Great Lakes Watershed Ecological Sustainability Strategy Phase II: Transactions for Agricultural Ecosystem Services

Designing Transactions to Gauge Farmer Willingness to Provide Environmental Services in the Lake Erie Basin

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Overview and Objectives

Agricultural best management practices (BMPs) can reduce the negative impacts of agricultural production on surrounding ecosystems while maintaining productivity; but BMPs are effective only if farmers adopt them. A host of factors affect farmer choices about adopting new practices, including costs, benefits, personal preferences, and risk. Some BMPs offer environmental benefits but reduce farm profitability. Often in these cases, farmers will only adopt the BMP when incentives are offered in return. Using conservation procurement (reverse) auctions, our project identifies incentives that can effectively motivate voluntary BMP adoption.

In order to get the greatest conservation impact from limited funds for incentive payments, two kinds of information are essential. The first is a reliable prediction of ecosystem benefits from adopting the BMP on a specific farm. Well validated ecological simulation models are increasingly able to provide sound predictions. The second is an understanding of the costs, benefits, and preferences that affect farmers' willingness to accept payments for BMP adoption. An effective way to learn about both the farm and the farmer is to use procurement auctions in which farmers compete to win the low bid to offer conservation benefits from BMP adoption. Such auctions can be designed so that farmers reveal the minimum payment that they are willing to accept in order to adopt a given BMP, based not only on the cost of adopting it, but also on their attitudes about the benefits it would engender. Knowledge of the minimum payments that farmers are willing to accept for BMP adoption can inform the design of cost-effective transactions for future programs.

In Year 2 of the project, "Great Lakes Watershed Ecological Sustainability Strategy (GLWESS) Phase II: Transactions for Agricultural Ecosystem Services," farmer focus groups will be used to pilot test conservation procurement auctions, using four types of incentives to encourage BMP adoption: 1. direct payments, 2. tax reductions, 3. payments + yield protection insurance, and 4. market price premiums. Farmers will compete for conservation contracts through a competitive bidding process. Two hydrological models managed by the LimnoTech team – Soil and Water Assessment Tool (SWAT) and Western Lake Erie Ecosystem Model (WLEEM) – will inform the ranking of bids by predicting the magnitude of aquatic ecological benefits from those practices in the farm's specific geographical setting. In multiple rounds of bidding, we will compare individual bidding with a collective bidding mechanism designed to

motivate the kind of coordinated landscape management needed for aquatic improvements within a watershed.

Using procurement auctions as a tool, this project will evaluate the cost-effectiveness of various transaction types that can lead to widespread adoption of agricultural practices that improve aquatic ecology in the Great Lakes. Under the GLWESS overarching objective 3b, designing transactions to gauge farmer willingness to provide environmental services in the Lake Erie Basin, the plan for pilot conservation auctions has three primary objectives:

i. To design conservation auctions that will result in the cost-effective procurement of environmental services in the Lake Erie Basin (results will be applicable to other areas).

ii. To compare the effectiveness of four types of transactions used to expand BMP adoption.

iii. To identify auction mechanisms and incentive combinations that lead to widespread collective land management.

Incentives via transactions

Paying farmers to provide environmental services has become the standard incentive used by government and NGOs to induce voluntary provision of enhanced ecosystem services in the United States (Kroeger and Casey, 2007). Payment for environmental services (PES) contracts vary – some rely on cost-share agreements for BMP adoption, while others provide annual payments for general land and water stewardship. By facilitating markets for environmental goods, PES programs have led to enhanced provision of ecosystem services in a number of cases.

PES programs are not necessarily cost-effective at inducing BMP adoption that leads to environmental benefits. For example, when landowners are predisposed to adopt the BMP without payment, a PES program may actually discourage participation by compromising an individual's sense of autonomy (Bowles and Polanía-Reyes, 2012). In some settings, collective action may lead to greater provision of environmental goods than the individual actions typically fostered by PES programs. Also, when target adopters are risk averse and perceive exaggerated risks from BMP adoption, they may insist upon higher PES compensation than would be necessary if risks were accurately perceived. The proposed research will address all three of these concerns in exploring cost-effective ways to induce adoption of BMPs that generate ecological benefits.

One alternative to paying directly for environmental goods is to reduce current taxes or fees incurred by the farmer. Evidence suggests that many individuals are loss averse, which implies that they would rather avoid a loss than acquire an equal sized gain (Marzilli Ericson and Fuster, 2011). This preference may imply that conservation programs could be more cost-effective by reducing farmers' taxes or fees instead of making payments for conservation.

Farmers are often hesitant to adopt suggested practices because of perceived risk and/or beliefs that BMPs will reduce yields. Crop yield insurance[1] linked to BMPs has the potential to facilitate the adoption of environmentally sound BMPs when farmers are risk averse and misperceive the downside risk of BMPs on farm profitability (Mitchell and Hennessy, 2003). BMP insurance, also called "green insurance" has been identified as one tool to overcome risk perceptions and promote BMP adoption by allowing farmers to try the management practices risk-free.

Another alternative means to induce improved agro-environmental management is via programs that certify stewardship. Certification[2] programs verify and monitor production methods. Certification provides a market signal about farmers' actions to promote ecosystem health. Benefits to farmers could take the form of price premiums for sustainably produced agricultural goods or increased access to markets. Even without market benefits, some farmers may seek certification for social recognition or because the standards align with their personal preferences for environmental stewardship. This project will explore the cost-effectiveness of an environmental certification program that confers market benefits to producers.

Designing procurement auctions

Conservation procurement auctions allow multiple sellers of environmental goods to compete for contracts from a buyer of environmental goods. These are sometimes called "reverse auctions" because the winner is the bidder who offers to accept the lowest (rather than highest) payment. Through the bidding process, auctions reveal private information about the sellers' costs and preferences. That information can be used to design cost-effective incentives for farmers to manage for environmental benefits. The accompanying literature review outlines the theoretical underpinnings of appropriate reverse auction design[3]. To be successful in practice, reverse auctions should be easy for farmers to understand, thus requiring a simple and efficient protocol[4]. Our project will use pilot auctions with focus groups to test auction design principles suggested in the literature and to develop an effective auction mechanism to use for real procurement auctions.

[1] See attached literature review, "Using BMP Insurance to Improve Farm Management" by Leah M. Harris and Scott M. Swinton (Dec. 2012).
[2] See attached literature review, "Prospects for using supply chain standards to reduce water pollution by commodity crops in the Great Lakes Basin: a review." By Kurt Waldman, John Kerr, and Katherine Groble (Dec. 2012).
[3] See attached literature review, "Designing Effective Conservation Auctions" by Leah M. Harris and Scott M. Swinton (Dec. 2012).
[4] Observation based on conversations with Tom Van Wagner (NRCS) about conservation auctions in Lenawee, MI.

Pilot Auctions

Pilot auctions will test various auction mechanisms and refine the ranking procedure using the ecological models developed by LimnoTech. The pilot auctions will be conducted based on constructed farm scenarios. The pilot procurement auctions will not result in actual BMP implementation on participants' farms. Rather, they will be run as experimental auctions to compare the cost-effectiveness of different transaction types so as to identify the best one(s) for use in the GLWESS Year 3 auctions. By presenting auction participants with constructed scenarios, we expect three primary benefits: (1) farmers will have relevant production information immediately at hand, allowing for timely bid formulation during the 2-3 hour focus group, (2) ecological model simulations can be run before the experimental auctions are held, allowing rapid ranking of bids during the focus groups, and (3) farmers can participate in multiple auctions to test various design strategies.

Before inviting farmers to participate in focus groups, four test runs of the auction set-up will be conducted with students from Michigan State University. Following the test auctions, a total of four focus groups will be convened for reverse auctions, with 16 farmers in each session. Focus group participants will be restricted to farmers within the Maumee watershed (excluding the Tiffin subwatershed[5]). We will recruit participants in cooperation with The Nature Conservancy and extension personnel at Michigan State University and The Ohio State University. The focus group agendas will include three stages: (1) welcome and information collection about participants' farms, (2) introduction and auction example, and (3) pilot auctions. Subsequent to the focus group meeting, participants will be invited to engage in a follow-up auction based on their actual farms. All participants will be paid a flat amount for participating and will have the opportunity to win additional money during the experimental auctions. The following sections describe how the hypothetical farms will be constructed, how ecological outputs will be ranked, and how the pilot auctions are designed.

(i) Constructing hypothetical farms for the pilot auctions

Each focus group will include 16 farmer participants and thus require the creation of 16 hypothetical farms. As illustrated in Figure 1 at the end of this document, the 16 farms will be divided evenly into four groups, which will each be assigned to a different subbasin. Within each group, the four farms will be located in close proximity – two farmers will be closer to a stream and two farmers will be further away (see Figure 1). Two of the four farms in each group will be classified as "large" operations and the other two classified as "small" farms. Large farms will consist of two fields – one that is 300 acres and another that is 100 acres. Small farms will consist of one 150 acre field and another 50 acre field.

Two soil types will be assigned to each group according to the most common soils in the subbasin. Each soil type will be assigned to a set of small and large farms in the same subbasin.

[5] Farmers located in the Tiffin subwatershed will be invited to participate in the conservation auctions in Year 3. Farmers in this area will be excluded from the pilot auctions to avoid overexposing these famers to the procurement auctions.

The two fields that constitute a single farm will be assigned the same land characteristics, including soil type. Table 1 lists the soil type assignments by subbasin.

In the pilot auction, farmers will be provided with a map that shows the location of their farm relative to others. Farmers will also be provided with a card that describes their farm, including its size, soil type, current crop rotation, current input use, annual production plan, commodity prices, expected yields, and costs of alternative production practices.[6] During the pilot auction, farmers will make bids on five or more BMPs from the following list: winter cover crops, no fall fertilizer application, fertilizer reduction, no-till, and 30 foot filter strip installation.

(ii.) Ranking ecological outcomes

Bids for the BMP scenarios will be ranked based on an index of cost-effectiveness – i.e. cost divided by ecological benefit. Low values are associated with higher cost-effectiveness. The cost portion the ranking will be determined by a farmer's bid. The ecological benefit will be computed based on the predicted reduction of total phosphorus (TP) flowing off of the fields to waterways that lead to the Western Lake Erie Basin. Predicted reductions will be computed by the LimnoTech team using two models – Soil and Water Assessment Tool (SWAT) and Western Lake Erie Ecosystem Model (WLEEM). Rankings for the pilot auctions will depend on the geographic characteristics of the constructed farm (defined by the hydrological response unit (HRU) classification) and the farm's location within the Maumee Watershed (defined by the 12 digit hydrological unit code (HUC-12) zone).

Total reduction of TP from BMP adoption will be a weighted average of the predicted reduction in TP delivery at two points[7], the nearest surface water to the farm field and the mouth of Lake Erie. Contribution of TP to the nearest surface water will be strongly influenced by soil type and topography of the farm's HRU . Delivery to the mouth of Lake Erie will be calculated by multiplying the stream delivery of TP by a transfer coefficient assigned to the HUC-12 zone in which the farm is located. Weighting TP delivery at these two points captures the impact of the BMPs at two stages: local stream impacts (e.g. fish health) and lake impacts (e.g. reduced algal blooms).

(iii.) Pilot auction design

Pilot auctions are meant to test the effect of three different design treatments. The first treatment (Auctions 1 & 2) examines how farmers' willingness to adopt agricultural conservation practices is influenced by four transaction types: 1. direct payments (PES), 2. fee or tax reductions, 3. direct payments + BMP yield insurance, and 4. market price premiums linked to certification. The second treatment (Auction 3) investigates how farmers can be encouraged to coordinate their actions using group bidding incentives. The third treatment (Focus Groups B & D as compared to groups A & C) tests how bidding behavior changes between a single round

[6] Farm characteristics that are important to disclose have been selected based on farmer interviews.

[7] This approach is similar to the methodology used by the Lenawee County Conservation District for ranking conservation auction bids (Contact: Tom Van Wagner, USDA-NRCS District Conservationist).

auction and a multi-stage auction. To test the three treatments, auction set-up will vary between focus groups as follows.

Focus Groups A & C – Procurement auctions with second stage bidding

Each of the auctions will consist of 4 stages:

1. First round of bidding
2. Rank bids and accept most cost-effective bids.
3. Bidders with rejected bids in round one can resubmit bids in a second round
4. Announce round two bid acceptance and make payments.
5. After each auction farmers will be asked to rank the underlying motivations that affected their actions in the auction.

Separate auction for each Transaction Type with Auctions 5 & 6 testing group bids

Auction 1a: Direct payments
Auction 1b: Fee/tax reduction
Auction 1c: BMP yield insurance + direct payments
Auction 2: Market benefits associated with certification
Auction 3: Individual payments that are triggered when participation exceeds a predetermined threshold

Auctions 1a, 1b, and 1c will be implemented using a single bid sheet to allow farmers to consider the tradeoffs between the incentives. To deter strategic game behavior, payments will only be made for one randomly selected auction.

Auction 2 focuses on eliciting farmers' willingness to adopt a suite of BMPs in exchange for benefits tied to certification. In this auction, farmers will be bidding on the lowest market price premium (for corn and soybeans) required for them to seek certification.

Auction 3 focuses on encouraging higher aggregate adoption of BMPs by tying payment implementation to a trigger threshold for group enrollment.

Focus Groups B & D – Procurement auctions without second stage bidding

Auctions in Workshops B & D will follow the same format as that in Workshops A & C, but with only a single round of bidding. Participants *will **not** be able to adjust bids* and participate in a second stage of bidding.

Although auction setup will vary between focus groups, several design factors will remain constant. As in other conservation auctions, bids will be sealed and bid acceptance will begin with the highest ranked bid and continue until the budget constraint is met (Smith et al., 2009; Stoneham et al., 2003). Participants will have the option to opt out of each auction, but will be asked to explain their decision. Farmers will be paid based on a discriminatory pricing

system in which they receive the amount of money they bid. This type of pricing system results in more cost-effective procurement of environmental benefits (Cason and Gangadharan, 2004; Connor et al., 2008; Rolfe et al., 2009).

The appropriate number of rounds in a procurement auction is debated in the literature. Some research suggests using single round auctions to avoid issues with strategic bidding behavior and collusion (Latacz-Lohmann and Schilizzi, 2005; Rolfe et al., 2009). On the other hand, multiple rounds may increase efficiency when bidders are inexperienced by facilitating the learning process (Cason and Gangadharan, 2004; Lusk et al., 2004). The lack of consensus on this design issue will be explored in the pilot auctions. Half of the auctions will consist of two rounds and the other half will be a single round so that efficiency gains or losses can be evaluated after the fact.

Following the auctions, participants will complete an exit questionnaire to debrief the motivation for their decisions during the auctions.

In order to test the feasibility and potential participation rates in online auctions, follow-up auctions will be conducted online[8] after the workshop. Farmers will receive additional payment upon completion of online auction. Bids submitted in the online auction will be associated with the farmers' actual farm enterprise and bids will be ranked based on information gathered by the questionnaire completed during the focus group.

Conservation auction

In the final year of the project, farmers across the Tiffin Watershed will have the opportunity to participate in a conservation auction. Farmers will bid on contracts to adopt one or more of several BMPs with potential to significantly reduce phosphorus loads in streams and lakes. The design for these auctions will be based on the results and success of various auction mechanisms tested during the pilot auctions.

Action plan moving forward

Year 2 – Practice pilot auctions with MSU students will be held during January-February, 2013. Based on lessons from the practice auctions, farmer focus groups with pilot auctions will be conducted in July-August 2013. Data analysis and preliminary results will be completed by the end of 2013.

Year 3 – Informed by the pilot auction results, conservation auctions will be held in January, 2014. Farmers will be notified about bid acceptance by March, 2014 and BMP implementation will occur in the 2014 growing season. A report of analysis from the pilot auctions will be completed for diffusion.

[8] Farmers will be given the option to mail in their bids.

Conclusion

Using procurement auctions as a tool, this project activity area will identify cost-effective incentives that can lead to widespread adoption of agricultural practices that improve water resources in the Great Lakes. Results from our research can help regulators understand farmer willingness to adopt new BMPs and will guide the development of incentive programs that motivate coordinated land management leading to enhanced aquatic benefits across a watershed.

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Figures and Tables

Figure 1. An example of how four groups of four farms might be stratified across the watershed.

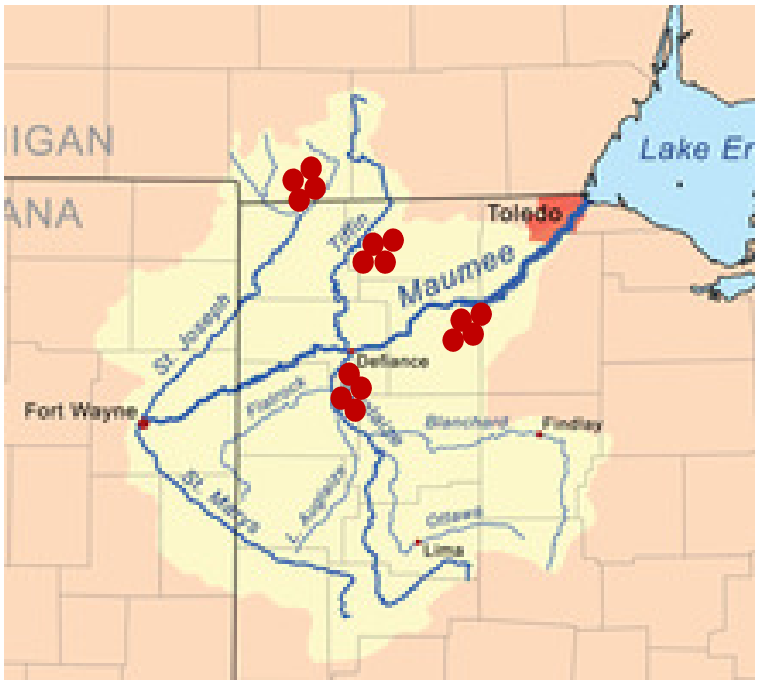

Table 1. Soil type assignments for each group of hypothetical farms. Each set contains a large farm (400ac) and small farm (200ac).[9]

Group	Subwatershed	Farm Type	Soil Name
1	St. Joseph	Set 1	GLYNWOOD
		Set 2	MIAMI
2	Tiffin	Set 1	OTTOKEE
		Set 2	LATTY
3	Lower Auglaize	Set 1	PAULDING
		Set 2	TOLEDO
4	Lower Maumee	Set 1	HOYTVILLE
		Set 2	MERMILL

[9] Table created by Todd Redder, Senior Project Engineer, LimnoTech, 12/6/2012.