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Paying for Environmental Performance: Potential Cost Savings Using a Reverse Auction in Program Sign-up

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Key Findings

A reverse auction in the Conestoga watershed in Pennsylvania demonstrated that auctions are a more cost-effective way to allocate conservation funding than the traditional funding allocation process used in the U.S. Department of Agriculture's Environmental Quality Incentives Program (EQIP). On average, the reverse auction resulted in a seven-fold increase in the reduction of phosphorus runoff per dollar spent compared to EQIP during the same period and in the same watershed.

In a reverse auction, multiple sellers compete to provide services (environmental outcomes) to a single buyer. In the context of conservation programs, sellers are typically land managers such as farmers or ranchers; the buyer is typically a governmental entity. The Conestoga Reverse Auction differed from traditional funding allocation strategies in three ways:

- It quantitatively estimated the expected reduction in phosphorus runoff from proposed changes in management practices.
- It allowed farmers and ranchers to compete for funding through unrestricted bidding.
- It prioritized program payments based on how cost-effectively reductions in phosphorus runoff could be achieved. Cost-effectiveness was measured as the expected reduction in phosphorus runoff per program dollar spent.

Policy Implications

Government could improve the cost-effectiveness of their conservation funding by implementing reverse auctions or incorporating the principles of reverse auctions into their conservation program design. Specifically, policy-makers could improve the allocation of conservation funding in three ways:

- Increase the use of quantitative measurements of performance (e.g., measuring the reduction in nutrient runoff for water quality improvement) to rank funding applicants.
- Use measures of cost-effectiveness to rank funding applicants.
- Allow competitive bidding between funding applicants.

How Does the Traditional Allocation of Conservation Funding Compare to a Reverse Auction?

Traditional U.S. agricultural conservation programs like the Environmental Quality Incentives Program (EQIP), administered by the U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS), are often criticized for not being cost-effective[1]—that is, they fail to provide the maximum environmental outcomes per program dollar spent.

This policy note compares two ways to allocate conservation funding—the current allocation approach through EQIP and a reverse auction. We base our comparison on how cost-effectively each approach achieves reductions in phosphorus runoff in the Conestoga watershed in Pennsylvania. Cost-effectiveness is measured in terms of program dollars spent per unit reduction in phosphorus runoff.

How Does EQIP Work?

EQIP is a USDA "working lands" conservation program managed by NRCS. It is aimed at promoting agricultural conservation measures that reduce soil erosion, improve water and air quality, increase wildlife habitat, and conserve water resources. The program is designed to provide eligible farmers and ranchers with financial and technical assistance to install or implement structural and management practices on their lands.

To allocate funding, each state develops an "offer index," which ranks applicants using proxy environmental indicators. The offer index is developed in accordance with national, state, and local resource priorities. Applications are awarded points according to the extent that they address the various priority environmental resource concerns (for example, water quality or wildlife habitat) identified for that watershed or state, the conservation efforts currently being undertaken by the applicant, and the applicant's willingness to adopt or install certain recommended conservation practices sometimes referred to as best management practices (BMPs).[2]

Once scoring is complete, each application is ranked as "low," "medium," or "high" priority based on the applicant's offer index score. The offer index score is used as a general indicator of expected environmental outcomes. However, the type of BMP to be implemented is frequently used as the proxy for environmental outcomes, rather than quantifying how well the BMP meets the resource concerns. Furthermore, project implementation costs are typically not considered when ranking applications.

Once an application is approved, EQIP provides cost-share payments to farmers, which cover between 50 and 75 percent of estimated projects costs (up to 90 percent for low-income farmers). Project costs are generally estimated using a standard EQIP price list developed by each state, though for some structural practices such as stacking pads and manure storage areas, EQIP uses professional estimates as the basis for the project cost.

At one time, EQIP used competitive bidding to minimize program costs. However, in the 2002 Farm Bill, Congress eliminated language from the Farm Bill that required conservation programs to "maximize net environmental outcomes per dollar expended." As a result, the practice of bidding and selecting successful applications based on cost-effectiveness was eliminated as a requirement for the EQIP program.

What is a Reverse Auction?

In reverse auctions, multiple sellers compete to sell goods to a single buyer, as opposed to standard auctions in which multiple buyers compete to buy goods from a single seller. Reverse auctions are also known as "procurement auctions."

The bidding process is a key component of reverse auctions. By making bid selection competitive, the participants have an incentive not to inflate their bid beyond the minimum price they are willing to accept to implement or install the relevant practice(s), since an inflated bid may be rejected by the buyer. This pricing information is important to reverse auction administrators, who want to minimize the cost of achieving program goals. One study by the USDA Economic Research Service concluded that competitive bidding coupled with the use of performance-based indices was the most cost-effective allocation strategy for conservation funding.[3]

There are three possible bidding strategies for reverse auctions:

- *Bid for cost*. Bids are ranked according to cost and winning bids are funded from lowest to highest cost.
- *Bid for benefits*. Bids are ranked according to their total environmental outcomes and winning bids are funded from greatest to least environmental outcomes.
- *Bid for cost-effectiveness*. Bids are ranked and funded based on a combination of both costs and environmental outcomes (i.e., the cost-effectiveness of a bid at addressing specific resource concerns). Using this approach al-

lows program administrators to maximize environmental outcomes given a limited program budget.[4]

In the context of allocating conservation funding, reverse auctions using "bid for benefits" or "bid for cost-effectiveness" strategies must necessarily couple quantitative measures of environmental performance with competitive bidding to identify projects with the greatest expected environmental outcomes.[5]

The Conestoga Reverse Auction

The World Resources Institute (WRI), together with the Pennsylvania Environmental Council and other project partners, received a grant from the USDA/NRCS Conservation Innovation Grants Program to conduct two reverse auction demonstration projects in Pennsylvania's Conestoga watershed.[6] The Conestoga watershed is located primarily within the heavily agricultural community of Lancaster County. In 1996 the Conestoga watershed was listed as a phosphoros-impaired waterbody, with agriculture being the primary source of the phosphorus loadings. For this reason, the project team selected water quality as the focus of the reverse auction. The intent of the Conestoga Reverse Auction was to improve water quality within the watershed by compensating farmers for reducing phosphorus runoff through the implementation of BMPs.

The Conestoga Reverse Auction used a "bidding for cost-effectiveness" strategy. Winning bids were selected using both environmental outcomes—that is, the expected reduction in phosphorus runoff associated with a BMP—and cost, or the price farmers were willing to accept to implement a proposed BMP. A trial auction was conducted in June 2005. After administrative modifications were made to streamline the auction mechanism, a second reverse auction was conducted between October 2005 and February 2006.

During the auction sign-up period, farmers selected one or more BMPs they were willing to implement from a suite of practices similar to those available under EQIP. Technicians from the Lancaster County Conservation District (LCCD) then used a version of WRI's NutrientNet software to estimate the reductions in phosphorus runoff that were expected to result from implementation of the proposed BMP.[7] The expected reductions in phosphorus runoff were estimated based on several farm-specific variables, including current management practices and the location of the farm within the Conestoga watershed, as well as the best available science regarding the effectiveness of various BMPs at reducing phosphorus runoff.

Farmers were asked to bid the minimum payment they would be willing to accept to implement their chosen BMP. The farmer's bid price and the expected reductions in phosphorus runoff were then used to calculate the price per pound of reduced phosphorus runoff. The bids then were ranked according to their cost-effectiveness. Bids were accepted in order of cost-effectiveness until the reverse auction funds were exhausted.[8]

Comparing Reverse Auctions and EQIP Allocations

Within the Conestoga watershed, we examined the contracts funded through EQIP in December 2005 and those funded through the Conestoga Reverse Auction in February 2006. The projects funded by EQIP and the reverse auction are outlined in Table 1. In total, EQIP received 19 applications for the December 2005 enrollment period; of these, 13 were funded. We estimated the reduction in phosphorus runoff from the EQIP-funded projects using NutrientNet—the same software used to calculate reductions in phosphorus runoff in the reverse auction. Our results showed that EQIP-funded projects are expected to reduce approximately 10,520 pounds of phosphorus runoff over the life of the projects.[9] Total EQIP program expenditures for these 13 projects were $275,552.

The Conestoga Reverse Auction received 23 bids; of these, 13 were successful and funded. In aggregate, the reverse auction is expected to reduce phosphorus runoff within the watershed by 88,327 pounds over the life of the projects. The total expenditure for the reverse auction was $446,990.

Our analysis compares the performance of EQIP and the reverse auction in terms of reductions in phosphorus runoff and overall cost-effectiveness. Because the total program expenditures under the reverse auction were twice those of EQIP (Table 1), we created a virtual budget constraint of $293,000 for the reverse auction. Constraining the budget in this manner allows us to make a more valid comparison with the 2005 EQIP expenditures in the Conestoga watershed, which were $275,552.[10] This means that the first seven reverse auction contracts are compared to the 13 EQIP contracts. The shaded area in Table 1 represents the contracts that were funded in the reverse auction but not included in this comparison because they would fall outside of our virtual budget constraint of $293,000.

TABLE 1 Funded EQIP and Reverse Auction Contracts in the Conestoga Watershed

EQIP (December 2005)				Reverse Auction (February 2006)			
Project Type	**Payments† (cumulative)**	**Reductions in P Runoff (lbs)* (cumulative)**	**Cost-effectiveness† ($/lb) (cumulative)**	**Project Type**	**Bids† (cumulative)**	**Reductions in P Runoff (lbs)* (cumulative)**	**Cost-effectiveness† ($/lb) (cumulative)**
Livestock Mgt[a]	$4,500	2,219	$2.03	Livestock Mgt[a,p]	$84,000	35,576	$2.36
Field Mgt[b]	$1,829 ($6,329)	462 (2,681)	$3.96 ($2.36)	Livestock Mgt[a,p]	$59,000 ($143,000)	24,350 (59,926)	$2.42 ($2.39)
Field Mgt[c,d,e,f]	$19,099 ($25,428)	2,729 (5,410)	$7.00 ($4.70)	Field Mgt[e]	$1,678 ($144,678)	590 (60,516)	$2.84 ($2.39)
Livestock Mgt[a]	$4,200 ($29,628)	466 (5,876)	$9.01 ($5.04)	Livestock Mgt[g]	$36,722 ($181,450)	12,886 (61,106)	$2.85 ($2.47)
Livestock Mgt[a]	$9,000 ($38,628)	914 (6,790)	$9.85 ($5.69)	Livestock Mgt[n,j]	$3,185 ($184,635)	428 (73,992)	$7.44 ($2.50)
Livestock Mgt[a]	$9,000 ($47,628)	914 (7,704)	$9.85 ($6.18)	Field Mgt[m,o]	$2,000 ($186,635)	215 (74,420)	$9.30 ($2.52)
Livestock Mgt[a]	$6,249 ($53,877)	188 (7,892)	$33.24 ($6.83)	Livestock Mgt[a,p]	$106,000 ($292,635)	6,742 (80,787)	$15.72 ($3.62)
Livestock Mgt[a]	$1,320 ($55,197)	29 (7,921)	$45.52 ($6.97)	Livestock Mgt[p,q]	$104,140 ($396,775)	6,198 (86,985)	$16.80 ($4.56)
Livestock/ Field Mgt[e,a,g,h,c,f]	$56,190 ($111,387)	1201 (9,122)	$46.79 ($12.21)	Livestock Mgt[f]	$1,500 ($398,275)	78 (87,063)	$19.23 ($4.57)
Livestock/ Field Mgt[h,e,i,j,a,g,k]	$29,056 ($140,443)	382 (9,504)	$76.06 ($14.78)	Field Mgt[d,n]	$9,464 ($407,739)	282 (87,345)	$33.56 ($4.67)
Livestock/ Field Mgt[l,e,f,a,g,j,c,h]	$64,747 ($205,190)	628 (10,132)	$103.10 ($20.25)	Field Mgt[d,n]	$4,500 ($412,239)	129 (87,474)	$34.88 ($4.71)
Field Mgt[h,e,d,a,m,n]	$61,573 ($266,763)	346 (10,478)	$177.96 ($25.46)	Livestock Mgt[p,q]	$31,051 ($443,290)	785 (88,259)	$39.56 ($5.02)
Field Mgt[l,e,o,n]	$8,789 ($275,552)	42 (10,520)	$209.26 ($26.19)	Field Mgt[e]	$3,700 ($446,990)	68 (88,327)	$54.41 ($5.06)
Cumulative Total	$275,552	10,520	$26.19	Cumulative Total	$446,990	88,327	$5.06

† Some values are rounded.

*All phosphorus reductions are adjusted for delivery to the mouth of the Conestoga watershed. Where a project includes livestock and field management practices, the reductions in phosphorus runoff were estimated separately for each category and then added.

[a] nutrient management plan, [b] no till, [c] fence, [d] terraces, [e] grassed waterway, [f] stream crossing, [g] waste storage, [h] conservation cover, [i] pasture and hay planting, [j] heavy use protection, [k] roof runoff, [l] diversion, [m] contour farming, [n] subsurface drain, [o] strip cropping, [p] stacking pad, [q] animal composting

Funding Allocation Process

Unlike the ranking process in EQIP, the reverse auction used a quantitative approach to rank bids. Bids were ranked using the estimated reductions in phosphorus runoff and the bid price. The Pennsylvania EQIP ranking process, on the other hand, scored applicants based on an offer index using national, state, and local resource priorities. Some of the key differences are:

- EQIP considers more environmental resource concerns than just the ability to reduce phosphorus runoff when scoring each application. For example EQIP applications are also scored according to their ability to improve wildlife habitat and control for pests.
- EQIP considers various social equity concerns that are not represented in the reverse auction, such as being a low-income farmer. In Pennsylvania, social and equity concerns make up roughly 12 percent of the total possible points for each of the ranking sheets.
- EQIP uses a mixture of qualitative and quantitative approaches for awarding points. For example, some EQIP ranking sheets awarded points to applicants based on the number of practices they were willing to implement.
- The costs of implementing a BMP are not considered when awarding points or ranking applicants on the Pennsylvania EQIP ranking sheets.

Applicants and Funded Applications

Both the EQIP program and the reverse auction attracted farmers with similar farming enterprises and land uses, and funded a similar mix of BMPs. This is not surprising given the relatively small size of the Conestoga watershed and relative uniformity of farm sizes and nature of land uses. As shown in Table 2, roughly two-thirds of the funded EQIP and reverse auction contracts were for livestock management BMPs (for example, manure stacking pads and heavy use projection areas), and the remaining one-third were for field management BMPs (for example, contour strip cropping and grassed waterways). However, in the reverse auction, livestock management contracts make up nearly all of the funding and generated nearly all of the reductions in phosphorus runoff.

Expenditure and Reduction in Phosphorus Runoff per Contract

Individual contract expenditures generally tended to be higher in the reverse auction compared to those in EQIP (Figure 1 and Table 1). Likely factors accounting for this include:

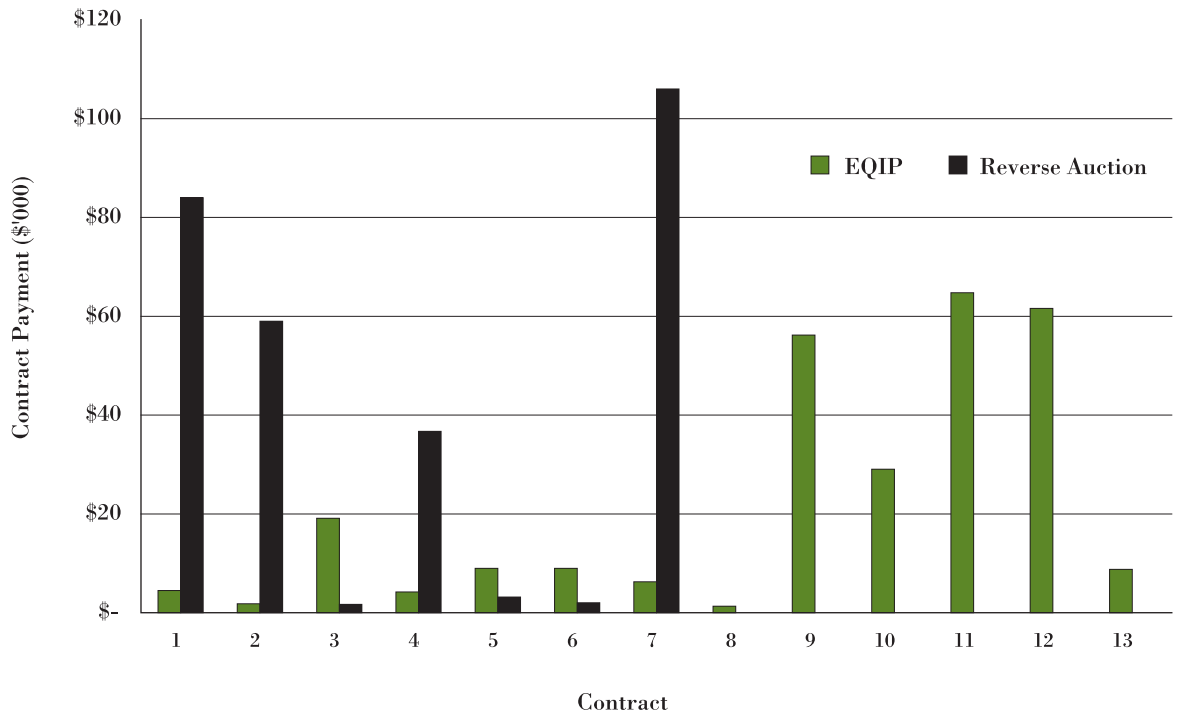
- In the reverse auction, there was no restriction on the maximum price farmers could bid. Several bids reflected the expected total project costs, whereas in EQIP, contract payments are based on fixed-rate payments for certain practices and cover no more than 75 percent of total project costs.
- As the reverse auction did not limit participants to bidding the standard cost-share payment rates, it attracted farmers with a higher "willingness to accept" (that is, those that would not have participated in EQIP because

TABLE 2 Categories of Best Management Practices Funded by the Conestoga Reverse Auction and EQIP

	Livestock Management		Field Management	
	EQIP	**Reverse Auction**	**EQIP**	**Reverse Auction**
Number of Funded Projects *(% of Funded Projects)*	9 *(69%)*	5 *(71%)*	4 *(31%)*	2 *(29%)*
Program Costs for Projects *(% of Program Budget)*	$184,262 *(67%)*	$288,957 *(99%)*	$91,290 *(33%)*	$3,679 *(1%)*
Phosphorus Reductions† *(% of Total P Reduction)*	6,941 *(66%)*	79,982 *(99%)*	3,579 *(34%)*	805 *(1%)*

† Reductions in phosphorus runoff were estimated using NutrientNet and are in pounds of phosphorus runoff reduced over the entire useful life of the BMP. They are adjusted for delivery to the mouth of the Conestoga watershed.

FIGURE 1 Individual Reverse Auction and EQIP Contract Payments



they were unwilling or unable to pay the farmer's share of the project costs as stipulated by EQIP).

- The competing presence of the EQIP program resulted in strategic bidding where farmers were unwilling to place bids that would result in a lower payment than they would receive through EQIP—reasoning that if their bid in the reverse auction was unsuccessful, they had the option of applying to EQIP the next year.

Overall the reverse auction contracts resulted in greater reductions in phosphorus runoff on a per contract basis (Figure 2). As a result, many of the reverse auction bids were more cost-effective than EQIP contracts despite the higher bid prices.

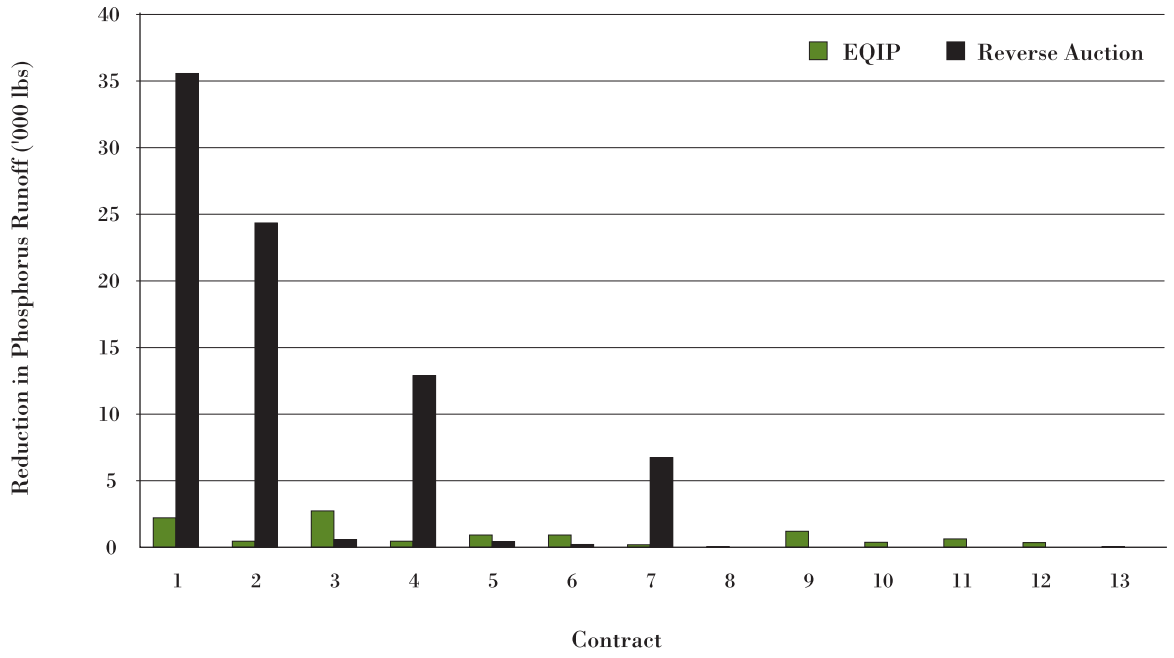
Cost-effectiveness

Cost-effectiveness in this comparison refers to the average *program* cost of reducing a pound of phosphorus runoff.[11] The average cost-effectiveness of the EQIP contracts was $26.19/lb of phosphorus, while the average cost-effectiveness of the reverse auction was $3.62/lb of phosphorus (Table 3). This is approximately a seven-fold increase in cost savings in the reverse auction. The least cost-effective winning bids in the reverse auction and EQIP, respectively, were $15.72/lb phosphorus reduced[12] and $209.26/lb phosphorus reduced—further illustrating the magnitude of price differences between the two programs.

Several factors may contribute to the difference in cost-effectiveness between the two programs:

- *Single versus multiple environmental resource concerns.* The reverse auction ranked bids based on a single environmental outcome (reductions in phosphorus runoff), whereas the EQIP offer index ranked applications according to several resource concerns, not just water quality. Therefore, some EQIP contracts that appear to be less cost-effective in reducing phosphorus runoff may have ranked higher in terms of other resource or equity concerns considered in the offer index. However, the Pennsylvania EQIP ranking forms are weighted heavily towards water quality resource concerns. Between 57 and 84 percent of the points are awarded for activities that improve water quality (through both nutrient management and soil erosion control measures).[13] In addition, the mix of BMPs funded by EQIP and those funded by the reverse auction were similar

FIGURE 2 Estimated Reductions in Phosphorus Runoff by Program



and therefore likely to produce a similar mix of environmental outcomes.

- *Environmental outcomes versus BMP adoption*. The reverse auction evaluated bids according to cost-effectiveness, which was based on quantitative measures of expected environmental outcomes (that is, the reduction in phosphorus runoff per dollar spent). In contrast, EQIP emphasized the adoption of best management practices. Because the EQIP offer index awards more points to applicants who agree to implement more BMPs, applications that included multiple practices tended to rank higher and were funded. Of the 13 funded EQIP applications, 6 included more than two practices, whereas none of the bids in the reverse auction included more than two practices (see Table 4). The average cost-effectiveness of EQIP contracts with more than 2 practices is $44.94/lb of phosphorus, while those with one or two practices was $6.95/lb of phosphorus. It appears that contracts with more than 2 practices were less cost-effective overall because additional practices led to higher overall costs but achieved diminished marginal phosphorus reductions.
- *Differences in applicant pool.* Because the reverse auction did not limit bid prices, it attracted farmers who may not have otherwise participated in EQIP. Because some BMPs are costly to implement (for example, manure storage systems often cost as much as much as $100,000

TABLE 3 Comparison of the Average Cost-Effectiveness Between Programs

Program	Number of Projects Funded	Total Cost ($)	Total Estimated Phosphorus Reduction† (lbs of P)	Cost-effectiveness ($/lb P reduced)
EQIP	13	$275,552	10,502	$26.19
Reverse Auction	7	$292,635	80,787	$3.62

† Phosphorus reductions are estimated over the entire useful life of the BMP using NutrientNet.

TABLE 4 Comparison of Average EQIP Cost-effectiveness Based on the Number of Practices

Number of practices per EQIP contract	Number of Projects Funded	Total Cost	Total Estimated Phosphorus Reduction† (lbs)	Cost-effectiveness ($/lb of P)
2 or less	7	$36,098	5,192	$6.95
more than 2	6	$239,454	5,328	$44.94

† Reductions in phosphorus runoff are estimated over the entire useful life of the BMP using NutrientNet.

per system), some farmers are not willing, or cannot afford, to implement these practices even with the EQIP cost-share funding. This was the situation for at least one reverse auction participant. The farmer needed a manure management system on his recently purchased farm and had been approached by LCCD technicians to enroll in earlier EQIP rounds. However, he had refused based on his own financial constraints. He was, however, willing to participate in the reverse auction because the auction provided enough flexibility to cover all of his project costs. It turns out that his bid was one of the most cost-effective in the auction. The ability of the reverse auction to attract these types of farmers helped improve its overall cost-effectiveness.

Implementing Performance-Based Strategies to Maximize Conservation Funding

The comparison between the traditional EQIP program funding allocation and a reverse auction suggests that government could significantly increase the effectiveness of its conservation funding by implementing the principles employed by reverse auctions. While our results indicate a seven-fold increase in the cost-effectiveness of conservation funding (based on program dollars per pound of phosphorus runoff reduced), we realize that our sample size is small and these results may not be typical. However, many other reverse auction pilots have demonstrated substantial cost savings over traditional allocation methods. For example, USDA's Wetland Reserve Program piloted the use of auctions to reduce the acquisition costs of wetland easements in 2006 and 2007. In the 2006 auction, enrollment applications were prioritized according to an environmental benefits index determined by dividing the landowner bid by an environmental self-assessment score. The 2006 auction enrolled 3,500 acres into the program and reduced acquisition costs by around 14 percent, or $820,000.[14]

Given the effectiveness of reverse auctions in maximizing environmental outcomes for every program dollar spent, policy-makers should consider revising traditional funding allocation strategies within working lands programs like EQIP to incorporate the principles used in reverse auctions. Specifically, the following elements can significantly improve the cost-effectiveness of conservation funding:

- Incorporate improved quantitative measures of environmental outcomes (for example, pounds of phosphorus runoff reduced) so that payments can be made based on environmental performance rather than by type and/or number of BMPs.[15]
- Include cost-effectiveness as a factor for evaluating applications.
- Incorporate provisions for applicant bidding. Competitive bidding has the potential to further minimize program costs by revealing the minimum price a producer is willing to accept to implement certain practices.

Some steps that will help implement these concepts into conservation programs include:

- Develop tools to consistently and transparently quantify the multiple environmental outcomes of BMPs.
- Insert language into future Farm Bill legislation and state funding programs that mandates the use of cost-effective allocation strategies for working lands programs.

Notes

1. See T. Searchinger and S. Friedman. 2003. *Getting More Bang for The Buck: Nine Suggestions For Improving State EQIP Ranking Criteria: A Discussion Paper*. Washington, DC: Environmental Defense.
2. See http://www.pa.nrcs.usda.gov/programs/eqip/ranking.html for the Pennsylvania EQIP ranking forms.
3. See A. Catteneo, R. Claassen, R. Johansson, and M. Weinberg. 2005. *Flexible Conservation Measures on Working Land*. Washington, DC: USDA ERS.
4. See R. Johansson. 2006. *Conservation Program Design: Participant Bidding Enhances Cost Effectiveness*. Economic Brief Number 3. Washington, DC: USDA ERS.
5. See S. Greenhalgh, M. Selman, and J. Guiling. 2006. *Paying for Environmental Performance: Investing In Farmers and The Environment*. WRI Policy Note Environmental Markets No. 2. Washington, DC: World Resources Institute.
6. Other project partners include Lancaster County Conservation District, NatSource LLC, and The Conservation Fund.
7. Estimating environmental outcomes requires tools that are able to consistently estimate the environmental performance of various BMPs. For more details on how to quantitatively estimate the environmental performance of agricultural BMPs, see Guiling and St. John. 2007. ***Paying for Environmental Performance: Estimating the Environmental Outcomes of Best Management Practices***. Washington, DC: World Resources Institute. Visit http://conestoga.nutrientnet.org to see the on-line tool developed to estimate environmental outcomes for the Conestoga Reverse Auction.
8. For more details on the reverse auction, see Greenhalgh, Guiling, Selman, and St. John. 2007. ***Paying for Environmental Performance: Using Reverse Auctions to Allocate Funding for Conservation***. Washington, DC: World Resources Institute.
9. The life of the project refers to the period of time over which the BMP will reduce phosphorus runoff. For instance, the life of a cover crop is 1 year, while the life a stacking pad is 15 years.
10. Alternately, we could have constrained the reverse auction budget at $187,635 (including only the first 6 contracts). This would have resulted in an overall cost-effectiveness of $2.52/lb. However, it was felt that this budget constraint may be perceived as biased toward maximizing the cost-effectiveness of the reverse auction, so the decision was made to include the seventh contract.
11. Our analysis is focused on the cost-effectiveness of program dollars. We do not look at cost-effectiveness in terms of total dollars spent—that is., the sum of public (or government payment) and private (or farmer/rancher payment) dollars.
12. Without the artificial budget constraint in the reverse auction, the highest price paid was $54.41 per pound of phosphorus reduced.
13. Pennsylvania developed four ranking sheets to rank various on-farm management activities. The ranking sheets include livestock, cropland, no-till, and nutrient management. The number of points available for activities that improve water quality varied by ranking sheet as follows: livestock, 57 percent, cropland, 68 percent, no-till, 76 percent, and nutrient management, 84 percent.
14. NRCS. 2006. "Reverse auction saves wetlands and money." Available online at: http://www.nrcs.usda.gov/news/releases/2006/reverseauctionpilotresults.html
15. See S. Greenhalgh, M. Selman, and J. Guiling. 2006. ***Paying for Environmental Performance: Investing in Farmers and the Environment***. WRI Policy Note Environmental Markets No. 2. Washington, DC: World Resources Institute.

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Related Policy Notes

Suzie Greenhalgh, Mindy Selman, and Jenny Guiling. 2006. *Paying for Environmental Performance: Investing In Farmers and the Environment*. Washington, DC: World Resources Institute.

Suzie Greenhalgh, Jenny Guiling, Mindy Selman, and Michael Taylor. 2007. *Paying For Environmental Performance: Using Reverse Auctions to Allocate Funding For Conservation*. Washington, DC: World Resources Institute.

Jenny Guiling and Jon St. John. 2007. *Paying for Environmental Performance: Estimating the Environmental Outcomes of Agricultural Best Management Practices*. Washington, DC: World Resources Institute.

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