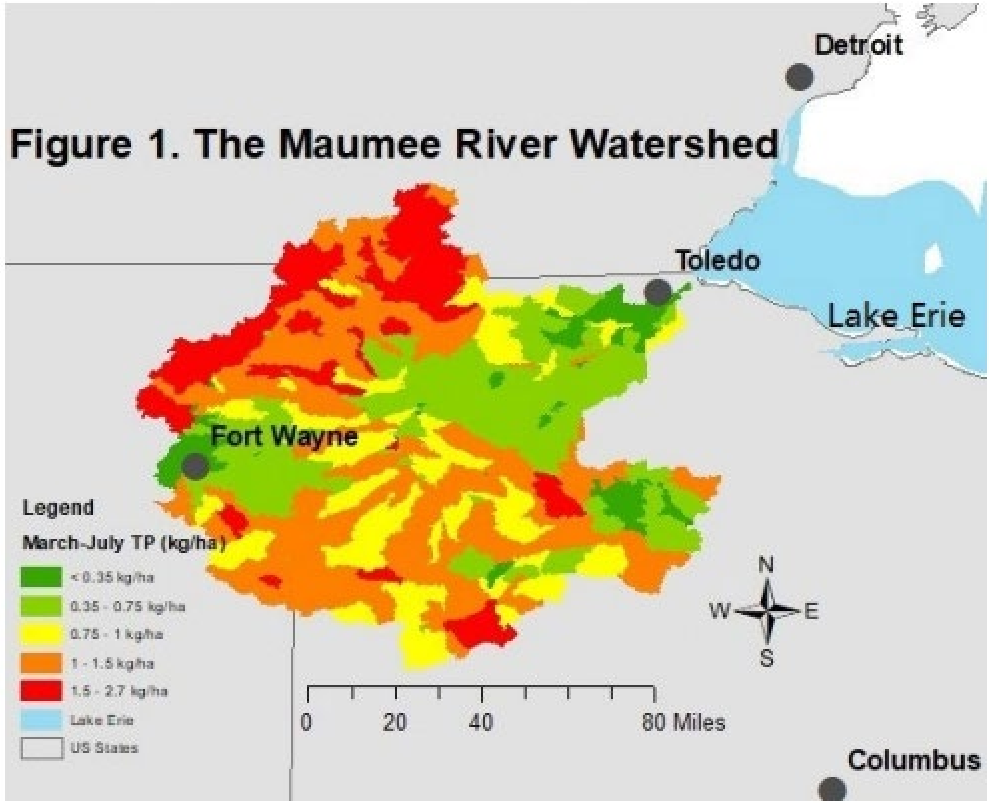
Nutrient reduction target for Western Lake Erie Basin

2016 Great Lakes Water Quality Agreement
Protocol, Annex 4 **Spring** (March-July) Targets

Baseline Load Year: 2008	**Maumee Watershed**	**Western Lake Erie**
Dissolved Reactive P (**DRP**)	186 MT	**40% less**
Total P (**TP**)	860 MT	**40% less**

Maumee River Watershed

Figure 1. Map of the Maumee River watershed highlighting the per-acre phosphorus loading across subbasins.

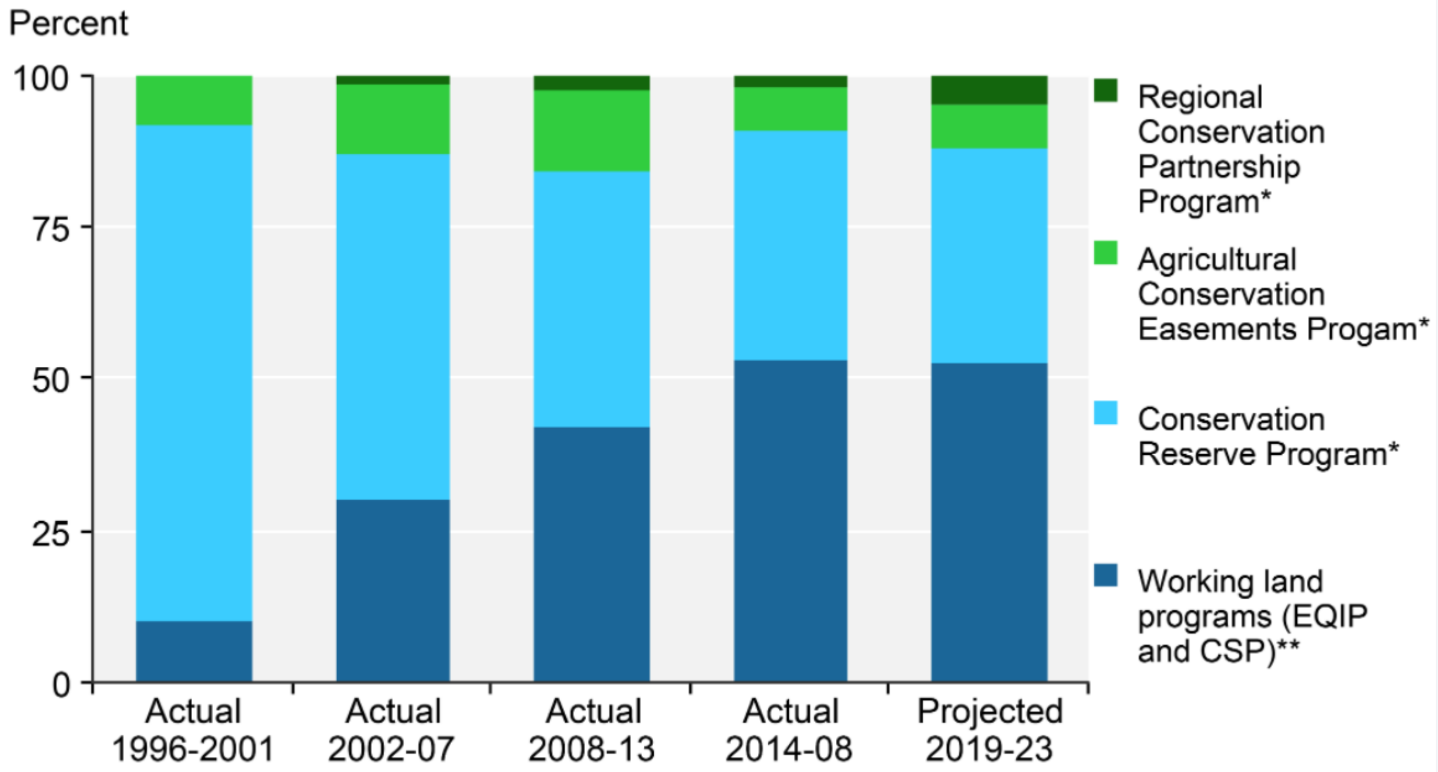


Introduction: Voluntary Cost-Share Programs

USDA and state governments provide financial support annually for voluntary conservation incentive programs, now and in the future (Pavelis et al. 2011; 113th Congress 2014).

Certain characteristics of some conservation programs can hinder their ability to deliver water quality improvements at a low cost (Ferraro and Kiss 2002; Duke et al. 2013; Duke et al. 2014; Jack et al. 2008).

Share of conservation spending by major programs and predecessors in the 2018 and previous farm acts



*Includes predecessor programs.
**Includes the Environmental Quality Incentives Program (EQIP), Conservation Stewardship Program (CSP), and predecessor programs (these are combined in the Congressional Budget Office estimates of spending under the 2018 Farm Act).
Sources: ERS analysis of Office of Budget and Policy Analysis data for 1996-2018 and Congressional Budget Office projections for 2019-23.

Source: USDA Economic Research Service

A Side Note about Your Dissertation Research: Be Patient!

Land Economics

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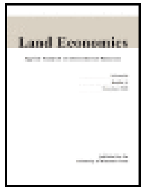

Full Text (PDF)

Hongxing Liu, Wendong Zhang, Elena Irwin, Jeffrey Kast, Noel Aloysius, Jay Martin, and Margaret Kalcic

Best Management Practices and Nutrient Reduction: An Integrated Economic-Hydrologic Model of the Western Lake Erie Basin

Land Economics November 2020 96:510-530;

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Improving the Effectiveness of Conservation Programs through Innovative Reverse Auctions and Sensible Enrollment Restrictions

Date: Sep 2017

Investigators: Wendong Zhang, Gregory Howard

Improving Cost Efficiency In Conservation Programs

Many conservation programs exist as defined cost shares

- Uniform payment levels

Economists (i.e., Hill et al. 2011, Palm-Forster et al. 2016b)

have pushed for innovations that can improve cost efficiency by either

- Boosting benefits (loadings reduced)
  - Enrollment restrictions, targeting high-potential-runoff fields, etc.
- Reducing costs
  - Price discrimination through reverse auctions or other devices

Some of these innovations have been implemented in select jurisdictions (e.g. ranking criteria for which contracts to accept); others less so

Goal

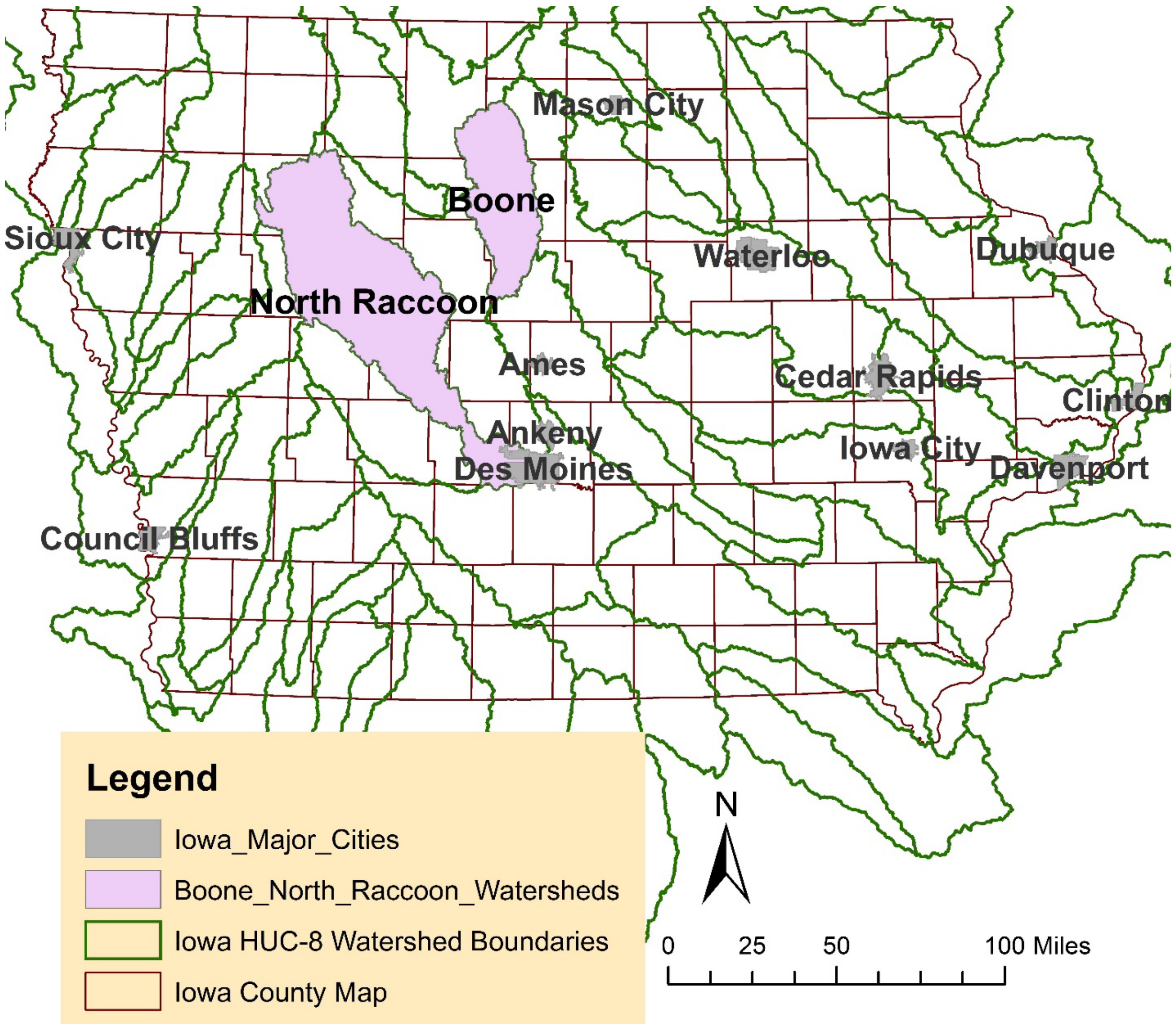
Examine the impact of program characteristics on the scope of program adoption among farmers as well as program efficiency

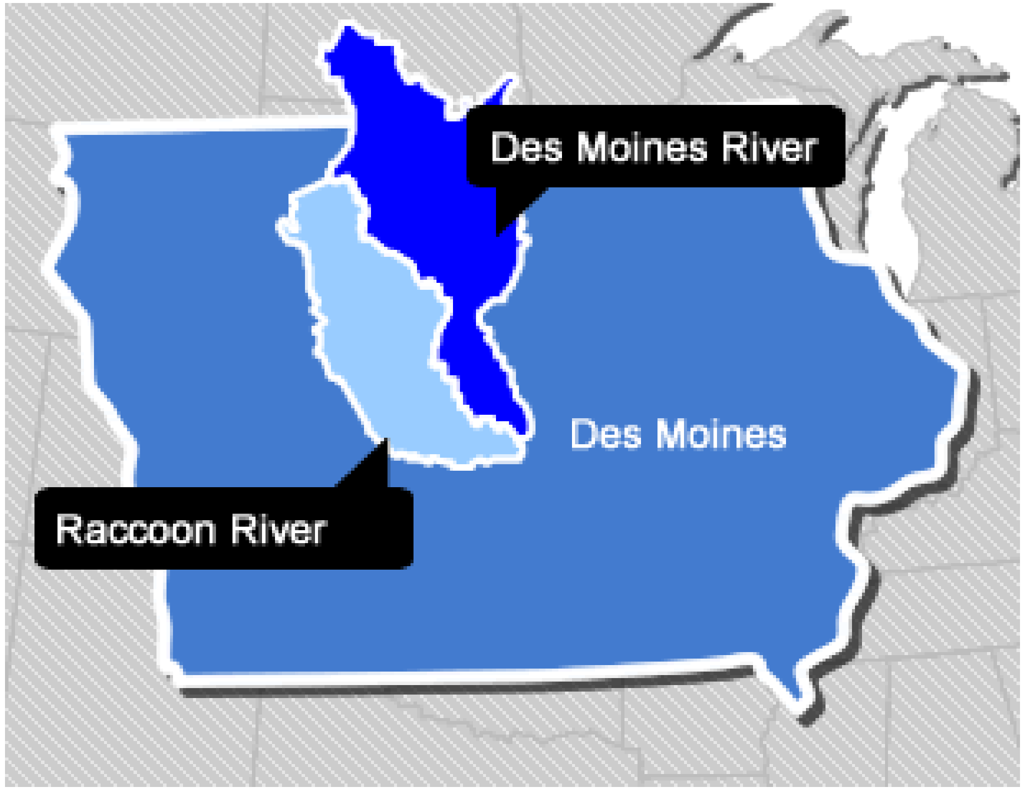
<u>Interested policy tools</u>

- Reverse Auctions (RAs) vs. Cost Shares (CSs)
- Spatial targeting of high-projected benefit townships vs. no targeting
- Increased maximum allowable bids in RAs

Plan: Survey Iowa farmers → Estimate preferences for contracts → Combine with SWAT model N reduction predictions to compare enrollment and efficiency of different policy tools by simulating take-up of programs with different contract characteristics

Study Area: Boone and North Raccoon Watersheds in Iowa





Des Moines Water Works
Water You Can Trust for Life

Data

Survey of Iowa Farmers following Dillman's Tailored Design framework (Dillman et al. 2014)

- Online + Two Rounds of Mail Surveys

Two waves of the survey: March 2019 and December 2019

- Each wave sent to different samples
- Second wave completed before COVID lockdowns

Wave 1: 1,800 recipients Mixed mode (online and mail) survey

Wave 2: 600 recipients mail only survey

Data

Survey asked about farm characteristics, farmer demographics, and asks farmers to focus on a single field where runoff is the greatest concern in their operation

Choice experiment offering voluntary conservation contracts for the field in question

28.6% total response rate

Total of 430 with valid responses for the choice experiments and other necessary information

Table 1. Demographics of Survey Samples

	Full Sample		First Wave (2018)		Second Wave (2019)	
	Mean	**Std. Dev**	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**
Age	59.15 (413)	12.72	58.36 (283)	12.93	61.83 (130)	12.14
Male	0.96 (417)	0.19	0.95 (285)	0.22	0.98 (132)	0.12
Owned Farm Size	309.94 (407)	407.55	342.81 (273)	464.35	242.97 (134)	243.60
Income > $250k	0.51 (400)	0.50	0.51 (272)	0.50	0.50 (128)	0.50
Experience	34.33 (410)	14.65	33.35 (279)	15.26	36.42 (131)	13.09
% Rent Farmland	0.90 (389)	0.30	0.93 (259)	0.25	0.84 (130)	0.37
Total Observations	430		295		135	

Notes: *Owned Farm Size* refers to the acreage owned by the respondent and under production in the previous season. *Income > $250k* is an indicator variable equal to 1 if reported farm income exceeds $250,000. *Experience* is the number of years farming, and *Rent Farmland* is an indicator variable equal to 1 if the respondent indicated that they rent farmland.

Choice Experiment

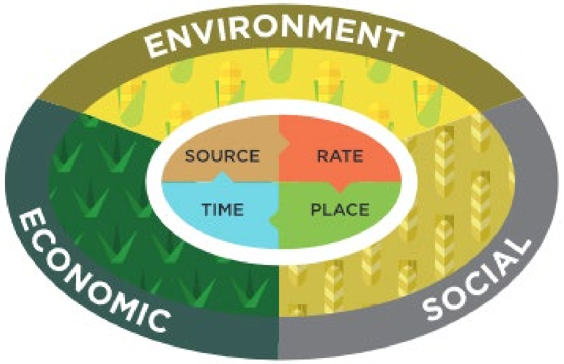
Two choices

Each choice has two contracts as well as a status-quo of neither contract

Attributes

- Required management practices
  - Cover Crops
  - No-till/Split tillage
  - Split N application
- Contract Length (2 or 4 years)
- Per-acre annual payment ($10, $40, $70, $100, $130)

Conservation Practices in Focus



split the application so that some is applied at planting and the rest is applied in the growing crop. Farmers can then adjust the rate and timing of the second application depending on the weather.

https://www.nrcs.usda.gov/wps/portal/nrcs/ia/newsroom/factsheets/

Post Application Coverage Endorsement (PACE)

Insure Your Nitrogen With PACE

Split Nitrogen Applications? There's Insurance for That

3/4/2022 | 5:00 AM CST

By Katie Micik Dehlinger , Farm Business Editor

Choice Experiment: Treatment

Half of respondents offered cost share contracts;

the other half offered reverse auction contracts with maximum cost share bids specified

Scenario 1

Please consider the terms of Programs A & B below for your field and answer the questions that follow as if a real conservation contract was being offered to you.

	Program A	**Program B**
Length of Contract	4 years (2021 - 2024)	4 years (2021 - 2024)
No-Till or Strip-Till (Leaving more than 90% residue)	Not Required	Must be used in 2021-24, ***not*** used in 2020
Cover Crops (Planting a crop after harvesting the main cash crop)	Must be used in 2021-24, ***not*** used in 2020	Not Required
Split Nitrogen application (Apply some N preplant/at-plant and the remainder sidedress)	Must be used in 2021-24, ***not*** used in 2020	Not Required
Annual Cost Share Payment to You	$10/acre	$100/acre

24. Which program do you prefer?

1 = Program A   2 = Program B   3 = Neither Program (If Neither, go to Page 7)

Choice Experiment: Treatment

Half of respondents offered cost share contracts;

the other half offered reverse auction contracts with maximum cost share bids specified

Scenario 1

Please consider the terms of Programs A & B below for your field and answer the questions that follow as if a real conservation contract was being offered to you.

	Program A	Program B
Length of Contract	2 years (2021, 2022)	4 years (2021 - 2024)
No-Till or Strip-Till (Leaving more than 90% residue)	Not Required	Must be used in 2021-24, ***not*** used in 2020
Cover Crops (Planting a crop after harvesting the main cash crop)	Not Required	Must be used in 2021-24, ***not*** used in 2020
Split Nitrogen application (Apply some N preplant/at-plant and the remainder sidedress)	Must be used in 2021-22, ***not*** used in 2020	Must be used in 2021-24, ***not*** used in 2020
Maximum Cost Share Payments You Could Request	$100/acre	$130/acre

24. Which program do you prefer?

1 = Program A 2 = Program B 3 = Neither Program (If Neither, go to Page 7)

25. What is the **minimum** cost-share payment amount you would request for your preferred conservation program? (**Remember, lower cost share requests are more likely to be accepted and approved.**)

$ _______________ / acre

Discrete Choice Model

random parameters (mixed) logit

We utilize a random utility framework with unobserved preference heterogeneity in which the utility farmer i receives from choice j, U_{ij}, is a function of a vector of choice attributes X_{ij}:

$$U_{ij} = V_{ij} + \varepsilon_{ij} = \beta_i X_{ij} + \varepsilon_{ij}, \qquad (1)$$

where V_{ij} is the systematic component of utility that is based on observable attributes of each alternative; β_i is a vector of farmer i's latent preference parameters for the attributes of alternative j; X_{ij} is a set of attributes and alternative-specific constants for alternative j; and, ε_{ij} is a random error term with a type 1 extreme value distribution. We adopt a random parameters logit framework to model unobserved preference heterogeneity, in which each farmer's

We also allow for heterogeneity in preference for each attribute depending on the contract type (cost share or reverse auction):

$$V_{ij} = I(CS) * [\beta_{iC1} Length + \beta_{iC2} CoverCrop + \beta_{iC3} NoTill + \beta_{iC4} SplitN + \beta_{C5} Payment + \beta_{C6} SQ] + I(RA) * [\beta_{iR1} Length + \beta_{iR2} CoverCrop + \beta_{iR3} NoTill + \beta_{iR4} SplitN + \beta_{iR5} Payment + \beta_{iR6} SQ], \qquad (4)$$

Results: Mixed Logit

Attribute	*Contract Type*	*Mean*	*Std. Deviation*
Contract Length	Cost Share	-0.4072**	0.2211
		(0.2051)	(0.4228)
	Reverse Auction	-0.6137***	0.2839
		(0.1844)	(0.2606)
Cover Crops	Cost Share	-1.3435***	1.6714**
		(0.4615)	(0.8191)
	Reverse Auction	-0.8930**	0.5619
		(0.4044)	(1.2905)
No Till	Cost Share	-1.7633***	1.7230
		(0.6329)	(1.1258)
	Reverse Auction	-1.6698***	2.1131***
		(0.6102)	(0.8088)
Split Nitrogen	Cost Share	-0.8247*	1.4282*
		(0.4573)	(0.8348)
	Reverse Auction	-0.6561	1.6560**
		(0.4071)	(0.6847)
Payment	Cost Share	0.0321***	0.0085
		(0.0085)	(0.0165)
	Reverse Auction	0.0172***	0.0149
		(0.0051)	(0.0105)
Status-Quo ASC	Cost Share	-0.1595	5.1210***
		(0.7246)	(1.1874)
	Reverse Auction	-0.5530	2.6461***
		(0.6823)	(0.7612)
Observations		2,418	
(Respondents)		(430)	

Policy Simulation: Policy Scenarios

Using estimated farmer-specific minimum WTA estimates, can simulate response to conservation contract offers under 5 different policy environments:

1. Baseline: Uniform cost share payments set at EQIP levels
2. Cost share payments set at EQIP levels, targeted at fields that deliver above-median nutrient reductions using SWAT modeling
3. Cost share payments equal to bids in a reverse auction, where maximum bid is set at EQIP levels
4. Combination of 3. and 2.; reverse auction with spatial targeting
5. Same as 4., but with maximum bid set at 150% of EQIP level

Policy Simulation: Steps

1. For each scenario, we identify the percentage of our sample we project would enroll in the offered program (which occurs if their estimated WTA is below the offered cost share/maximum bid).
   - WTA estimation steps shown later
2. We also estimate average program cost per enrolled acre and average pounds of N reduced per enrolled acre. – N reduction estimated using the process-based hydrological model SWAT
3. We combine these to estimate the dollars spent per reduced pound of N and use an estimate of $9.48 as the monetized benefit of a one-pound reduction in N (Ribaudo, Heimlich, and Peters 2005) to estimate a benefit-cost ratio for each program
4. Finally, we calculate the percentage of N loadings from the fields in our sample that is projected to be eliminated
5. Extrapolating to the whole watershed based on # farms/county using a small ($600K) and large ($3 million) budget [each sampled farmer represents 10.4 farmers]

Policy Simulation: WTA Estimates

Mixed Logit estimates first two moments of a distribution of preferences for each attribute

- Payment fixed, normal for attributes and ASCs

Generate preference parameter estimates for each respondent, conditioned on actual responses

Using individual-specific preferences, estimate minimum WTA for a specified conservation contract as

$$WTA_i = \frac{-(V_{1i} - V_{SQi})}{\beta_{payment}},$$

Where V_{1i} is the estimated utility of the offered contract,

V_{SQi} is the estimated utility of the status-quo option, and

$\beta_{payment}$ is the preference parameter for contract payment

Policy Simulation Details: Reverse Auction Bids Generation

Modeling reverse auction bids:

Treat bids as % of maximum allowed bid

Use bid distribution in data to randomly assign bids to each farmer for reverse auctions

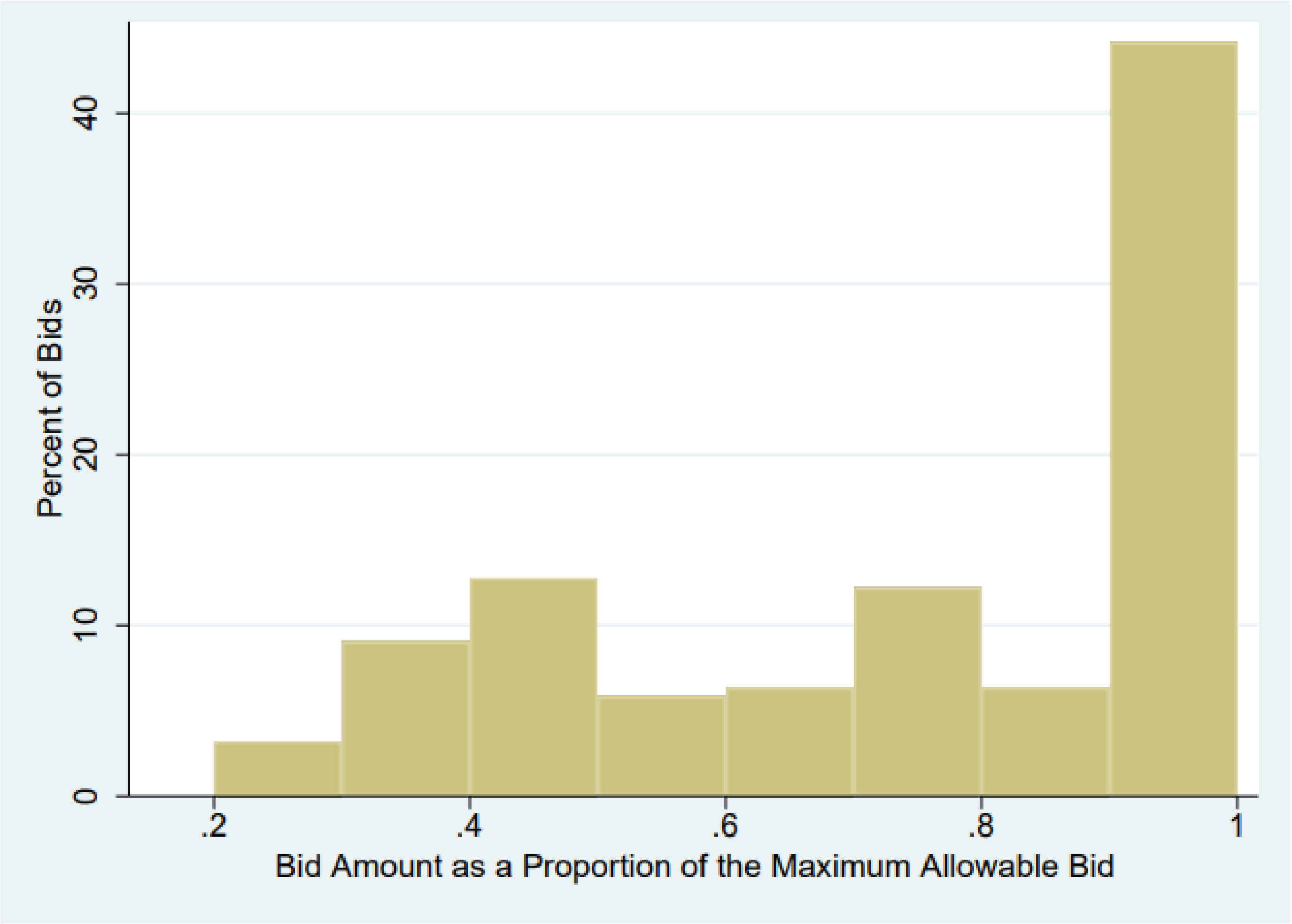
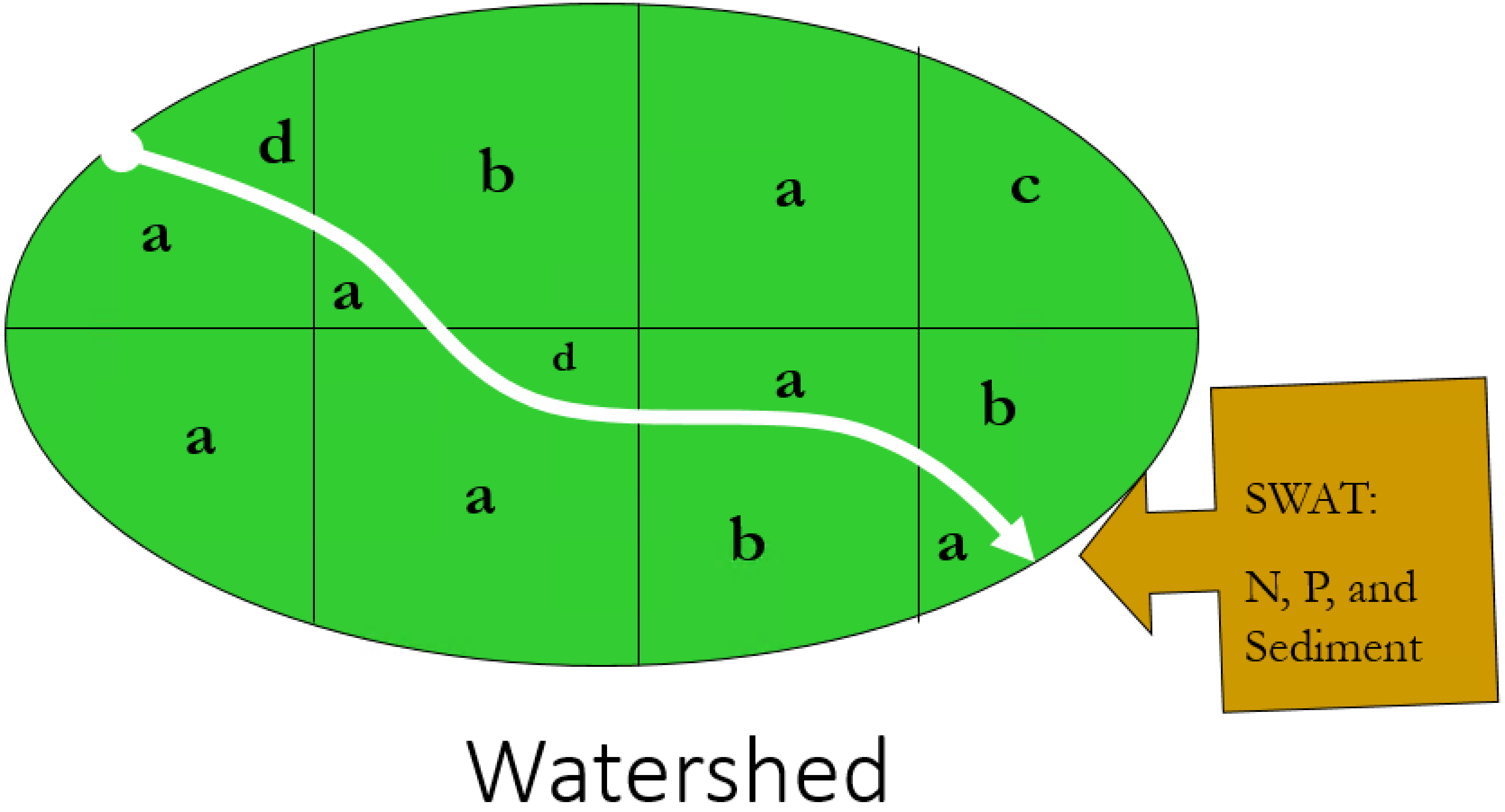


Figure 3. Distribution of bids as a proportion of maximum allowable bid in reverse auction choice scenarios.

SWAT simulates water quality under any combination of landuse/abatement activities

- Process-based Watershed-scale Ecohydrological simulation model developed by USDA - Agricultural Research Service
- Predicts ambient (instream) water quality associated with a spatially explicit set of land use/conservation practices



Soil and Water Assessment Tool (SWAT)

Table 2. Nutrient Reduction Efficiency Coefficients (pounds of reduced nitrogen runoff per acre) for each Conservation Practice at the Subwatershed Level

	No-till or Strip-till		Cover Crops		Reduced Fertilizer (Split Nitrogen)	
	Boone	**Raccoon**	**Boone**	**Raccoon**	**Boone**	**Raccoon**
Mean	0.08	0.08	6.60	6.11	0.45	0.48
Standard Error	0.14	0.08	1.24	1.71	0.25	0.18

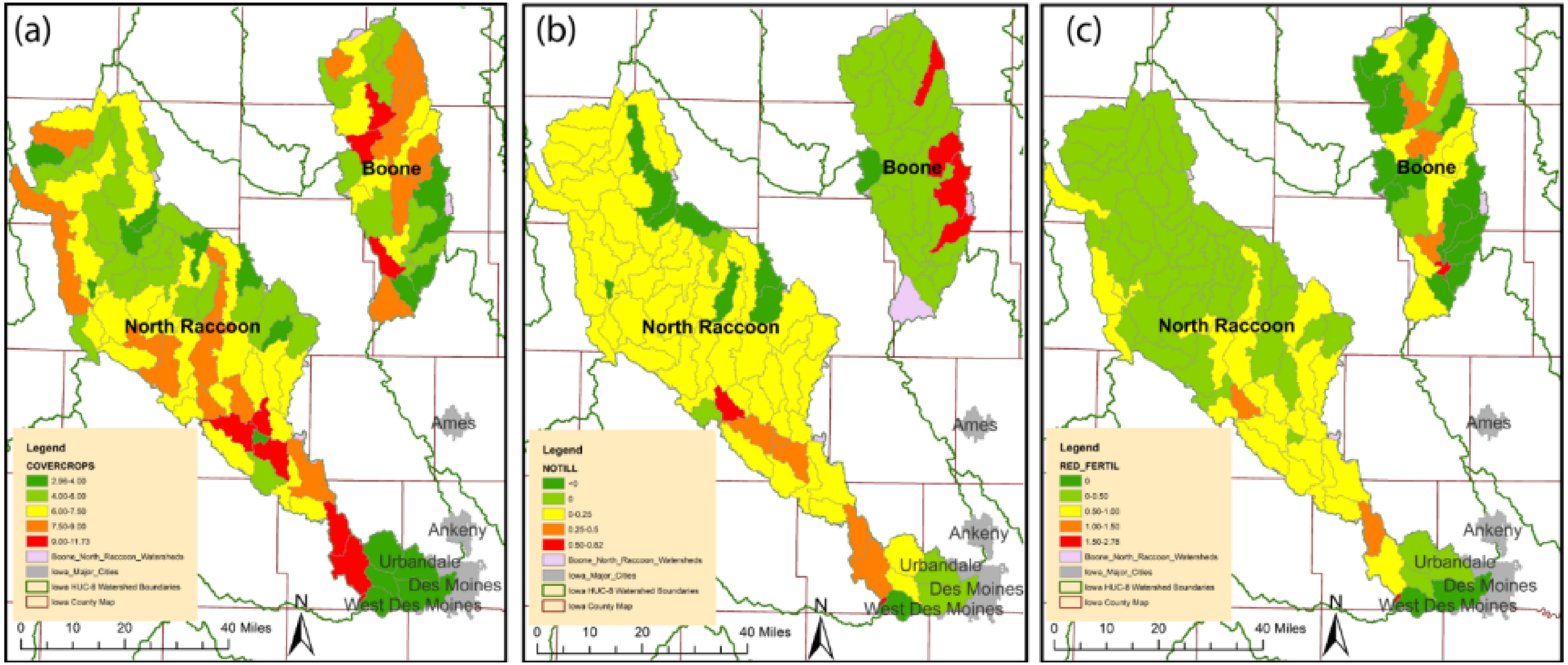


Figure 4. Spatial distribution of nitrogen reduction coefficients (lbs. of N reduced per acre of conservation practice adopted): (a) cover crops; (b) no-till; and, (c) split nitrogen proxied by reduced fertilizer.

Note: Based on Valcu-Lisman et al. (2017).

Table 5b. Full Watersheds Policy Simulation Results: Cover Crops Contracts, Large Budget

Policy Scenarios	Total Budget Spent	Cost per Acre	Projected Farmers Enrolled	Acres Enrolled	Lbs. Reduced per Acre	Predicted N Reduction	Dollars per lb. Reduced	B/C Ratio
1. Cost Share $50	$3,076,350	$50	634	61,527 acres	6.95 lbs.	427,987 lbs.	$7.18	1.32
2. Cost Share $50, >= Median reduction fields	$2,073,300	$50	416	41,466 acres	7.38 lbs.	306,135 lbs.	$6.77	1.40
3. Reverse Auction $50	$2,500,623	$37.06	707	67,475 acres	6.39 lbs.	430,992 lbs.	$5.80	2.60
4. Reverse Auction $50, Accepting >= Median reduction fields	$1,305,736	$38.43	364	33,977 acres	7.37 lbs.	250,309 lbs.	$5.22	2.30
5. Reverse Auction $75, Accepting >= Median reduction fields	$2,087,893	$57.64	395	36,223 acres	7.34 lbs.	265,947 lbs.	$7.85	1.23

Notes: Benefit-cost ratios assume a value of $9.48 in benefits from a one-pound reduction of N (Ribaudo, Heimlich, and Peters 2005). According to SWAT modeling, the median field in our data set is projected to reduce N loadings by 6.5 lbs. per acre with the use of cover crops. Average N loading estimates from our SWAT modeling are 17.69 lbs. per acre for the two watersheds. The baseline N loading in the Boone and North Raccoon River watersheds are 12.42 and 27.24 million lbs, respectively (Gassman et al. 2017, Jones et al. 2017). Total budget allocated for each scenario is $3,145,000.

Table 5a. Full Watersheds Policy Simulation Results: Cover Crops Contracts, Small Budget

Policy Scenarios	Total Budget Spent	Cost per Acre	Projected Farmers Enrolled	Acres Enrolled	Lbs. Reduced per Acre	Predicted N Reduction	Dollars per lb. Reduced	B/C Ratio
1. Cost Share $50	$593,300	$50	104	11,866 acres	8.09 lbs.	95,973 lbs.	$6.18	1.53
2. Cost Share $50, >= Median reduction fields	$593,300	$50	104	11,866 acres	8.09 lbs.	95,973 lbs.	$6.18	1.53
3. Reverse Auction $50	$569,462	$23.33	250	24,409 acres	6.71 lbs.	163,806 lbs.	$3.48	2.73
4. Reverse Auction $50, Accepting >= Median reduction fields	$599,813	$30.50	208	19,666 acres	7.54 lbs.	148,272 lbs.	$4.05	2.34
5. Reverse Auction $75, Accepting >= Median reduction fields	$596,280	$37.97	166	15,704 acres	7.44 lbs.	116,845 lbs.	$5.10	1.86

Notes: Benefit-cost ratios assume a value of $9.48 in benefits from a one-pound reduction of N (Ribaudo, Heimlich, and Peters 2005). According to SWAT modeling, the median field in our data set is projected to reduce N loadings by 6.5 lbs. per acre with the use of cover crops. Average N loading estimates from our SWAT modeling are 17.69 lbs. per acre for the two watersheds. The baseline N loading in the Boone and North Raccoon River watersheds are 12.42 and 27.24 million lbs, respectively (Gassman et al. 2017, Jones et al. 2017). Total budget allocated for each scenario is $603,000

Table 6a. Full Watersheds Policy Simulation Results: No-till/Strip-till Contracts, Small Budget

Policy Scenarios	Total Budget Spent	Cost per Acre	Projected Farmers Enrolled	Acres Enrolled	Lbs. Reduced per Acre	Predicted N Reduction	Dollars per lb. Reduced	B/C Ratio
1. Cost Share $10	$74,460	$10	73	7,446 acres	0.31 lbs.	2,332 lbs.	$31.93	0.30
2. Cost Share $10, >= Median reduction fields	$74,460	$10	73	7,446 acres	0.31 lbs.	2,332 lbs.	$31.93	0.30
3. Reverse Auction $10	$78,936	$5.75	83	13,728 acres	0.28 lbs.	3,848 lbs.	$20.51	0.46
4. Reverse Auction $10, Accepting >= Median reduction fields	$78,936	$5.75	83	13,728 acres	0.28 lbs.	3,848 lbs.	$20.51	0.46
5. Reverse Auction $15, Accepting >= Median reduction fields	$51,480	$7.50	42	6,864 acres	0.31 lbs.	2,145 lbs.	$23.99	0.40

Notes: Benefit-cost ratios assume a value of $9.48 in benefits from a one-pound reduction of N (Ribaudo, Heimlich, and Peters 2005). According to SWAT modeling, the median field in our data set is projected to reduce N loadings by 6.5 lbs. per acre with the use of cover crops. Average N loading estimates from our SWAT modeling are 17.69 lbs. per acre for the two watersheds. The baseline N loading in the Boone and North Raccoon River watersheds are 12.42 and 27.24 million lbs, respectively (Gassman et al. 2017, Jones et al. 2017). Total budget allocated for each scenario is $84,000.

Table 7b. Full Watersheds Policy Simulation Results: Split N Application Contracts, Large Budget

Policy Scenarios	Total Budget Spent	Cost per Acre	Projected Farmers Enrolled	Acres Enrolled	Lbs. Reduced per Acre	Predicted N Reduction	Dollars per lb. Reduced	B/C Ratio
1. Cost Share $10	$985,160	$10	1,009	98,516 acres	0.46 lbs.	45,210 lbs.	$21.79	0.44
2. Cost Share $10, >= Median reduction fields	$482,660	$10	499	48,266 acres	0.61 lbs.	29,521 lbs.	$16.35	0.60
3. Reverse Auction $10	$323,028	$7.18	510	44,990 acres	0.46 lbs.	20,818 lbs.	$15.52	0.61
4. Reverse Auction $10, Accepting >= Median reduction fields	$179,946	$7.69	270	23,400 acres	0.61 lbs.	14,342 lbs.	$12.55	0.76
5. Reverse Auction $15, Accepting >= Median reduction fields	$303,882	$11.54	292	26,333 acres	0.60 lbs.	15,872 lbs.	$19.14	0.50

Notes: Benefit-cost ratios assume a value of $9.48 in benefits from a one-pound reduction of N (Ribaudo, Heimlich, and Peters 2005). According to SWAT modeling, the median field in our data set is projected to reduce N loadings by 6.5 lbs. per acre with the use of cover crops. Average N loading estimates from our SWAT modeling are 17.69 lbs. per acre for the two watersheds. The baseline N loading in the Boone and North Raccoon River watersheds are 12.42 and 27.24 million lbs, respectively (Gassman et al. 2017, Jones et al. 2017). Total budget allocated for each scenario is $3,145,000.

Table 8: Benefit/Cost Ratios under different assumptions for benefits of per/lb. N reduction

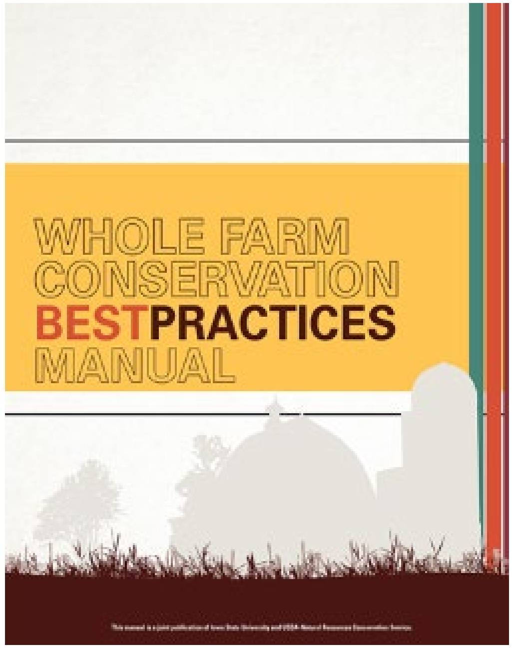
Policy	Cover Crops				No-till/Split-till			
Social cost of N	$9.48	$2	$5	$20	$9.48	$2	$5	$20
1.	1.53	0.32	0.81	3.24	0.30	0.06	0.16	0.63
2.	1.53	0.32	0.81	3.24	0.30	0.06	0.16	0.63
3.	2.73	0.58	1.44	5.75	0.46	0.10	0.24	0.98
4.	2.34	0.49	1.24	4.94	0.46	0.10	0.24	0.98
5.	1.86	0.39	0.98	3.92	0.40	0.08	0.21	0.83

SCIENCE ADVANCES | RESEARCH ARTICLE

ENVIRONMENTAL STUDIES

The social costs of nitrogen

Bonnie L. Keeler,[1]* Jesse D. Gourevitch,[1] Stephen Polasky,[1,2,3] Forest Isbell,[3] Chris W. Tessum,[4] Jason D. Hill,[5] Julian D. Marshall[4]



LEGEND

Strong
Moderate
Weak
No Impact

✓ Anecdotal Evidence
✓✓ Multiple Studies
✓✓✓ Scientific Consensus

ABILITY TO ADDRESS RESOURCE CONCERN

Practice	Soil Health		Nutrient Loss Reduction			Habitat	
	Impact	Confidence	Nitrogen Impact	Phosphorus Impact	Confidence	Impact	Confidence
Cover Crops	Strong	Scientific Consensus	Strong	Strong	Scientific Consensus	Weak	Multiple Studies
No-tillage	Strong	Scientific Consensus	No Impact	Strong	Multiple Studies	No Impact	Scientific Consensus
Strip-tillage	Moderate	Scientific Consensus	No Impact	Moderate	Anecdotal Evidence	No Impact	Scientific Consensus
N Management	No Impact	Multiple Studies	Weak	No Impact	Scientific Consensus	No Impact	Scientific Consensus
P Management	No Impact	Multiple Studies	No Impact	Moderate	Scientific Consensus	No Impact	Scientific Consensus
Diverse Rotations	Moderate	Multiple Studies	Moderate	Strong	Multiple Studies	Moderate	Scientific Consensus
Wetlands	No Impact	Multiple Studies	Strong	No Impact	Scientific Consensus	Strong	Scientific Consensus
Saturated Buffers	No Impact *	Multiple Studies	Strong	No Impact	Scientific Consensus	Moderate	Scientific Consensus
Bioreactors	No Impact *	Multiple Studies	Strong	No Impact	Scientific Consensus	No Impact #	Scientific Consensus
Field Buffers	No Impact *	Scientific Consensus	Weak	Strong	Multiple Studies	Moderate	Scientific Consensus
Grassed Waterways	No Impact *	Scientific Consensus	No Impact	Moderate	Multiple Studies	Weak	Scientific Consensus
Strategically Placed Perennials	No Impact *	Multiple Studies	Moderate	Strong	Multiple Studies	Moderate	Scientific Consensus
Prairie Strips	No Impact *	Scientific Consensus	Weak	Strong	Multiple Studies	Moderate	Scientific Consensus

Conclusions

- We find that both spatial targeting of contracts and replacing uniform cost-share offers with reverse auctions leads to substantial increases in the cost-effectiveness of programs but also shrinks the total impact of the conservation program, reducing enrollment by 30%–70%.
- It is critical to examine how program design affects farmers' participation, especially in reverse auction contracts, to ensure program effectiveness.
- We find that benefit-cost ratios are consistently below 1 for no-till and split N application contracts and are consistently above 1 (1.15 to 1.82) for cover crop contracts, and no-till are particularly ineffective.

Thank you!

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Work-in-progress:
The Effects of Enrollment Restrictions & Additionality

Joint with Xiaolan Wan (ISU), Greg Howard (ECU)

How to Grow and Sell Carbon Credits in US Agriculture

Ag Decision Maker
extension.iastate.edu/agdm

File A1-76

Prepared by Alejandro Plastina, extension economist, plastina@iastate.edu; Oranuch Wongpiyabovorn, graduate research assistant

www.extension.iastate.edu/agdm

While all programs require **additionality** to generate a credit, not all programs require that farmers change their production practices. **Additionality** means that farmers must do something **different** to reduce carbon and increase ecosystem services. However, programs use a wide array of benchmarks to determine what is **different**. Some programs require a change of practices with respect to past practices on the same field, while some others require that practices in the field be different from common practices in the area (even

https://www.extension.iastate.edu/agdm/crops/pdf/a1-76.pdf

The U.S. Department of Agriculture is investing up to $2.8 billion in 70 selected projects under the first funding pool of Partnerships for Climate-Smart Commodities.

CARD part of $80 million USDA grant

September 23, 2022

AMES, Iowa — Keeping plants continuously growing on farmland through the winter protects and enriches soil, improves water quality and reduces greenhouse gas emissions. That's why Lisa Schulte Moore, a professor of natural resource ecology and management at Iowa State University, is working to make year-round covered ground a conventional practice. "My vision is that when we drive around Iowa in December, we don't see a single bare field," she said.

While use of cover crops is growing, it's far from common. A new grant of up to $80 million from the U.S. Department of Agriculture will fund a project meant to spur more farmers to plant cover crops and perennial prairie grass, through both direct payments and a demonstration of how harvested winter-hearty crops and grass can be processed into renewable natural gas.

"This is about creating economic incentives so farmers' hearts and minds can align. They want to keep their soil. They want to keep their nutrients in place. We know they value environmental quality. But it needs to make financial sense for them," said Schulte Moore, co-director of Iowa State's Bioeconomy Institute and a 2021 McArthur Fellow.

The five-year grant is among the $2.8 billion in federal investments in 70 projects announced this month as part of the USDA's Partnerships for Climate-Smart Commodities program. The grant builds on the work of the Consortium for Cultivating Human and Naturally reGenerative Enterprises (C-CHANGE), founded in 2018 as an ISU Presidential Interdisciplinary Research Initiative. The initiative expanded in 2020 to a multi-institutional project led by Schulte Moore with a five-year, $10 million grant grant from the USDA's National Institute for Food and Agriculture.

Several CARD faculty members, including John Crespi, Dermot Hayes, Amani Elobeid, Alejandro Plastina, Wendong Zhang, and CARD Faculty Collaborator Jerome Dumortier will serve as principal investigators on the project.

Iowa State will receive roughly $10 million from the new grant and is one of 14 partners involved in the project, which is called Horizon II and is led by Roeslein Alternative Energy, a St. Louis-based company that is also an industry partner on C-CHANGE.

USDA U.S. DEPARTMENT OF AGRICULTURE
PARTNERSHIPS FOR CLIMATE-SMART COMMODITIES

Example Scenario with Enrollment Restriction

Section 3: Hypothetical Voluntary Conservation Program for Your Field

Conservation Program Overview.

Consider a hypothetical situation where a government agency or conservation group is offering multiple ***voluntary conservation contracts*** *with different lengths* ***starting the 2021 growing season*** (from after harvest in the fall of 2020 until harvest in the fall of 2021). All contracts include the adoption of one or more management practices to reduce nutrient loss that **are not already in use or planned for use in the 2020 growing season**, as well as an annual per-acre cost-share payment to the farmer. The practices, as well as the per-acre cost share, apply to the acreage of the entire field.

These conservation programs are designed to encourage **additional, new** acres of three conservation practices: no-till or strip-till, cover crops, and split N application. As a result, not all acres are eligible for this program. For example, a field which currently uses cover crops is not eligible for conservation programs adding cover crops.

24. Still considering your field from the previous section, please indicate whether this field would be eligible for a voluntary conservation program based on the practices you will use in the 2020 season. Note that in this new conservation funding concept, **funding is only available to add additional, new conservation practices**.

(Circle all that apply.)

1 = I will not use no-till/strip-till, cover crops, or split-N-application on this field in 2020, so it is eligible for any conservation contracts presented in the next two scenarios.

2 = No-till/strip-till will be used on this field for the 2020 crop, so it is not eligible for contracts in 2021 ***adding*** no-till/strip-till.

3 = Cover crops will be planted on this field for the 2020 crop year (post-harvest 2019 until harvest 2020), so it is not eligible for contracts in 2021 ***adding*** cover crops.

4 = Split nitrogen application will be used on the field for the 2020 crop, so it is not eligible for contracts in 2021 ***adding*** the practice of split nitrogen application.

Scenario 1

Please consider the terms of Programs A & B below for your field and answer the questions that follow as if a real conservation contract was being offered to you.

	Program A	Program B
Length of Contract	2 years (2021, 2022)	4 years (2021 - 2024)
No-Till or Strip-Till (Leaving more than 90% residue)	Not Required	Not Required
Cover Crops (Planting a crop after harvesting the main cash crop)	Must be used in 2021-22, ***not*** used in 2020	Not Required
Split Nitrogen application (Apply some N preplant/at-plant and the remainder sidedress)	Not Required	Must be used in 2021-24, ***not*** used in 2020
Annual Cost Share Payment to You	$10/acre	$70/acre

25. As mentioned earlier, the program is available for fields currently not using these practices. Based on the information above, is your field eligible for either Program A or Program B for the 2021 growing season?

    1 = Yes, eligible for A and B
    2 = Yes, but eligible for A only
    3 = Yes, but eligible for B only
    4 = Not eligible for either (If not eligible for either, go to Page 7)

26. If your field is eligible, which program do you prefer?

    1 = Program A   2 = Program B   3 = Neither Program (If Neither, go to Page 7)

Econometric Model

$$U_{ij} = (1 - R_i)\left\{\sum_{k=1}^{3} x_{kj}\beta_{kn,i} + SQ_j\left(\beta_{n,SQ} + G_i\gamma_{f,SQ}\right)\right\}$$
$$+R_i\left\{\sum_{k=1}^{3} x_{kj}\beta_{kr,i} + SQ_j\left(\beta_{r,SQ} + C_i\gamma_{c,SQ} + G_i\gamma_{f,SQ}\right)\right\} + l_j\beta_l + p_j\alpha + \epsilon_{ij} \quad (1)$$

where

- x_{1j}, x_{2j}, and x_{3j} denote contract j's requirements for the three practices: cover crop, no-till, and split N application; l_j and p_j denote the mandatory years and annual cost-share payment.
- SQ_j captures an alternative-specific constant for status-quo option.
- R_i is an indicator for a farmer receiving the restricted enrollment choice questions; G_i is an indicator for a green farmer; C_i is an indicator for a farmer with only one contract eligible.

Conditional Logit Regression Results

Variables	Explanation	Model 1
length	Contract length in years	-.227***
		(0.054)
payment	Contract payment rates	.012***
		(0.001)
$covercrops^{no}$	Subsidize cover crops without restrictions	-.555***
		(0.162)
$covercrops^{res}$	Subsidize cover crops with restrictions	-.508**
		(0.213)
$notill^{no}$	Subsidize no-till without restrictions	-.734***
		(0.169)
$notill^{res}$	Subsidize no-till with restrictions	-.556***
		(0.206)
$splitN^{no}$	Subsidize split N without restrictions	-0.035
		(0.171)
$splitN^{res}$	Subsidize split N with restrictions	-0.251
		(0.214)
ASC^{no}	ASQ for status-quo option without restrictions	0.379
		(0.268)
ASC^{res}	ASQ for status-quo option with restrictions	-0.371
		(0.316)

Years	Practices	Payment	Brown Farmer No Res	Brown Farmer Res	Brown Farmer Difference	Green Farmer No Res	Green Farmer Res	Green Farmer Difference
2	CC	$40	22.09%	39.15%	17.07%**	34.70%	54.67%	19.97%**
2	NT	$10	14.10%	29.52%	15.42%**	23.53%	43.97%	20.45%**
2	SN	$9	24.60%	36.62%	12.02%*	37.94%	51.98%	14.05%*
2	CC + NT	$50	13.26%	30.00%	16.74%***	22.27%	44.55%	22.27%***
2	CC + SN	$49	23.31%	37.16%	13.85%**	36.28%	52.56%	16.28%**
2	NT + SN	$19	14.96%	27.79%	12.83%**	24.80%	41.90%	17.10%**
4	CC	$40	15.19%	28.90%	13.71%**	25.13%	43.24%	18.11%**
4	NT	$10	9.40%	20.92%	11.53%**	16.27%	33.15%	16.88%**
4	SN	$9	17.08%	26.74%	9.66%	27.86%	40.61%	12.76%
4	CC + NT	$50	8.81%	21.31%	12.5%**	15.33%	33.66%	18.33%**
4	CC + SN	$49	16.10%	27.19%	11.09%**	26.45%	41.17%	14.72%**
4	NT + SN	$19	10.00%	19.55%	9.55%**	17.24%	31.30%	14.06%**

*** Indicates significance at 1 percent.
** Indicates significance at 5 percent.
* Indicates significance at 10 percent.

Figure: The Estimated Adoption Rate for Brown Farmers and Green Farmers

Thank you!

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