WINROCK INTERNATIONAL

PAY-FOR-PERFORMANCE CONSERVATION:
A HOW-TO GUIDE

delta institute

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Water quality impairments resulting, in part, from agricultural nutrient runoff have remained stubbornly difficult to solve in the United States.

EXECUTIVE SUMMARY

Water quality impairments resulting, in part, from agricultural nutrient runoff have remained stubbornly difficult to solve in the United States. In U.S. freshwaters alone, the cost of eutrophication is estimated to total at least $2.2 billion annually.[1] Fortunately, **farmers can cost effectively implement land management changes which minimize soil erosion and nutrient losses from their fields**. These agricultural changes, which do not disrupt commodity production in our agricultural lands, are often more cost-effective than urban-based approaches to mitigate pollution. Several government programs already exist to support farmers implementing improved practices. Historically these are 'pay-for-practice' programs, in which standardized financial payments are provided for a set of standardized management practices, regardless of the local field conditions. When these programs were initiated, the existing data and technology prevented cost-effective estimation of the nutrient reductions resulting from a specific change in practice for a given location.

In this guidance document, we present an alternative **"pay-for-performance" (PfP) conservation approach** that capitalizes on scientific and technological advances to deliver cost-effective and quantifiable estimates of nutrient reductions. Under the PfP program, field and farm specific information is combined with nutrient and economic modeling to find the most technically and cost-effective ways to reduce nonpoint source pollution. Payments to farmers are then based on the quantified estimate of nutrient reductions. The combination of a challenging problem, the freedom to creatively collaborate on a solution to that problem, and a data-driven framework for making decisions and providing incentive payments is powerful motivation for farmer involvement in solving a water quality problem.

We intend for this guidance document to serve as a **handbook** to **agricultural and conservation organizations** as well as **publicly-owned treatment works** (POTWs) and municipalities who are interested in planning and implementing a flexible solution to agricultural nonpoint source pollution. This guide strives to not only describe the **steps of implementing a new program**, but also to provide **examples of challenges and successes** from our experience administering these programs in Iowa, Vermont, Ontario, and in the Great Lakes region including Wisconsin, Michigan, and Ohio.

PfP conservation creates an exciting new framework for engaging farmers and other stakeholders, providing customized information about farming operations and solutions for how to best tackle "hot spots" or "problem areas" on specific farm fields. PfP has the potential to empower farmers to play an active, cost-effective, and significant role in meeting conservation and water quality goals.

1 Dodds, W. K., Bouska, W. W., Eitzmann, J. L., Pilger, T. J., Pitts, K. L., Riley, A. J., Schloesser, J.T. & Thornbrugh, D. J. (2009). Eutrophication of U.S. Freshwaters: Analysis of Potential Economic Damages. Environmental Science & Technology, 43(1), 12-19.

OVERVIEW

From the fluctuating "dead zone" in the Gulf of Mexico, to harmful algal blooms (HABs) in the Great Lakes, to sedimentation and eutrophication in the Chesapeake Bay, water quality problems have remained stubbornly difficult to solve in the United States.

Nutrient and soil loss from agriculture contribute to excess nutrients in our waterways, which promote the overgrowth of algae. High nutrient loading can begin a cascade of effects, leading to toxic excretions from algae, depletion of dissolved oxygen, and fish kills. In Lake Erie, after steady water quality improvements for two decades, benthic algae problems and cyanobacteria blooms returned in the mid-1990s, a problem primarily blamed on dissolved reactive phosphorus draining from agricultural fields.[2] In the Chesapeake Bay from 2013-2015, 63% of tidal tributaries still did not meet water quality standards,[3] and agriculture is the largest contributor to both nitrogen and phosphorus in the region.[4] These problems can cause significant economic losses, including losses from fishing and tourism. In U.S. freshwaters alone, the cost of eutrophication is estimated to total at least $2.2 billion annually.[5] Fortunately, farmers can cost effectively implement land management changes which minimize soil erosion and nutrient losses from their fields. These agricultural changes which do not disrupt commodity production in our agricultural lands, are often more cost-effective than urban-based approaches to mitigate pollution.

Pay-for-performance (PfP) conservation is a mode of providing flexible conservation options to farmers while delivering quantifiable water quality benefits in agricultural watersheds. It is an exciting new approach to engage farmers in conservation by finding the most technically- and cost-effective ways to reduce nonpoint source pollution from farmland. However, PfP is not a one-size-fits-all solution, and many components are necessary to make a PfP program successful. This guidance document synthesizes the experiences of Winrock International and Delta Institute, who have worked separately on PfP pilot programs in the U.S. and Canada since 2006, and together administered a PfP pilot program in the West Branch of the Milwaukee River in southeast Wisconsin from 2013-2017.

2 Scavia, D., Allan, J. D., Arend, K. K., Bartell, S., Beletsky, D., Bosch, N. S., Brandt, S. B., Briland, R. D., Daloğlu, I., DePinto, J. V., Dolan, D. M., Evans, M. A., Farmer, T. M., Goto, D., Han, H., Höök, T. O., Knight, R., Ludsin, S. A., Mason, D., Michalak, A. M., Richards, R. P., Roberts, J. J., Rucinski, D. K., Rutherford, E., Schwab, D. J., Sesterhenn, T. M., Zhang, H., Zhou, Y. (2014). Assessing and addressing the re-eutrophication of Lake Erie: Central basin hypoxia. Journal of Great Lakes Research, 40(2), 226-246.

3 Chesapeake Bay Program. (n.d.). "Water Quality Standards Achievement". http://www.chesapeakebay.net/indicators/indicator/achievement_of_chesapeake_bay_water_quality_standards

4 Chesapeake Bay Foundation. (n.d.). "Nitrogen & Phosphorus". http://www.cbf.org/about-the-bay/issues/dead-zones/nitrogen-phosphorus

5 Dodds, W. K., Bouska, W. W., Eitzmann, J. L., Pilger, T. J., Pitts, K. L., Riley, A. J., Schloesser, J.T. & Thornbrugh, D. J. (2009). Eutrophication of U.S. Freshwaters: Analysis of Potential Economic Damages. *Environmental Science & Technology, 43*(1), 12-19.

Intended Audience

This document will serve as a comprehensive guide to agricultural and conservation organizations as well as publicly-owned treatment works (POTWs) and municipalities who are interested in planning and implementing a flexible solution to agricultural nonpoint source pollution. Though water quality problems are found in many locations across the U.S. and the globe, and though PfP could be adapted to any region, we will focus most of our examples and commentary in this document to the Great Lakes basin. This guide strives to not only describe the steps of implementing a new program, but also to provide examples of challenges and successes from our experience administering these programs.

This guidance document and the PfP project in the West Branch of the Milwaukee River was funded by the Great Lakes Protection Fund in support of their mission to identify, demonstrate, and promote regional action to enhance the health of the Great Lakes ecosystem. Authored by Winrock International and Delta Institute, this document is the product of lessons learned during this project and the project team's combined experience implementing and managing other PfP projects in a variety of locations including Iowa, Vermont, Ontario, Michigan, and Ohio.

Guidance Document Layout

The guidance provided herein is aimed at practitioners in the agricultural conservation space, including project planners as well as program administrators and on-the-ground implementers. The document is divided into the following sections:

1. **Is pay-for-performance right for you?**
Here we will introduce the concept, compare it to related agricultural conservation programs, and provide the precursors to a successful program.

2. **Laying the groundwork for pay-for-performance for project planners and program administrators.**
This section will provide guidance on foundational work that should be completed in advance of program implementation.

3. **Breaking down the details of pay-for-performance for program implementers.**
This section will highlight the program specifics from project scoping to stakeholder engagement to verification of water quality improvements.

4. **Lessons learned.**
This section provides some key lessons the team has learned that will be useful for program developers and implementers and some lessons learned from the farmers' perspective.

We intend for this guidance document to serve as a handbook for those interested in planning and implementing their own PfP projects, and to that end we have included brief case studies throughout to illustrate successes and pitfalls that may be useful to the reader.

SECTION 1

IS PAY-FOR-PERFORMANCE RIGHT FOR YOU? AN INTRODUCTION TO THE CONCEPT AND ALTERNATIVES

Introduction

Existing programs and policies to help address environmental problems

Many practice-based programs exist to help farmers reduce their environmental impact, including federal voluntary working lands programs like the Environmental Quality Incentive Program (EQIP) and state programs like the Maryland Agricultural Cost Share (MACS) program and the North Carolina Agriculture Cost Share Program (ACSP). These conservation programs are pay-for-practice programs, which set standards for and assign payment rates (usually only a portion of implementation and maintenance costs) to specific conservation practices (Figure 1). Paying for practices has historically been preferred over a PfP approach, because measuring pollution reductions at the farm- or field-level was technically difficult or infeasible. In lieu of individualized monitoring, strict practice standards were used to streamline the administrative process and help ensure the utility and performance of each practice that was installed. However, the benefits of pay-for-practice programs are counterbalanced by drawbacks including a lengthy administrative process, inflexible conservation options, unknown technical effectiveness of applied practices at reducing nutrients and sediment in farm runoff, and therefore unknown cost-effectiveness of conservation efforts.

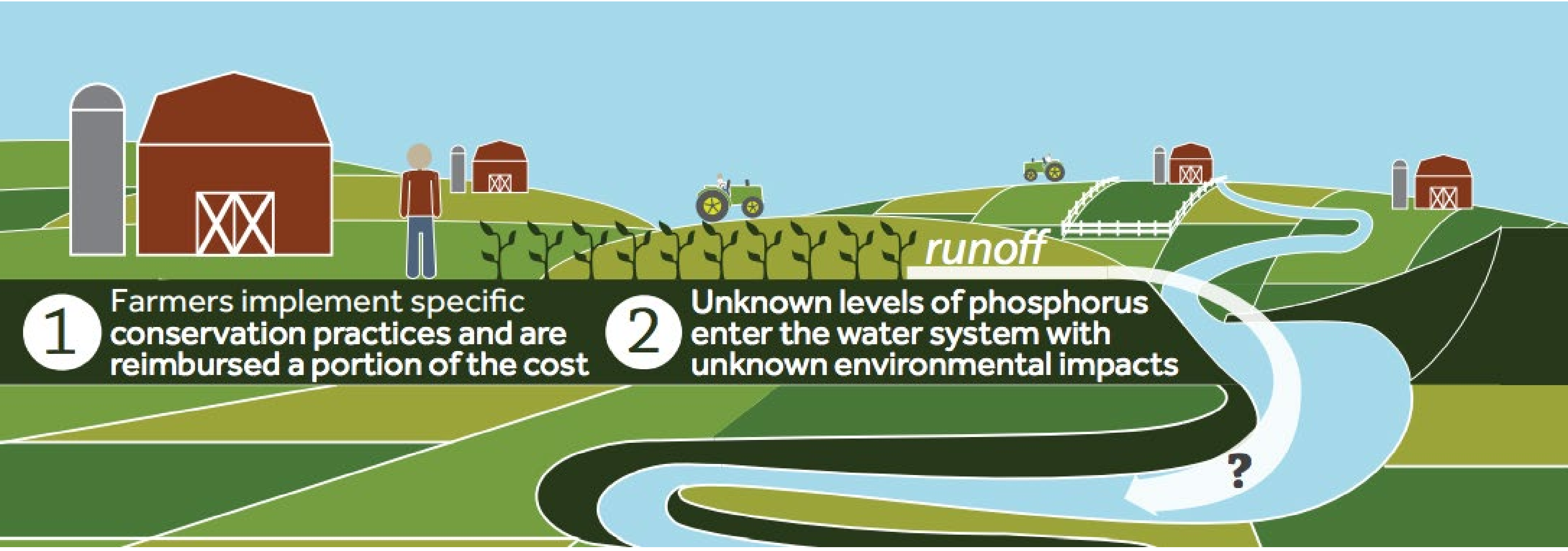
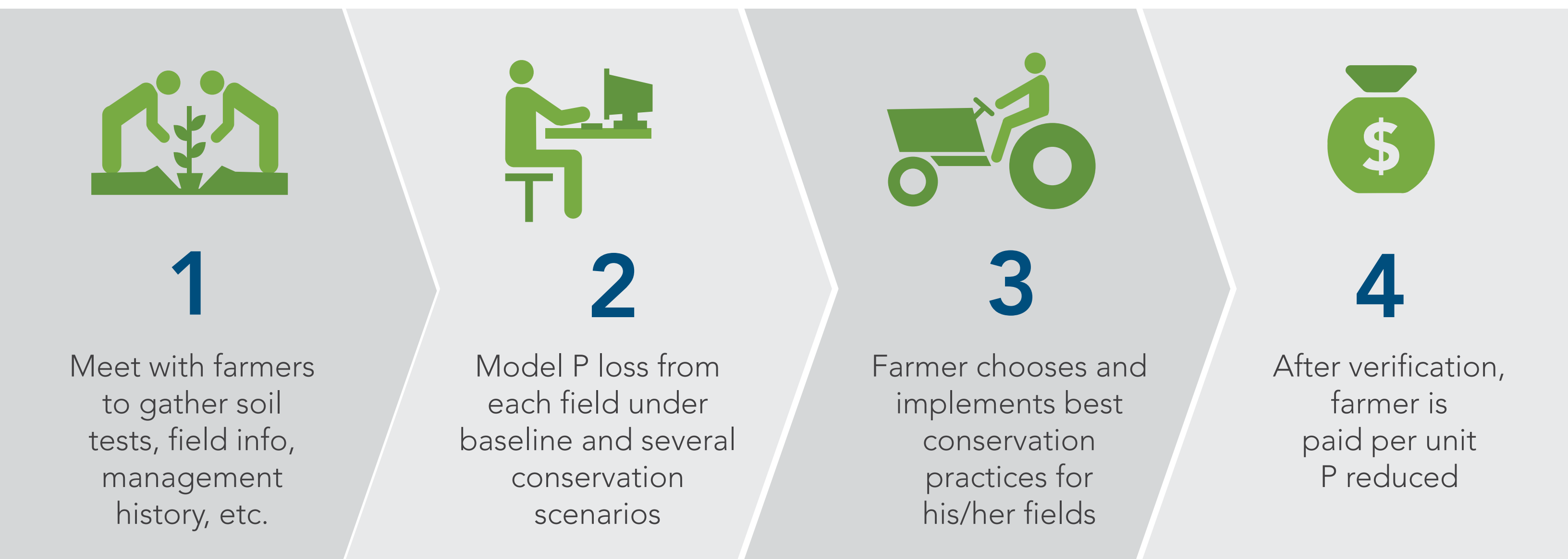


Figure 1. Pay-for-Practice Conservation Programs

An alternative approach to farm conservation

The PfP approach to conservation tweaks the pay-for-practice model by allowing farmers to be paid for a quantifiable environmental outcome rather than for a portion of the cost of a practice. For example, instead of being paid 75% of the cost of implementing a filter strip in a pay-for-practice program, a PfP program would pay the farmer for the pounds of phosphorus that are reduced in farm runoff as a result of installing the filter strip. The amount of phosphorus reduced by the implementation of a practice is not measured directly in the field, but rather is calculated by a field-scale model calibrated for use in the watershed (Figure 2). Farmers are free to choose how to implement management changes to maximize environmental outcomes, within the constraints of a quantification tool that accurately estimates the effect of the management change. This freedom of choice, coupled with a payment tied directly to a metric of improvement, incentivizes farmers to choose the conservation actions that maximize environmental improvements at the lowest cost. The improved cost-effectiveness from a PfP approach can be significant; a USDA Economic Research Service report indicated that a PfP approach could be twice as effective at the same program cost as a pay-for-practice program[6].

Figure 2. Four Steps in a Pay-for-Performance Conservation Program



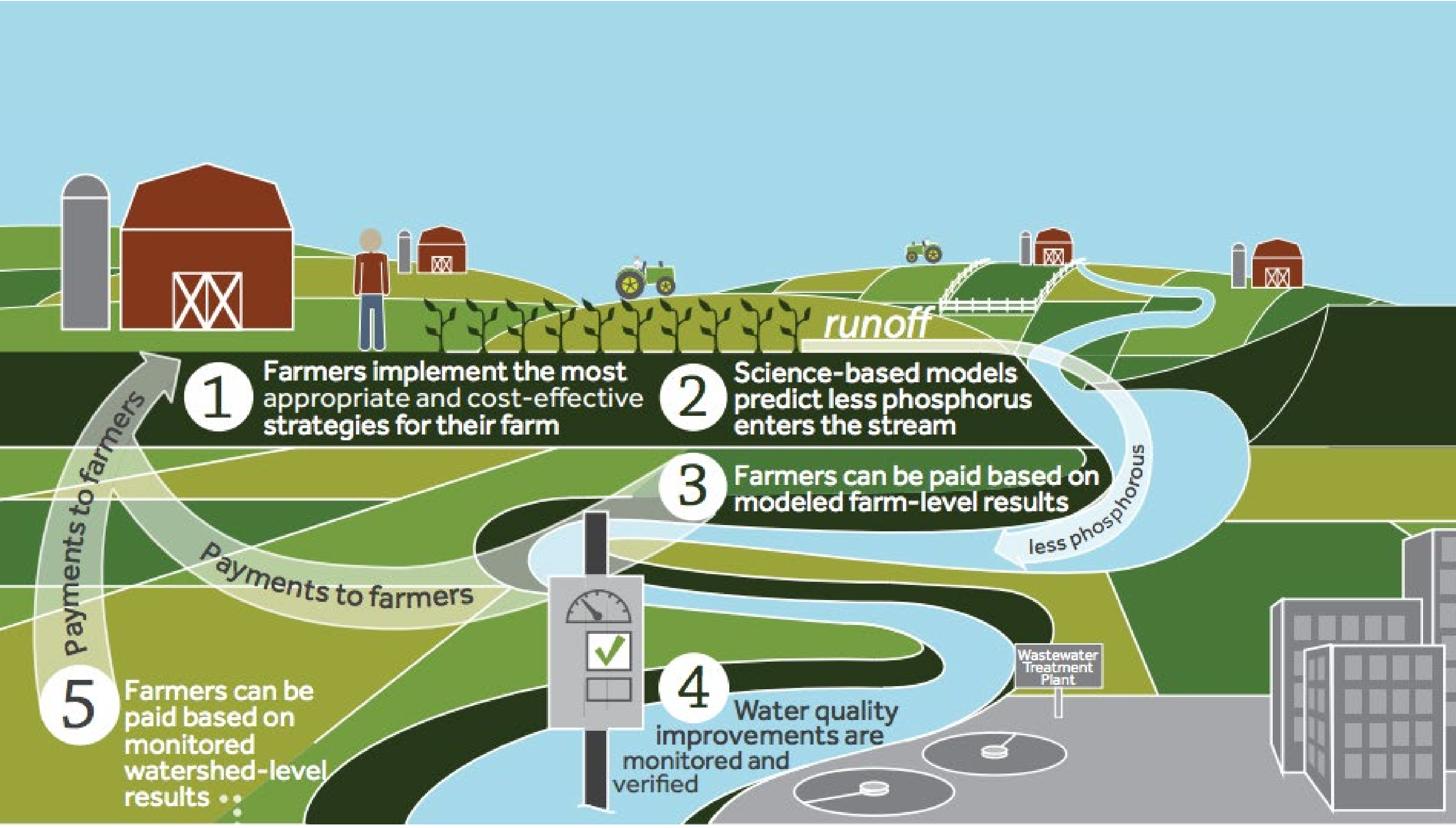
Pay-for-performance conservation programs maximize the cost-effectiveness of conservation dollars by capitalizing on the diversity inherent in agricultural landscapes. For example, in a given watershed, most of the phosphorus loading may originate in a handful of fields adjacent to key streams. In a traditional conservation program, you would set a price for farmers to plant cover crops on any field, paying equally for fields regardless of how successful that cover crop is at improving water quality. Through a PfP program, you would instead identify the fields in which cover crops are most efficient at reducing nutrient losses and where the cost per pound of nutrient retention would be lowest. Farmers would choose to implement cover crops on these fields, because the cost of doing so would be less than or equal to the payment they would get for the "performance" of that cover crop in retaining nutrients. The inherent variability in both the effectiveness of conservation practices in reducing nutrient losses on different fields, and the associated cost-effectiveness of such actions, makes PfP conservation an attractive economic approach to reducing agricultural nonpoint source pollution.

Pay-for-performance conservation can also include watershed-level monitoring, both to validate field-

6 Weinberg, M., & Claassen, R. L. (2006). Rewarding farm practices versus environmental performance. Washington, D.C.: U.S. Dept. of Agriculture, Economic Research Service. https://www.ers.usda.gov/publications/pub-details/?pubid=42914

level modeling and to focus program participants on the goal of a watershed-level improvement (Figure 3). Farmers, like all humans, are motivated, in part, by being agents of change; we all want to know our actions are making a difference. The monitoring information provides that necessary feedback loop. Water quality monitoring may have the additional effect of motivating farmers to reach out to other farmers in the watershed to implement conservation practices so that water quality improvement is more quickly and significantly measured. This model-at-the-farm, measure-at-the-watershed approach won an award in 2014 for a public-private innovation challenge around nutrient pollution.[7]

Figure 3. Including Watershed-Level Monitoring in a Pay-for-Performance Conservation Program



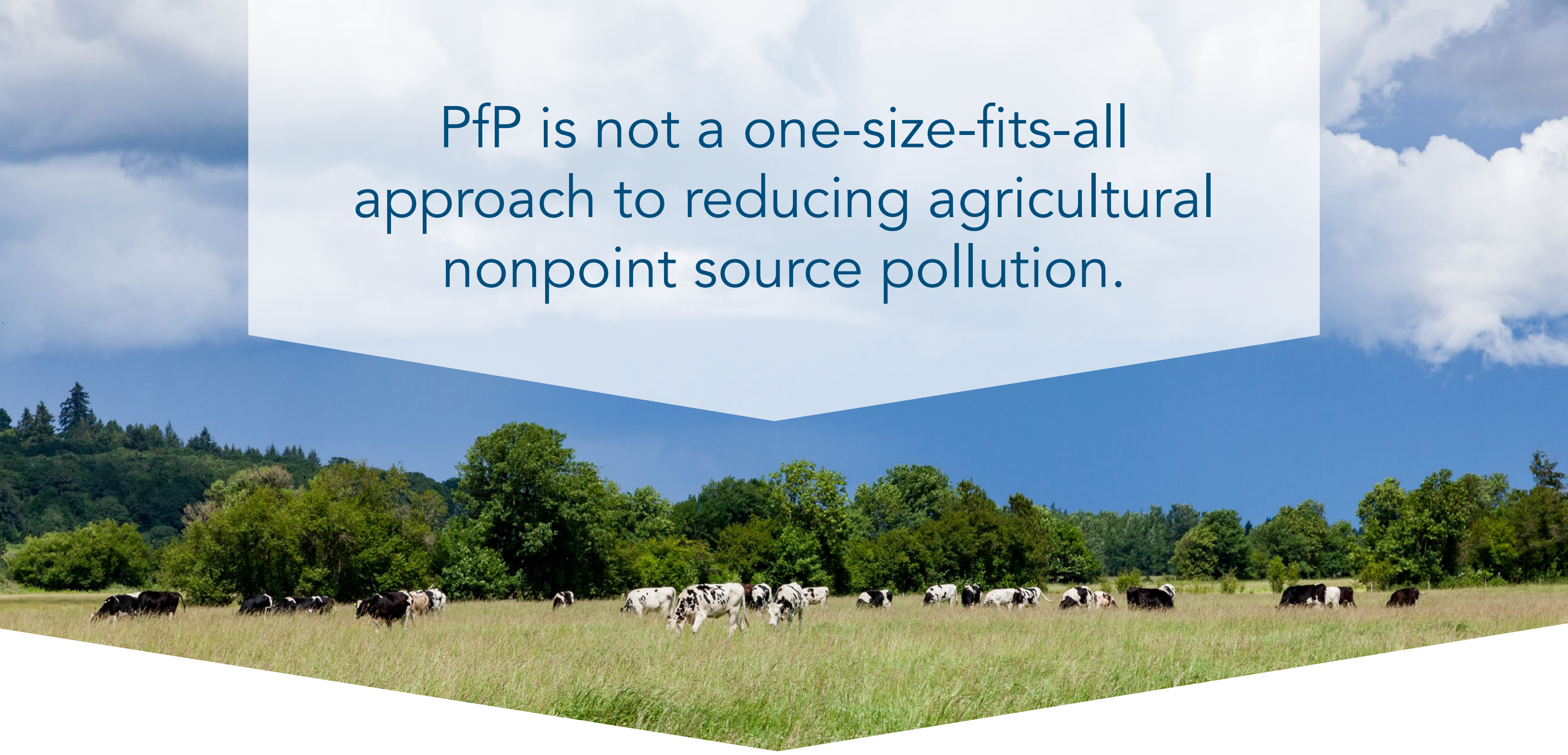
Flexibility and innovation are central to the PfP approach. The flexibility of PfP is one of its greatest strengths, and the concept continues to be built upon and customized to the particular goals and objectives of the watershed in which it is applied. Water quality concerns have been addressed by PfP programs in six watersheds in the Great Lakes region, and six additional watersheds in Vermont and Iowa by focusing on nitrogen, phosphorus, and/or sediment pollution as necessary in each region (see Table 5). Innovation is central to PfP, as farmers have the incentive to find the most cost-effective actions for their fields since PfP is goal-oriented rather than practice-oriented. There is limited possibility of this kind of flexibility with traditional pay-for-practice conservation programs. For example, while this document will focus on PfP conservation within the context of water quality problems, PfP could be used to combat other environmental impacts of farming, such as greenhouse gas emissions. Scenarios in which agricultural practices simultaneously reduce nitrogen losses by both reduced nitrate leaching and reduced nitrous oxide gas emissions open the door to developing stacked PfP payment schemes to capitalize upon these synergies.

How is pay-for-performance distinct from water quality credit trading?

7 https://blog.epa.gov/blog/2014/05/winning-solutions-for-nutrient-pollution/

Water quality credit trading (WQCT) and PfP conservation are both outcome-based programs that often overlap. WQCT involves the exchange of nutrient credits that are bought and sold to achieve a regulated cap on nutrient losses to a waterbody. Farmers who have met minimum standards, and who continue to reduce their nutrient losses may be able to sell nutrient credits to a wastewater treatment plant if the cost of implementing these conservation practices is lower than what it would cost a wastewater treatment plant to achieve the same pollution reduction. As we have described, PfP also pays per unit of pollution reduction. The only substantive distinction is that PfP does not necessarily involve an exchange between buyer and seller; PfP could be motivated by a need to meet water quality regulations but funded by government conservation programs, private funders, or by wastewater treatment and processing plants seeking compliance with effluent caps, as is common in water quality trading programs. WQCT may also involve regulatory and administrative controls that do not necessarily have to be present in PfP. Therefore, while both WQCT and PfP achieve nutrient reductions by quantifying and paying for the pounds of nutrients or tons of sediment retained on the landscape, not all PfP programs involve WQCT. However, all WQCT programs should involve a PfP model.

PfP is not a one-size-fits-all approach to reducing agricultural nonpoint source pollution.



Precursors to a successful pay-for-performance program

PfP is not a one-size-fits-all approach to reducing agricultural nonpoint source pollution. It is, however, a promising option for you to address water quality issues in watersheds where certain preconditions exist. These preconditions include: 1) the existence of a nonpoint source water quality concern, 2) stakeholder acknowledgement of their contribution to that water quality concern, 3) local support for addressing nonpoint source pollution, 4) the availability of tools necessary to carry out a PfP program, and 5) the existence of regulatory drivers for nutrient and/or sediment load reduction.

1. Does a water quality concern exist in your watershed?

The performance-based design of PfP conservation requires that a water quality concern exists that can be addressed by working with agricultural landowners under this type of program. For example, nutrients, specifically nitrogen and phosphorus, may be enriching streams, lakes, or coastal areas and causing eutrophication. Excess algae may be impairing drinking water, affecting the safety of fishing, or interfering with recreational uses of the water body. Excess sediment may be reducing the clarity of water in streams and reducing the quality of fish habitat, or manure from animals in densely-concentrated areas may be causing a drinking water concern downstream. For your PfP program to work, the pollutant should be identified and quantifiable, and agriculture must be a contributing source.

2. Do stakeholders acknowledge their contribution to the water quality problem?

Acknowledging the existence of a water quality issue may seem obvious as a precursor to setting up a PfP program, but if the water quality issue is not acknowledged by all potential participants in the PfP program, your path forward will be difficult. For example, a complex watershed draining to an impaired surface water may have subwatersheds where agriculture is not considered to be part of the problem, and setting up a PfP program there would likely garner little support. On the other hand, if farmers acknowledge their contribution to a water quality issue and feel motivated to engage in environmental stewardship, the conditions are right for PfP. These farmers may not only enroll themselves in a PfP program, but may also apply pressure to their peers to become involved as well. For example, existence of farmer-led watershed groups in Iowa and Michigan demonstrates that farmers in these areas acknowledge their contribution to the water quality issue and are interested in finding solutions.

3. Is there local support for addressing nonpoint source pollution?

Your PfP program will require a combination of local, technical, and financial support to be successful. As previously described, the agricultural community must see itself as part of the solution to a water quality issue and be motivated to implement conservation changes. In addition, support from local conservation entities, such as soil conservation districts, watershed groups, or conservation authorities, is vital for providing PfP assistance to participating farmers. These entities must provide the technical assistance for program administration, including "boots on the ground" for direct work with farmers, as well as expertise in modeling, economics, and agronomy. Finally, you should identify a source of funding to provide incentive payments to farmers, and possibly also for covering salaries and equipment. Potential funding partners include private foundations, government programs, and municipal or industrial point sources. Without these key support systems in place, your PfP program will struggle to gain momentum.

4. Are the appropriate tools available for carrying out a PfP program?

You will need a quantification model or tool for measuring nutrient or other pollution loss from agriculture, as comprehensive on-site field measurements could be too time-consuming and expensive for practical program administration. You can choose from a variety of modeling tools that are designed for different purposes and calibrated for different geographic areas.

In general, a model applied in a PfP program should be:

- accurate at the field scale,
- calibrated for your geographic area,
- user-friendly,
- flexible enough to simulate many best management practices (BMPs), and
- sensitive to small changes in management, like a reduction in tillage.

There are often tradeoffs among these characteristics in the body of tools currently available, but tools are actively being developed and calibrated for watersheds across the country (see Table 4).

5. Are there regulatory drivers for pollutant load reductions?

Regulatory drivers, such as Total Maximum Daily Loads (TMDLs) or other water quality standards, play an important role in establishing the need for and local support of achieving nutrient load reductions. All sectors contributing to the water quality issue, including agriculture, have pollution reduction targets that must be met, and all watershed stakeholders are aware of the water quality goal. This environment is conducive to pursuing actions to achieve water quality goals, including the implementation of a PfP program. Since the cost of meeting these load allocation targets often differs substantially among regulated sectors, water quality credit trading can become part of a long-term funding source for a PfP program to achieve nutrient reductions required by a TMDL. Regardless of how the watershed pursues actions to meet water quality targets, the presence of water quality regulations usually facilitates the implementation of a PfP conservation program, but is not essential to its success.

Now that we have introduced the concept, preconditions, and elements necessary for implementing a PfP program, you may be interested in pursuing the creation of such a program in your watershed. The next chapters will lay out the next steps in planning a PfP program from start to finish, including the details of watershed analysis, quantification tools, ground team support, and how to avoid possible setbacks and pitfalls along the way.

LAYING THE GROUNDWORK FOR PAY-FOR-PERFORMANCE CONSERVATION FOR PROGRAM ADMINISTRATORS AND PROJECT PLANNERS

Conducting a watershed analysis

The first step in determining whether a water quality concern exists in your project's area of interest is to confirm whether the watershed has an impairment attributed to agricultural nonpoint sources. Through the federal Clean Water Act (CWA), states are required to report assessment and impairment information for all waters within their jurisdiction every two years. These reports provide essential details about the condition, designated uses, causes of impairment, and probable sources by the following waterbody types: streams and rivers; lakes, reservoirs, and ponds; bays and estuaries; coastal/Great Lakes shoreline (if applicable); and wetlands. While summaries for the entire country and each state are available through U.S. EPA's Assessment and Total Maximum Daily Load Tracking and Implementation System (ATTAINS), this tool generally lags several years behind reporting by individual states.[8] Table 1 provides a summary of available data for Great Lakes basin states through ATTAINS, with links to the integrated water quality reports submitted by each state in 2016.

Table 1. Available Assessed and Impaired Watershed Data by Great Lakes State

State	ATTAINS Assessed Report	ATTAINS Impaired Report	State Agency Integrated Report Website
Illinois	2010	2006	epa.illinois.gov/topics/water-quality/watershed-management/resource-assessments/index
Indiana	2010	2008	in.gov/idem/nps/2639.htm
Michigan	2010	2010	michigan.gov/deq/0,4561,7-135-3313_3681_3686_3728-12711--,00.html
Minnesota	2012	2012	pca.state.mn.us/water/minnesotas-impaired-waters-list
New York	2014	2014	dec.ny.gov/chemical/8459.html
Ohio	2010	2008	epa.ohio.gov/dsw/tmdl/OhioIntegratedReport.aspx
Pennsylvania	2006	2004	dep.pa.gov/Business/Water/CleanWater/WaterQuality/Pages/default.aspx
Wisconsin	2016	2008	dnr.wi.gov/topic/surfacewater/assessments.html

Of these states, all except Illinois and Minnesota have impaired watersheds within the Great Lakes that are at least partially attributed to agricultural runoff. You can find more detailed information and nonpoint source pollution reduction strategies using the website links to the appropriate state agency in Table 1, and searching each site for watershed management plans that follow EPA's "nine key elements" for CWA Section 319 funding.[9]

8 EPA ATTAINS: https://ofmpub.epa.gov/waters10/attains_index.home

9 For a summary of the nine elements and additional resources, see: http://dnr.wi.gov/topic/nonpoint/9keyelementplans.html

POINT SOURCE

77%

of point source P loads to the lakes come from **24% of facilities,** with over **80%** of those loads and facilities **being POTWs**

AG LOADS

90%

of modeled ag P loads and cropland acres are in the **top 10 watersheds**

Such plans are also required for watershed-based projects to be eligible for nonpoint source implementation funding through EPA's Great Lakes Restoration Initiative. Since many watersheds do not have recent state- or EPA-approved plans, however, you may need to utilize additional tools and approaches to estimate pollutant loading from agricultural sources.[10]

Identifying and prioritizing pollutant loading by source

Once you identify a watershed with an impairment related to agriculture and understand the broader context described in its integrated management plan or other strategies by local stakeholders, you need to understand the landscape of pollutant loading and prioritize areas in which to target in your PfP program. There are several publicly-available tools and databases that provide modeled estimates or monitored values helpful in setting up a PfP program. The first is the U.S. Geological Survey's web-based SPARROW (SPAtially Referenced Regressions On Watershed attributes) model, which can be used from a 2-digit HUC basin to a stream reach scale for both nitrogen and phosphorus loading.[11] SPARROW also simulates nutrient loadings by major source, delivered to downstream reaches. Table 2 shows phosphorus (P) loading for 2002 to the five Great Lakes, attributed by state:

Table 2. Estimated Phosphorus Loading by Great Lakes State and Source

State	Contributing Area (acres)	Point Sources (lbs/yr)	Agricultural Sources* (lbs/yr)	Forest/ Wetland/ Scrub (lbs/yr)	Urban/Open (lbs/yr)	All Sources (lbs/yr)
Illinois	78,085	151,426	688	781	27,671	180,565
Indiana	2,256,563	432,021	726,916	38,186	224,061	1,421,184
Michigan	36,660,004	4,328,638	2,863,144	1,512,343	1,829,574	10,533,700
Minnesota	4,049,804	111,181	22,197	354,646	47,522	535,546
New York	9,381,588	1,944,956	1,857,390	637,457	363,117	4,802,922
Ohio	7,428,471	1,924,577	2,697,842	220,760	634,495	5,477,672
Pennsylvania	382,271	132,576	61,210	34,129	30,312	258,225
Wisconsin	10,976,898	1,279,288	1,741,465	536,199	385,904	3,942,858
Total	***71,213,684***	***10,304,662***	***9,970,853***	***3,334,500***	***3,542,657***	***27,152,672***
Share of Total		*38.0%*	*36.7%*	*12.3%*	*13.0%*	

**Agricultural Sources: Confined manure (17.7% of total), unconfined manure (2.8%), plus farm fertilizers (16.2%)*

10 To develop or update a watershed management plan consistent with EPA guidance, see: https://www.epa.gov/nps/handbook-developing-watershed-plans-restore-and-protect-our-waters

11 USGS SPARROW Decision Support System: https://cida.usgs.gov/sparrow/

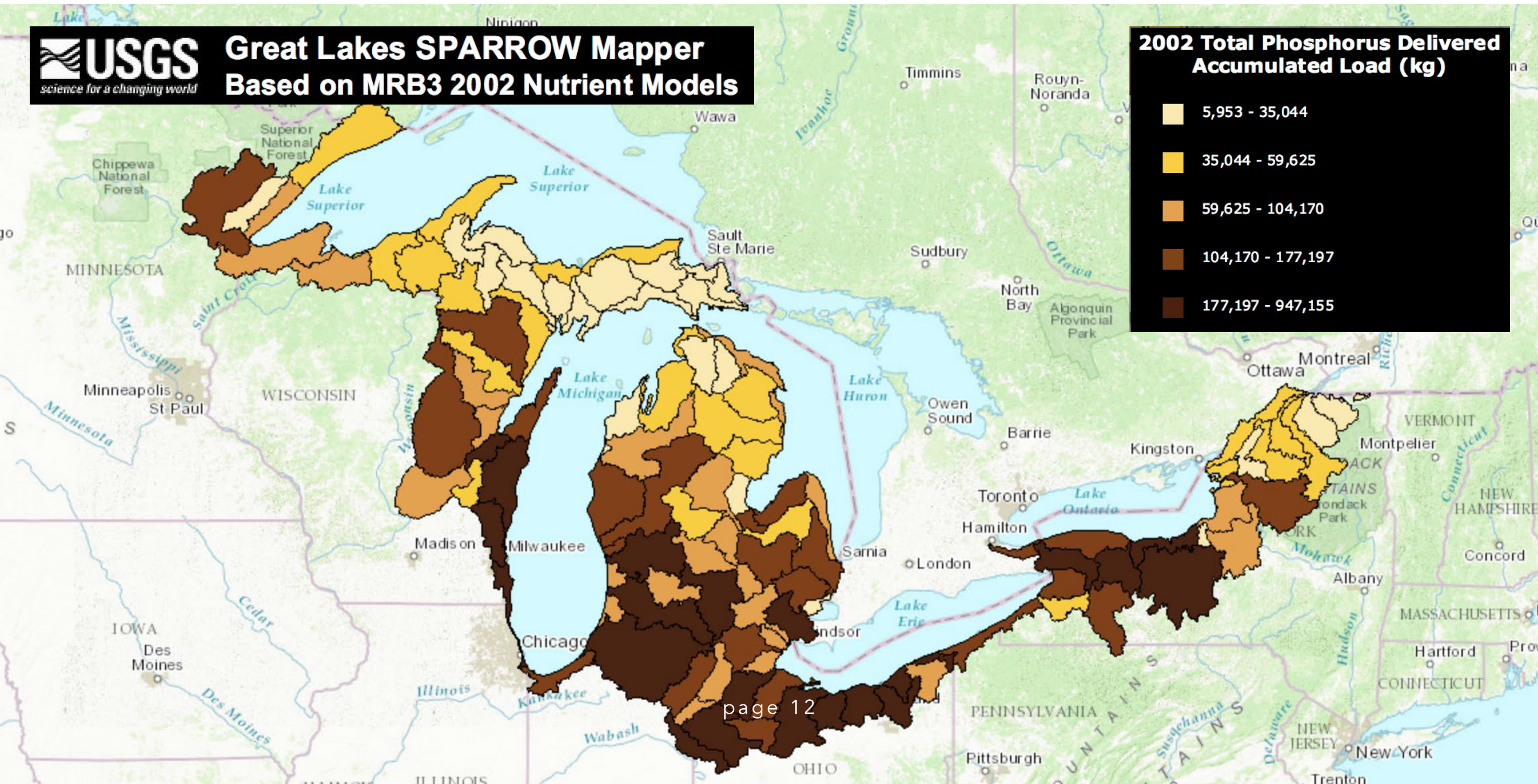
Based on this model, P loading from point and agricultural nonpoint sources are roughly equivalent at the basin-scale but vary widely by state. Viewed in terms of point source demand and agricultural supply, only four states (Michigan, Ohio, New York, and Wisconsin) appear to have significant potential for P-related water quality credit trading-based PfP programs. While SPARROW does not break down the contributing area or sources by land use, USDA's 2012 Census of Agriculture reports 116,832 farm operations spanning nearly 23 million acres across the basin. Of these, 86% of operations and 78% of acres are devoted to cropland. With detail down to the 6-digit HUC scale, the Census of Agriculture data can be compared to SPARROW results at the same scale to provide a more focused view of agricultural and point source loads. In the Great Lakes basin, the top 10 watersheds (out of 21) for agricultural P loading account for nearly 90% of the sector's total estimated by SPARROW and 87% of cropland acres. Within these watersheds, agriculture's share of total P loading is 45%, while point sources contribute 34% on average.

While there are multiple pathways to financially support PfP activities, long-term success is more likely when farmers are able to supply a service that point sources are willing to pay for (e.g. cost-effective P loss reductions) rather than relying exclusively on grants or donations.

The most up-to-date data on point sources permitted through the National Pollutant Discharge Elimination System (NPDES) can be obtained through the EPA Discharge Monitoring Report (DMR).[12] The DMR database includes a wide range of facility information, including monthly or annual nutrient loads by outfall, receiving subwatershed (12-digit HUC), permit expiration dates, and impairment status of the watershed. While many facilities lack current or complete monitoring data, EPA prioritizes compliance for "major" facilities with an annual average design flow of at least 1 million gallons per day.

Out of 1,503 point sources discharging 6.4 million pounds of P to the five Great Lakes in 2016, major facilities account for only 24% of permitted facilities but over 77% of modeled or monitored loading. By count and discharges, over 80% of these major facilities are POTWs. In impaired watersheds with significant agricultural loading, as determined by SPARROW, facility-level data from DMR can provide a detailed view of which POTWs to engage and what their needs as a potential partner in a PfP program might be. For example, you could generate a list of all major POTWs that are discharging near or above their allowable P loads and with permit expiration dates in the next 12 months, with an additional filter for the subwatersheds you prioritized for agricultural nonpoint source reductions.

12 EPA Discharge Monitoring Report Pollutant Loading Tool: https://cfpub.epa.gov/dmr/index.cfm



Understanding the policy environment and identifying a regulatory driver

Total Maximum Daily Loads as drivers of PfP conservation

The Total Maximum Daily Load (TMDL) program is the most relevant policy program that would potentially affect PfP conservation. Technically, a TMDL is the maximum daily amount of a specific pollutant that a waterway can assimilate without exceeding state water quality standards. The TMDL program was created within Section 303(d) of the Clean Water Act and focused initially on point source pollution. Over the past 15 years, the focus has broadened to include nonpoint source pollution, including nutrient and sediment runoff from agricultural land. Any waterway that is not adequately clean for its designated use (e.g. recreation, drinking water, fishing) is deemed impaired. All impaired waterways are listed on EPA's 303(d) list and are supposed to have a TMDL established for them. Of more than 70,000 approved TMDLs across the U.S., over 10,000 are related to nutrient and/or sediment loading.

There are many approved TMDLs for agricultural watersheds and mixed watersheds with intensive agricultural production. Within each of these TMDLs, agriculture would be assigned a load allocation to achieve. The challenge, however, is that agricultural land is far from homogeneous; it varies by slope, soil type, crops grown, tillage and fertilization practices. Each of these factors, and others, impact the quantity of nutrients lost from the field to surface and groundwater and makes an average load allocation applied across the entire agricultural sector somewhat arbitrary.

To be effective in the agricultural sector, a TMDL needs to be able estimate field-specific losses and understand the range of potential reductions and their associated costs to the farmer. Unfortunately, there is no current system in place to use field-specific information in this way. As such, the TMDLs use broad estimated averages and assign somewhat arbitrary reductions to the agricultural sector. Pay-for-performance conservation has the potential to contribute to the TMDL process by providing a quantitative process that, by working with farmers, can identify how to achieve the reductions required in the most cost-effective way and reward farmers for doing their part.

You could potentially adapt PfP to areas without TMDLs or other regulatory water quality standards, but the success of a PfP program in such a watershed would be much more difficult to achieve. A lack of clear goals, both for total watershed pollutant loading and for loading by source, makes it difficult to assess the appropriate focus and incentives for a successful PfP program, as point and nonpoint sources alike would feel no pressure to change. If water quality credit trading were to be part of a PfP program, a lack of clear, enforceable goals for point source emissions would eliminate the market for credit trading. The success of a PfP program in an unregulated watershed would depend upon voluntary actions. These might include funding from a large private-sector point source interested in generating positive public relations surrounding their commitment to clean water, pressure from supply chain initiatives focused on purchasing agricultural products from conservation-minded farms, or funding from groups interested in either altruistic improvement in agricultural practices or interest in getting ahead of anticipated environmental regulations.

Scaling up PfP conservation

An enabling policy environment is required for the sustainability of any conservation program. In the U.S., conservation is primarily driven by federal policies and programs that originate in the Farm Bill. Although implemented by USDA, the Farm Bill is written by Congress and outlines implementation details of many programs, including those related to agricultural conservation. The conservation title of the Farm Bill contains numerous programs related to agriculture's impact on the environment and dictates, through statutes, how each of these programs will be implemented. The two largest working lands conservation programs are the Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program (CSP). Neither of

these, nor any other Farm Bill program as currently designed, enables a performance-based incentive mechanism that focuses on one conservation issue, such as nutrient loss from agricultural land.

EQIP is an example of a pay-for-practice program designed to help farmers implement specific practices and/or develop specific Conservation Activity Plans. Incentive payments cover a portion of the cost of implementation, are specific to each practice, and are set each year. EQIP only funds specific practices that are listed in the Field Office Technical Guide, and all practices must adhere to rigorous specifications. EQIP's rules limit a farmer's flexibility to seek out new and innovative ways to address conservation issues, and a lack of estimates or measurements of environmental performance at the field- and farm-level make understanding the cost-effectiveness of this program impossible.

Unlike EQIP, CSP was designed to be a performance-based program. Initially, it required that the conservation "performance" of a farm be estimated using the Conservation Measurement Tool (CMT), which included 27 different resource concerns ranging from energy conservation to soil compaction. Each resource concern was scored, which resulted in a very holistic conservation tool, but not one in which the performance of any one parameter was actually measured. Starting with the Fiscal Year 2017 sign-up period, CSP no longer requires the use of the CMT. The CMT has been replaced with the Conservation Evaluation Application Tool (CAET) for meeting the minimum stewardship threshold and the Application, Evaluation, and Ranking Tool (AERT) for scoring and ranking applications. Participating farmers earn payments based on the amount of conservation currently applied across their farm plus enhanced payments for adding additional conservation that addresses resources concerns.

CSP offers farmers quite a bit of flexibility and potentially significant payments. With over 70 million acres enrolled, farmers seem to have responded well to the program. Although it is the closest program USDA has to PfP, CSP still does not address the fact that the performance or outcome of any conservation practice is going to be determined by the physical characteristics and management history of the field upon which it is applied. This lack of field-specific information is what still makes PfP stand apart from existing programs. At the heart of the PfP concept is (1) the use of field-specific information to estimate the performance and cost-effectiveness of any conservation practice the farmer wants to consider, and (2) the ability of the farmer to profit from implementing the most cost-effective conservation actions for their specific fields. Sometimes, management changes can reduce or eliminate costs incurred by the farmer, but CSP does not allow payments for any conservation for which there is no cost incurred or income foregone by the farmer. It is possible that with some statutory changes, CSP could be transformed into a true PfP program.

The concept of PfP conservation has been well received during conversations between Winrock staff and senior USDA officials. However, USDA must implement the programs that Congress creates and approves. So, while USDA staff may want to maximize the impact of public conservation investments, PfP mechanisms must first be incorporated into USDA conservation programs, and this would require significant changes to both policy and how conservation is delivered by local technical service providers. State conservation programs largely follow the lead of the federal programs in terms of their practice-based incentive structure, often contributing a small amount of additional cost-share to participating farmers. Despite this emphasis on practice-based conservation, we remain confident that in the medium- to long-term, the increased focus on accountability under TMDLs and other regulatory drivers will necessitate a move toward performance-based conservation. It is possible that a successful state-led effort could be used to demonstrate to Congress that some federal programs can and should become performance-based. However, the successful transition to performance-based conservation will require a concerted education and outreach effort to demonstrate how PfP works and why it is worth the extra effort to quantify field-level performance.

Milwaukee Metropolitan Sewerage District

MILWAUKEE RIVER TMDL: WHY POLICY DRIVERS MATTER

Although the Milwaukee River TMDL for phosphorus, sediment, and fecal coliform bacteria was originally scheduled to be released in 2013, the draft was not unveiled until July 2016 and (as of August 2017) no date has been set for its finalization. The TMDL is critical because it translates the statewide phosphorus rule (in place since 2011) to enforceable wasteload allocations for all point sources in the watershed, and provides a mechanism for pursuing alternative compliance options including WQCT or adaptive management. The lack of a regulatory driver for reductions in nutrient loading during our project period meant that POTWs in the region had little incentive to be involved in the development of a mechanism to help them meet their regulatory effluent limits. As a result of this significant delay, the original goals of our project based in the West Branch had to be modified. Instead of pilot-testing a water quality credit trading program between farmers and POTWs, the PfP program had to rely on farmer interest in adopting conservation practices in a new way and in anticipation of coming regulations. For the latest Milwaukee River TMDL information, see: http://dnr.wi.gov/topic/TMDLs/Milwaukee/.

SECTION 3

BREAKING DOWN THE DETAILS OF PAY-FOR-PERFORMANCE CONSERVATION FOR PROGRAM IMPLEMENTERS

Build a project timeline

It's helpful to break out the project tasks according to the implementation timeline. The basic components of a PfP program include:

- identifying project area suitability and administration needs,
- developing infrastructure for water quality modeling/monitoring,
- estimating field- and farm-scale conservation performance,
- conducting farmer outreach, and
- contracting and paying participating landowners/farmers for sediment/nutrient reductions.

Here we discuss these key first steps in developing a PfP program. Not all steps will be necessary for every program; an adaptive management approach in which the program design and details are revisited with regularity may be helpful for crafting a program that works for your region.

Table 3 presents a project timeline broken out by tasks that may be useful in building your project implementation plan. While this table was created based on the experience of the authors, each PfP project will likely require different timelines and goals. For example, a three-year project may only have one or two years of incentive payments issued to farmers for nutrient reductions achieved by conservation practice implementation.

Table 3. Sample Pay-for-Performance Project Timeline

Major Components	Sub-Components	Pre-Project	Q1	Q2	Q3	Q4	Year 2 & Beyond	Program End
Identify project area suitability and administration needs	1. Determine the appropriate watershed and water quality goal	■						
	2. Identify the appropriate organizations with whom to partner	■						
	3. Identify funding opportunities to develop a PfP program	■						
	4. Identify staffing needs and make appropriate changes/hires		■	■				
	5. Identify any restrictions on BMPs that can be implemented under the program (e.g. must meet NRCS standards)		■					
	6. Develop performance payment framework (pricing, contracting, payment terms, verification, reporting)		■	■				
Develop infrastructure for water quality modeling/ monitoring	1. Explore and choose appropriate models for quantification of nutrient reductions; confirm that desired BMPs can be modeled using the tool	■						
	2. Identify existing water quality monitoring infrastructure and needs (if applicable)			■	■			
Estimate field- and farm-scale conservation performance	1. Use model to predict baseline farm management sediment and nutrient losses and reductions under various implementation scenarios				■	■	■	
	2. Calculate cost-effectiveness of modeled scenarios				■	■	■	
	3. Discuss cost-effectiveness of modeled scenarios with farmers and brainstorm additional conservation scenarios to consider				■	■	■	
Conduct farmer outreach	1. Develop an outreach plan aimed to increase awareness about the program to landowners and operators that will include workshops, field days, mailings, and site visits		■	■			■	
	2. Conduct site visits to meet with eligible landowners/operators to discuss BMP implementation for sediment and nutrient reduction				■	■	■	
Contract and pay participating landownders/ farmers for sediment/ nutrient reductions	1. Quantify sediment and nutrient reductions through chosen model				■	■	■	
	2. Execute contracts with eligible landowner/operator				■	■	■	
	3. Verify implementation of BMPs				■	■	■	
	4. Payment to landowners for sediment/nutrient reduction through implementation of BMPs				■	■	■	
Ongoing development of program	1. Conduct review of programmatic performance							■
	2. Report findings successes and challenges in a final narrative							■

Develop quantification infrastructure and estimate performance

Monitoring

Every PfP program requires effective monitoring tools to measure water quality improvements. Agricultural and water quality monitoring refers to the collection of data used to aid in decision-making and measure efficiency in achieving nutrient reductions. Monitoring is used to measure inputs into a system, like rainfall, as well as outputs, like crop yield. Monitoring can be small scale, for example collecting soil data at the field level, or large scale, such as collecting data across the Mississippi River Basin. Data may be collected directly through in-field measurements or through remote sensing. This data collection helps to determine the nutrient or sediment reduction effectiveness of BMPs and identify changes to field or farm management practices that would have the greatest impact on the quality of water leaving the farm. Monitoring is essential in PfP to assess changes in water quality within a watershed, creating the possibility for paying farmers for watershed level improvements.

Modeling

Modeling tools are needed to manage and make sense of the vast amounts of data collected from monitoring. Modeling is the creation of a mathematical or conceptual simulation of a system.[13] Agricultural modeling moves past the study of individual components, to understanding an agricultural system as a whole, and how the components and processes within that system interact. Modeling helps predict the behavior of an agro-ecosystem under varying conditions which may be difficult to study in isolation. Agricultural systems models in practice help identify optimal management practices, move toward pollution reduction goals, and predict the performance of an agro-ecosystem.[14]

A quantification model for measuring nutrient or other pollution loss from agriculture is necessary for PfP since field measurements are not practical for every field. Quantification tools should be capable of modeling at the field level, since effectiveness of BMPs differs even on fields within the same farm. Tools should also be scientifically defensible and validated with field data in the geographic region in which you are working. Ideally, tools should also strive to maintain user-friendliness along with accuracy, but tradeoffs between these concepts are common in the current body of tools. The simulation model of choice should be flexible enough to model a wide variety of BMPs, including structural practices like buffer strips, tile drainage systems, and grassed waterways as well as agronomic BMPs like tillage systems and nutrient management. Finally, models should have the capacity to estimate the effect of marginal changes, like reduction in number of tillage passes, reduction in fertilizer application, or increasing the width of a buffer.

[13] FAO (1993) Guidelines for land-use planning.

[14] Jones, J.W., et al., (2016) Brief history of agricultural systems modeling. Agricultural Systems.

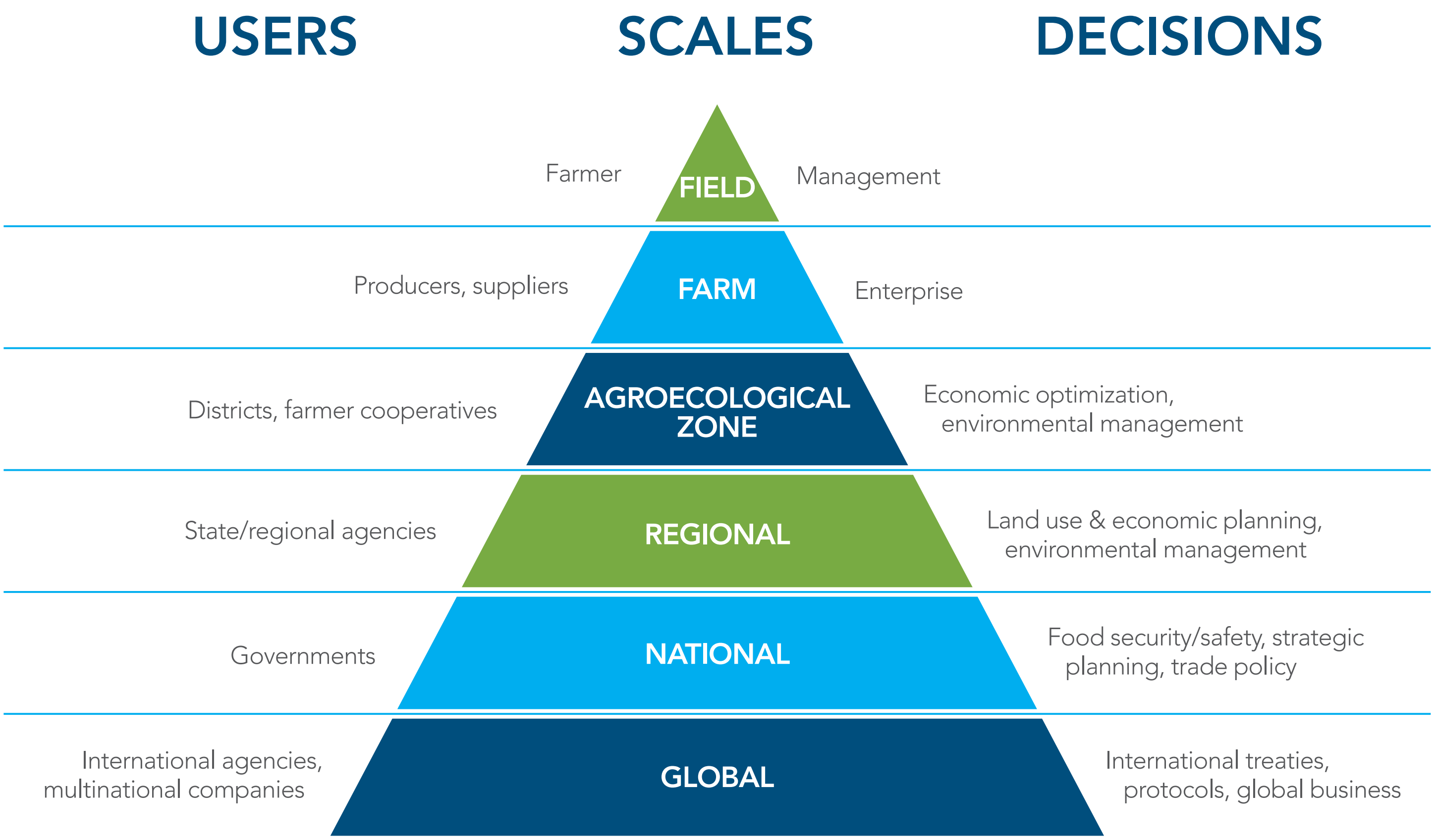


Figure 4. Scales/levels at which agricultural system models are developed along with types of users and decisions and policies of interest.[15]

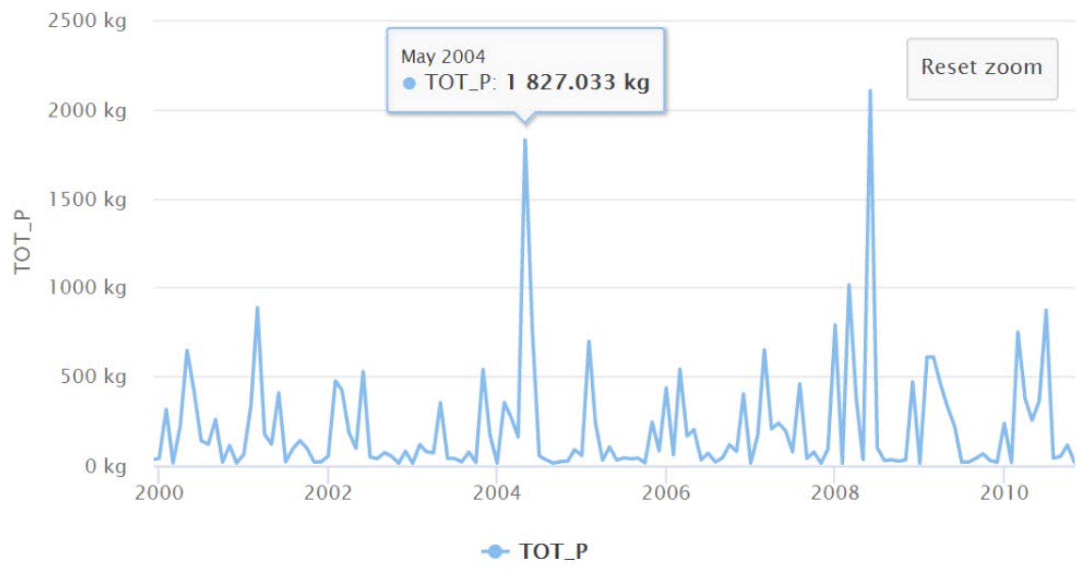
Advances in the understanding of physical, chemical, and biological processes influencing water quality, coupled with improvements in the collection and analysis of hydrologic data, provide opportunities for significant improvements in the manner and level with which watershed-scale processes may be explored and modeled. Once you choose a specific watershed in which to implement a PfP program, you can use watershed models to identify smaller Hydrologic Unit Codes (HUC) areas where nutrient losses may be higher. This allows you to prioritize areas within the watershed and predict and identify areas where a PfP program would be useful.

[15] Ibid.

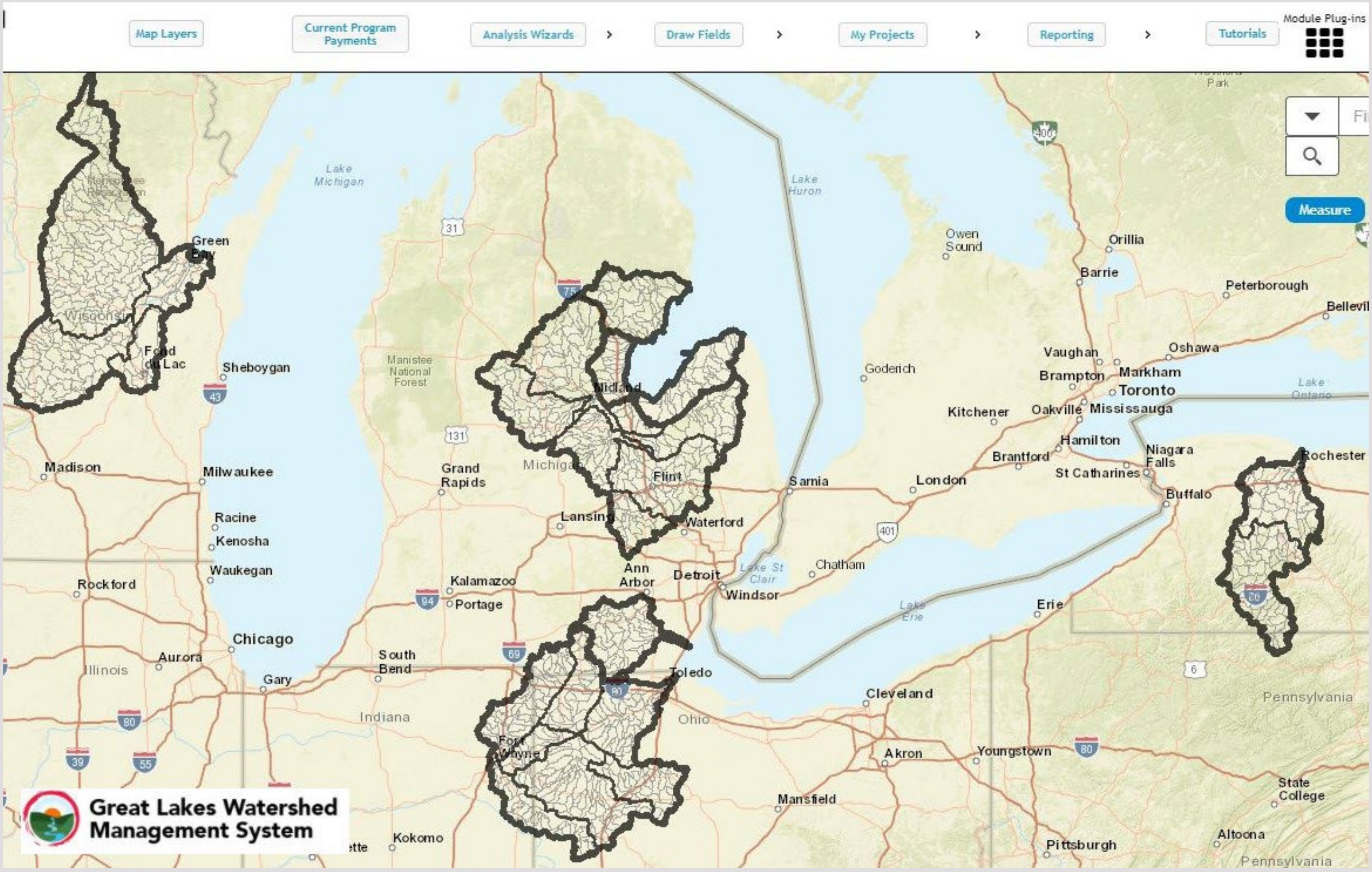
THE HYDROLOGIC AND WATER QUALITY SYSTEM: MAKING WATERSHED-SCALE MODELING ACCESSIBLE

In 2016, EPA released the web-based Hydrologic and Water Quality System (HAWQS) as a user-friendly interface for detailed analysis at the 8-digit, 10-digit, or 12-digit HUC scales. HAWQS is based on the Soil and Water Assessment Tool (SWAT), an advanced and highly-customizable model used in projects globally. The output below shows average monthly P loading from the West Branch of the Milwaukee River watershed, as estimated by default inputs, for the period from January 2000 to December 2010.

To access HAWQS and learn more, visit: https://epahawqs.tamu.edu/.



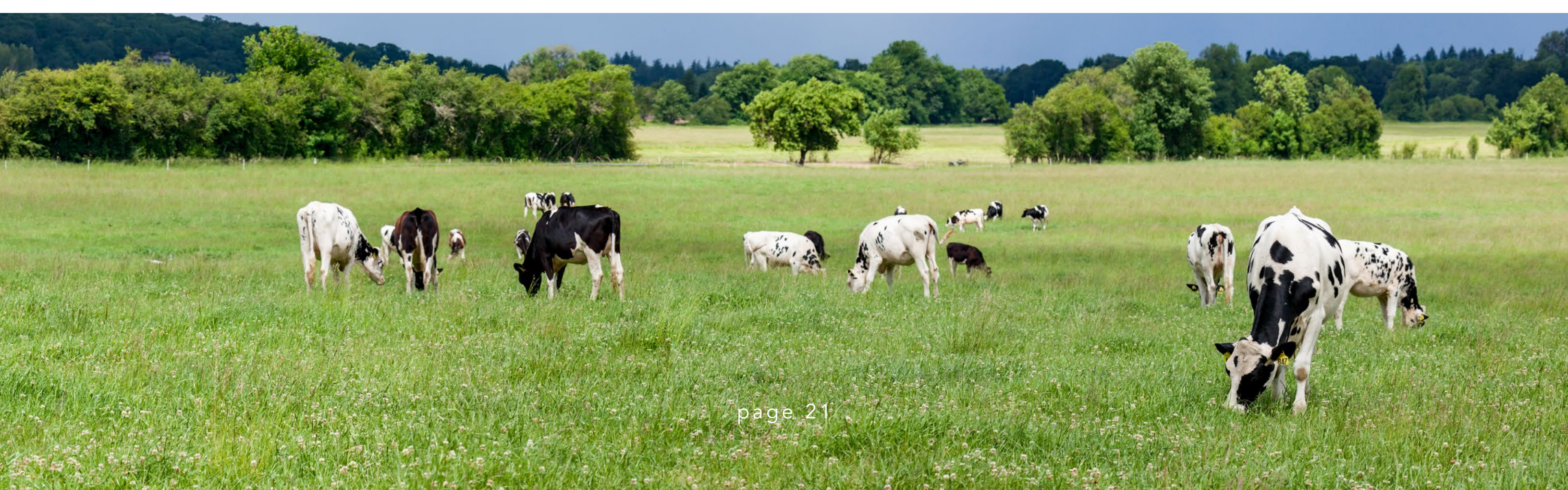
You might select a field-scale model when you want to know the BMPs that meet production, profitability, and environmental protection goals (Figure 4). Field-scale models are important for a PfP program, because the engine of PfP is spatial variability in the performance of BMPs.



ESTIMATING SEDIMENT LOADS AND REDUCTION SCENARIOS AT THE FIELD-SCALE

The Great Lakes Watershed Management System (GLWMS) was developed by Michigan State University's Institute of Water Research as a web-based decision support tool to improve water resources management across the Great Lakes. GLWMS can perform watershed and field-level analysis, estimating sediment and nutrient losses by implementing a suite of conservation practices across the agricultural landscape. GLWMS is currently available in the three basins prioritized for nutrient reductions in the EPA Great Lakes Restoration Initiative (Michigan's Saginaw River, Ohio's Maumee River, Wisconsin's Lower Fox River) as well as Michigan's River Raisin and New York's Genesee River watersheds. A PfP project in the Saginaw Bay watershed uses GLWMS to estimate sediment loading and reductions from a handful of BMPs that can be modeled by the system.

In Table 4, we provide a comparison of models and tools that are used in the Great Lakes basin at the watershed- to field-level scales. Depending on your watershed, goals, and available input data, other models or tools may be more appropriate for use in your PfP program.



Name	Description	Developer	Spatial/ Temporal Extent	Inputs	Outputs	Geography	Link
Erosion Vulnerability Assessment of Agricultural Lands (EVAAL)	EVAAL prioritizes areas within a watershed which may be vulnerable to water erosion that may contribute to downstream surface water quality problems. It evaluates locations of relative vulnerability to sheet, rill and gully erosion using information about topography, soils, rainfall and land cover.	Wisconsin Department of Natural Resources	Field/ Farm	Area of Interest (AOI), LiDAR data, soils, culvert lines	Erosion Vulnerability Index	Wisconsin	http://dnr.wi.gov/topic/Nonpoint/EVAAL.html
Agricultural Conservation Planning Framework (ACPF)	ACPF identifies agricultural fields most prone to deliver runoff directly to streams, maps and clasifies riparian zones to inform whole-watershed riparian corridor management, and maps out locations appropriate to install conservation practices.	USDA Agricultural Research Service	Field/ Farm	AOI, LiDAR data, soil type and characteristics, land use data, cropping history	Runoff risk assessment, optimal locations for field-scale and edge-of-field practices, riparian management opportunities	Illinois, Iowa, Kansas, Minnesota, Missouri, Nebraska, Wisconsin	http://northcentralwater.org/acpf/
Soil Nutrient Application Planner (SnapPlus)	SnapPlus is desktop application for nutrient management planning that informs farmers about on-farm nutrients and calculates potential soil and P loss runoff on a fied-by-field basis while assisting in economic planning of fertilizer and manure application.	University of Wisconsin-Madison	Field/ Farm	AOI, crop rotation, county, soil test information, nutrient management information	P loading and reduction, nutrient application recommendations	Wisconsin	https://snapplus.wisc.edu/
Great Lakes Watershed Management System (GLWMS)	GLWMS is a web-based tool containing sediment and nutrient calculators capable of assessing the environmental benefits of various conservation practices from a field-to-watershed scale. The tool assists in targeting BMPs to areas expected to provide the greatest environmental benefit.	Michigan State University	Field/ Farm/ Watershed	AOI, BMP practices and area applied	Contributing acres, sediment loading and reduction, areas at high risk	Fox River, Saginaw River, River Raisin, Maumee River, Genessee River basins	http://www.iwr.msu.edu/glwms/
Nutrient Tracking Tool (NTT)	NTT estimates nutrient and sediment losses from fields managed under a variety of cropping patterns and management practices. the tool can help farmers to determine the most cost-effective conservation practice alternatives for their individual operations.	Tarleton State University	Field/ Farm	AOI, soil type and characteristics, BMP type, fertilizer rate and source	Baseline and alternative conditions, reduction of N and P, estimated crop yield	United States	http://nn.tarleton.edu/ntt/
EPA Region 5 Model	The EPA Region 5 Model estimates sediment and nutrient load reductions from a suite of conservation practices.	EPA and Tetra Tech	Field/ Farm	State, county, RUSLE factors, soil texture, BMP type	Sediment, N and P load reduction	United States	http://it.tetratech-ffx.com/steplweb/
Spreadsheet Tool for Estimating Pollutant Loads (STEPL)	STEPL calculates nutrients and sediment loads from different land uses and the load reductions that would result from the implementation of a suite of BMPs	EPA and Tetra Tech	Watershed	AOI, climate history and information, livestock information, state and county, BMP practices and area applied	N, P, BOD, and sediment loads (with and without BMPs applied)	United States	http://it.tetratech-ffx.com/steplweb/
Soil and Water Assessment Tool (SWAT)	SWAT is a river basin- to subwatershed-scale model developed to quantify and predict the impacts of land management practices on water, sediment, and nutrients in watersheds with varying soils, land use, and management conditions over long periods of time.	Texas A&M University, USDA Agricultural Research Service	Watershed	Digital elevation models (DEMs), soils, basic land use, stream network and outlet points, precipitation and streamflow	Reports of crop yields, total phosphorus (TP) yield loading, total suspended solids (TSS) yield loading, and total sediment delivery within the chosen watershed	Global	http://swat.tamu.edu/

Table 4. Models and Tools Available for Determining Nutrient Loads

Supporting data

In order to accurately run the models and establish the baseline scenarios for your PfP program, you will need a variety of supporting data and documents. This information is vitally important; if left out of the model or not recorded accurately, it can jeopardize the accurate calculation of the farm baseline. Without baseline data, modeling or monitoring of any type is difficult to predict and assess. Below is a list of information that various parties should provide or have access to in order to have a successful program.

Information from the farmer/operator

With technology getting more sophisticated, it has become easier for farmers to record field and management information in real time using precision agriculture and geospatial technology. This information is vital for landowners that want to participate in a PfP program. Many existing models and monitoring programs require similar data to accurately depict baseline data. Once baseline data is established, you can add new management changes into the model, which can be used to generate reduction amounts when future implementation data is entered.

Types of information needed from farmers/operators for modeling and monitoring purposes include the following:

- Farm/field location (size in acres)
- Crop type and rotation (planting and harvest dates)
- Tillage practices
- Nutrient application (time, place, rate, source)
- Current soil test results
- Manure test analysis (if applicable)
- Animal type, number of animals (if applicable)
- Manure storage and spreading information (if applicable)

SWCDs

Soil and Water Conservation Districts (SWCD) and other organizations, such as watershed councils and environmental nonprofits, are fundamentals to the success of a PfP program. Often, staff at these organizations work closely with landowners and operators on a regular basis, designing and implementing agricultural BMPs to achieve environmental improvements. SWCDs usually have access to landowner and operator information through county, state, and federal records and often have close working relationships with operators (e.g., a simple phone call or email can secure the information needed). These organizations have access to technology and information that may not be available to landowners. Moreover, these organizations have the knowledge and skill to use the information to its fullest potential.

The types of information needed from SWCDs and other organizations for modeling and monitoring purposes include the following:

- Water management (drainage, irrigation, water bodies)
- Land classification and management (farmland and ecological classification, erosion hazard)
- BMP information and design (existing and planned)
- Land, soil, and water information and interpretation (land use, land cover, hydrology)
- Soil properties and qualities (erosion factors, soil health, physical properties)

Conduct farmer outreach

The combination of a challenging problem, the freedom to creatively collaborate on a solution to that problem, and a data-driven framework for making decisions and providing incentive payments is powerful motivation for farmer involvement in solving a water quality problem. To maximize farmer outreach and engagement efforts in a close-knit farming community, the most effective outreach strategy is to tap into farmers' existing relationship networks, including conservation districts, university extension staff, technical service providers, fertilizer companies or other private sector agronomists, farm groups like the Farm Bureau, commodity groups, or other farmers. The support of these trusted organizations is vital to the success of a new PfP program, whether you or they will be the ones working directly with farmers in the watershed. Engaging with these groups early in the development of a PfP program gives you time to explain the objectives of your program, get their buy-in, and incorporate their input into program development.

It's critical that you build in long-term project support for "boots on the ground" staff who will work directly with farmers in agronomic and conservation roles. Without these partners identified and appropriately funded, the PfP program will suffer. During budget development, be realistic about the number of farmers you expect to work with and the time needed to support farmers at each step of the PfP process. Gathering and entering baseline information into modeling programs usually takes the most time. It is better to have more than one technical person assigned to the PfP program to make sure it runs smoothly during busy periods.

ENGAGING LOCAL AGRONOMIC SERVICE PROVIDERS

In the Milwaukee River watershed pilot project, partnering with a leading agronomic service provider in the area proved to be essential in recruiting farmers. Within several weeks of presenting to a group of agronomists and offering them a $50 bonus per referral, the project team signed up 6 new farmers working with one of the agronomic service provider companies represented (Country Visions Cooperative).

According to the Wisconsin Department of Agriculture, Trade, and Consumer Protection, 76% of all nutrient management plans in 2016 were developed by agronomists and the focal county of the pilot project (Fond du Lac) ranked highest by total acreage.

Farmer-led watershed councils

One potential method for engaging the agricultural community is for you to create a farmer-led watershed council (FLWC). FLWCs bring farmers together to foster a sense of community around a local watershed issue and to work toward common goals, such as achieving nutrient load reduction targets. The current government approach to conservation, in which farmers are passive recipients of information and solutions (i.e. BMPs) does not maximize farmer motivation or harness their skills to solve the problem. PfP fits very well with FLWCs because it provides the opportunity for innovation, flexibility, and an incentive for farmers to seek out and implement the best and most cost-effective actions for their specific fields.

Within the FLWC, farmers share ideas about conservation practices and brainstorm on innovative approaches that work well with their type of farming operations. In-depth interviews with participating producers in PfP programs in Iowa revealed that the creation of FLWCs generated a sense of ownership of the local water quality issue that had not existed previously. In some cases, water quality monitoring data for the watershed served as both a focal point for goal-setting and as a real-time report card for the producers to gauge the impact of their collective actions. Almost all of the producers indicated that this information and the desire to show measurable impact motivated them to accelerate conservation efforts on the farm. Even the more reluctant farmers were convinced to participate by the peer pressure from other farmers and the group's desire to achieve local water quality goals. From anecdotal evidence, it appears that PfP projects that included FLWCs were more successful than those without them in brainstorming innovative ideas, applying conservation practices on farms, and improving water quality.

A new FLWC can be set up in any watershed, provided certain key components are present. Key farmer leaders must be identified who are willing to be spokespeople for the new FLWC and promote the organization among their peers. Farmers in the watershed must understand that agricultural land is a significant contributor to local or regional water quality degradation. This level of understanding usually results from education and outreach efforts to the farm community over several years. Iowa State University Extension has compiled an in-depth set of online resources called the Watershed Group Development Guide, which should be read by anyone interested in helping to organize a FLWC.[16]

THE IMPACT OF A SUCCESSFUL FARMER-LED WATERSHED COUNCIL IN IOWA

Iowa State University Extension has facilitated the development of numerous farmer-led watershed councils (FLWC) throughout the state. Winrock partnered with Iowa State University Extension to pilot-test PfP in several of these watersheds. The motivation of the farmers in these FLWCs to be proactive on local water quality issues was truly impressive. Forming the FLWC put farmers in the driver's seat to improve conservation and they applied the same ingenuity, focus, and hard work to the goal of reducing nutrient runoff that they do in running their farms.

These FLWCs achieved participation rates from 60-85% of farmers in their respective watersheds. In Hewitt Creek, the farmers in the FLWC were able to collectively reduce more than 8,000 tons of sediment loss and 10,400 lbs of P loss per year. In the Coldwater-Palmer watershed, the FLWC was able to reduce estimated P loss by 35%.

16 http://www.soc.iastate.edu/extension/watershed/modules.html

Challenges to farmer engagement when developing a new PfP program

In past PfP programs, there were four primary reasons for farmer reluctance to participate. Below we outline those reasons and provide you with strategies to address those farmer concerns.

1. Reduced motivation due to the temporary nature of pilot programs

To date, most PfP programs have been short-term, grant-funded pilot projects lasting 2-4 years. Some farmers have expressed a lack of interest in enrolling in such a short-lived program, because the long-term benefits of investing their time in such an effort are not clear. Longer PfP programs might benefit from interacting with and gaining the trust of farmers over a longer period of time. However, longer projects require long-term sources of funding, which may not be an option in your watershed.

2. Concern related to privacy of information used in the program

The detailed nature of farm-specific information necessary to successfully execute a PfP program is a concern to some farmers, especially if the work is funded by a state or federal regulatory agency. This can often be resolved by working with the funder to write privacy notices on program documents. If farmers can see that their privacy has been considered and can see details in writing, they are often more comfortable participating in the program. The text, below, is an example of such language:

> *Privacy Statement: The only information specific to your farm that will be released will be the type of BMPs implemented and the township in which your farm is located, which the project funder (U.S. EPA) requires. The project will only make other results available in an anonymous fashion, including the nutrient runoff reductions and cost-effectiveness of the field management changes analyzed. All other information, such as individual soil test results, fertilizer application rates, and field-specific nutrient or sediment runoff estimates, will be held as confidential within the project team and will not be released to any persons or entities without the prior written permission of the farmer.*

3. Lags in communication with the project team

New PfP programs may include several technical staff to fully execute the conservation planning, modeling, analysis, and program administration. If this is the case, it is vital that there be a program manager who helps coordinate communication among project staff and who will facilitate the smooth operation of the PfP program. Enthusiasm for a new program can quickly wane if participants have trouble getting their questions answered, data entered, contracting forms processed, or incentive payments approved. With appropriate attention paid to having clear roles and responsibilities assigned from the start of the program, as well as regular calls or meetings to coordinate on progress, a large team can still effectively and successfully roll out a PfP program.

4. Low incentive payments for the conservation practices of greatest interest to farmers

A final challenge that is sometimes faced in PfP programs is that popular conservation strategies do not end up being the most cost-effective ones, and so the incentive payment for implementing them is small or does not cover their cost. While this can certainly be frustrating for some farmers, it is important to be clear about program goals. For example, if the program is paying for phosphorus reductions, the P reduced by planting a cover crop may be small and the associated incentive payment may be less than the cost of planting the cover crop. However, the program isn't designed to consider the other benefits associated with cover crops, such as N or sediment loss reductions, and so these practices may still be valuable to farmers for reasons not addressed by the PfP program. It can also be helpful to reiterate that program dollars are going to pay for the most cost-effective practices for the pollutant-of-interest in the field in question; while cover crops may not be cost-effective for reducing P losses from a flat field far away from a stream, it may be cost-effective to plant cover crops to reduce P losses from a highly sloped field adjacent to a waterway. Reminding farmers that the program is structured to find the most cost-effective way to reduce the pollutant-of-interest from their specific fields may help reorient them to the specific, and valuable, goals of the program.

The best way to deal with the challenges of setting up a new PfP program is to acknowledge them up front and make sure that farmer concerns are addressed. Many projects have benefitted from the formation of a project advisory team that meets periodically to address program questions and concerns. The project advisory team can be composed of a variety of stakeholders with interest in water quality in the watershed. These stakeholders may be researchers from local or regional universities, citizen or watershed groups, farmer organizations, university extension agents, and private sector companies, such as fertilizer companies or other technical service providers. Often, these stakeholders have important perspectives on the water quality issue and can contribute to the overall success of the PfP project. By relying on a project advisory team to help support decisions and brainstorm solutions to problems, farmer concerns can be addressed and confidence in the PfP program and program staff can be maintained.

Program execution and administration

Setting a price per unit of nutrient or sediment loss reduction

The central driver of your PfP project, and therefore one of the most important decisions you will make in program execution, is the structure of the incentive payment and the price per unit of pollutant mitigated. It will determine a threshold for cost-effective conservation and should be sufficient to motivate some cost-effective changes, but not so costly that the program is unsustainably expensive. Before setting the price, you should analyze the cost-effectiveness of a range of management changes affecting the pollutant of interest in your area to guarantee that the price will fully cover some changes while effectively acting as a cost-share for others. This analysis should be accomplished by modeling a variety of BMPs using your chosen modeling tool, estimating the cost to the farmer for implementing each, and then determining the cost per unit of pollutant mitigated. Just as the same BMP will not always have the same cost-effectiveness in your area, the cost-effectiveness of BMPs also varies between regions. Thus, the price per pound of pollutant may need to be different in your state or watershed compared to other regions to be a sufficient incentive for farmer action.

In the case of trading-based PfP, the price will, by necessity, be determined by the market value per unit of mitigation. More specifically, the price will be negotiated between the cost per pound mitigated by sellers (likely agricultural sources) and the cost per pound mitigated by buyers, or point sources. For example, if upgrades to a municipal wastewater treatment plant will cost about $40 per pound of phosphorus, but upstream farm nutrient management changes cost about $25 per pound of phosphorus, then farmers and municipalities may agree on a price of around $30 per pound.

There are several types of payments to consider in a PfP program; these include:

Participation Payment:

This payment is designed to get farmers in the door and thinking about the most appropriate and cost-effective actions for their specific fields. Prompting farmers to think in new ways about conservation implementation is an essential part of reducing nutrient loss from agricultural land. Although this payment is not attached to reductions, it is a small incentive to encourage farmers to complete the assessment with the project or program staff. For example, one project used a one-time payment of $250 per farmer, which sends a signal that we recognize that their time has value. A participation payment can be very helpful to encourage broader farmer participation, although it may not be essential for program success.

Farm-level (or Primary) Incentive Payment:

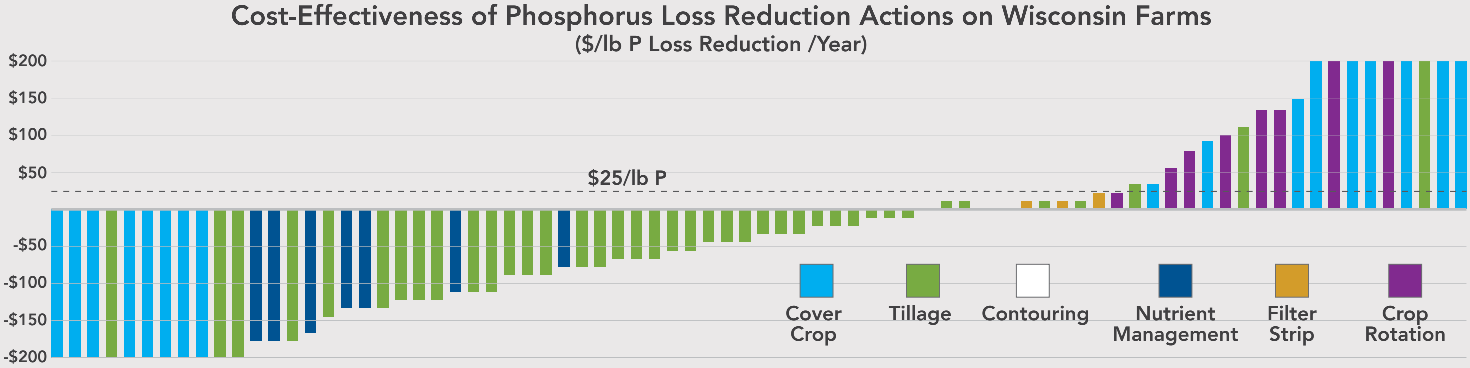
This payment is at the heart of the PfP program: rewarding farmers based on the amount of nutrient loss reduction that each farmer achieves. As previously discussed, reductions need to be estimated using an appropriate simulation model, because it is not practical to measure nonpoint source pollution at the edge of each field. Further, modeling allows for farmers to assess outcomes before making changes and eliminates the uncertainties caused by erratic weather. Structuring the payment as dollars paid per pound of reduction is most straightforward, but there may be other metrics that could be considered, depending on program goals. The level of this payment will depend on several factors, including how much reduction is needed from agricultural land in the watershed and how much funding is available to be allocated to this payment. In general, the payment should be high enough to entice farmers to take actions, meaning the payment rate should be greater than the lowest cost per pound of reduction for many of the interested farmers. A higher payment rate will make these on-farm changes good business decisions and will achieve more pounds of nutrient reduction. According to economic theory, farmers would start with the most cost-effective actions and continue to reduce losses up to the point where their cost equals the payment rate (i.e. recall marginal revenue equals marginal cost from introductory economics). Therefore, if greater nutrient loss reductions are required in a watershed and there is sufficient budget, setting the farm-level incentive payment at a higher rate would be appropriate.

Setting the payment rate may be dictated by budget constraints and/or nutrient loss reduction requirements. However, to ensure that the payment rate is in the right ballpark for your watershed, it is a good idea to conduct some analyses on representative farms in the watershed. This is done by analyzing a variety of management changes on each farm, including estimating loss reductions (using the chosen model), the full economic costs, and the cost per pound of reduction for each action. The range of results for cost per pound will provide a sense of the appropriate price per pound for the watershed. The more farms and the more actions that are analyzed, the greater certainty you have in setting the price.

In the below example, our project set the farm-level incentive payment rate at $25 per pound of total P loss reduction. We found that this payment rate was central in the distribution of costs per pound for actions on farms in the watershed.

DETERMINING COST PER POUND IN WISCONSIN'S WEST BRANCH OF THE MILWAUKEE RIVER

In the West Branch project, our project team estimated the full economic costs of implementing BMPs on specific fields and modeled the corresponding phosphorus loss mitigation. A measure of cost-effectiveness, or cost per pound P, is shown here. At a $25/lb P payment, the cost of many BMPs were completely covered (and some already were cost savings), while other BMPs were more expensive per pound P and were less likely to be implemented at this price point.



Watershed-level (or Secondary) Performance Payment:

Estimating losses and loss reductions at the field and farm-level is essential, but actual load reductions at the mouth of the watershed is where the rubber meets the road. As such, Winrock has developed a concept called "Model at the Farm, Measure at the Watershed Pay-for-Performance Conservation," in which a bonus incentive payment is made to each participating farmer when measured in-stream load reductions are achieved. The reason for this payment is to motivate participating farmers who want to move the needle on water quality issues to encourage their neighboring farmers to join the program. The greater the percentage of participating acres in a watershed, the greater the probability of detecting a statistically significant reduction in nutrient loading in the stream. This bonus payment can be structured in many ways, but a bonus of 20% of the amount earned by each farm for its farm-level incentive payment is a method we have used in the past. This way the bonus payment reflects each farmer's effort and contribution to solving the nutrient loading problem.

Stewardship Payment:

While the three payments described above (participation, farm-level, and watershed-level) can be packaged together into a PfP program, the stewardship payment is also an option to be considered. This payment is designed to reward farmers for being at or below some average threshold level of losses per acre from across their farm. Although this type of payment does not accrue additional nutrient loss reductions and in that sense is not cost-effective, it can be viewed as a fair payment structure for farmers who have previously made efforts to reduce nutrient losses from their farm. This type of payment, if large enough, would also impute a greater relative value to farming land that is less vulnerable to nutrient losses. Imputing this value to favor farming "safer" land is a good outcome.

Winrock has used this stewardship payment in previous projects, awarding $2 per acre for being at or below 0.5 pounds of P loss per acre on average across the entire farm. This payment went up to $5 per acre for being at or below 0.1 pounds of P loss per acre. We feel that this graduated payment structure motivates farmers to reduce losses further. We did allow farmers to earn both a payment for reduction and a stewardship payment if applicable. The level of the stewardship payment will be highly influenced by program goals and budget constraints.

Estimating baselines, reductions, and costs

Early in the PfP project development, your team must decide on the quantification tool that will be used to determine the appropriate baseline for each farm, beyond which the reduction in pollutant losses will be eligible for payments. In this document, we primarily refer to a "current practice" baseline, where farms can be paid for any improvement beyond what they are currently achieving. However, other baselines are possible, such as a regional average performance or a target number for nutrient loss.

Training conservation staff who will be working with farmers may take time, as models each have their own intricacies and capabilities. Pay-for-performance programs are more time-consuming for on-the-ground personnel relative to pay-for-practice programs, because each field on the farm must have its management information, soil tests, acreage, and slope measurements gathered and entered into the quantification tool. In addition, conservation staff may need to be trained to work collaboratively with farmers, both to elicit creative suggestions from producers and to provide guidance on the diverse set of conservation practices that could be pursued. Acknowledged up front, these characteristics of PfP programs should not be difficult to overcome and are likely to be outweighed by the potential cost-savings from choosing PfP over traditional pay-for-practice conservation.

A PfP program may also benefit from providing producers with the costs and cost-effectiveness estimates of each management change to aid in decision-making (Figures 5 and 6). Providing farmers with a menu of options with graphs and tables of the expected costs, environmental benefit, and net farm profit of each conservation activity may help clarify which practices are most cost-effective and promote adoption of those changes.

It's important to make sure that any PfP program is designed so that any qualifying actions that receive payment are fully justifiable and defensible. Below are some best practices to consider:

1. **Be sure to avoid the occurrence or appearance of farmers double-dipping** (i.e. collecting funds from the government for a conservation practice and also collecting funds from the government based on the nutrient loss reduction of that same practice on the same fields. This is not to be confused with the USDA policy that allows farmers to sell ecosystem service credits in an environmental marketplace that result from USDA cost-shared practices). It is unacceptable for the government to be paying twice for the same practice change on the same land. As such, it's important that the PfP implementers have access to, and understand the specific details of, any and all conservation-related government contracts with any participating farms. Changes that are already funded should always become part of the farm's baseline condition.

2. **Include all fields and acres used by any participating farm, whether owned or rented, in the baseline calculation for the farm.** If only some of a farm's fields are included, it's possible that reductions from one field could be offset by changes that increase losses on another field that is not included in the program. A prime example is when a farmer chooses to spread manure differently across the farm: when reducing the application of manure on one field, presumably that manure will be spread on another field, which needs to be recognized. This type of change could be a cost-effective action, as some fields will have lower risk of nutrient loss, but all fields need to be included in the assessment. Numerous on-farm examples support this point.

3. **Avoid the moral hazard potential when setting a baseline.** If a farmer is going to be paid for nutrient loss reductions relative to the farm's baseline, a farmer could take steps to increase their baseline losses. For example, in anticipation of participating in a PfP program next year, a farmer could switch this year from no-till to a moldboard plow in order to increase the farm's baseline losses. There are several ways to address this issue, including use of a performance standard for the area or an average of a field's past 3-5 years as a baseline. Using adequate verification of all information is another important factor in a successful PfP program.

ESTIMATED FIELD-SCALE P LOSS REDUCTIONS AND COSTS TO AID IN DECISION-MAKING

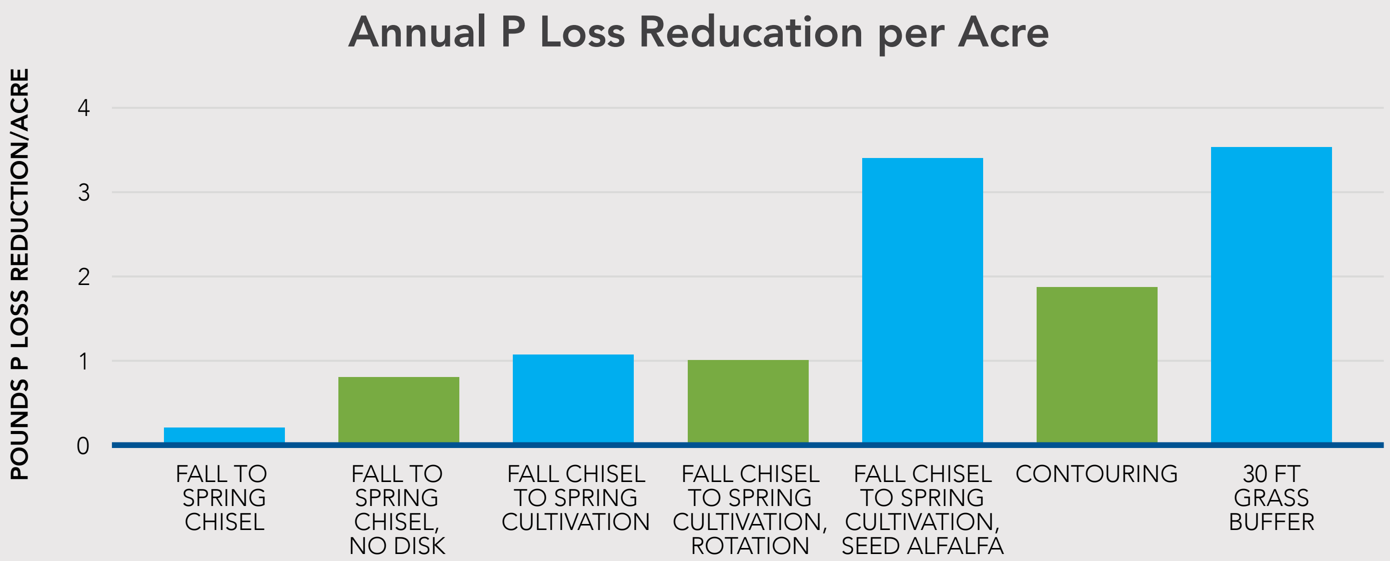


Figure 5. Annual P Loss Reduction in Pounds for Various Conservation Activities

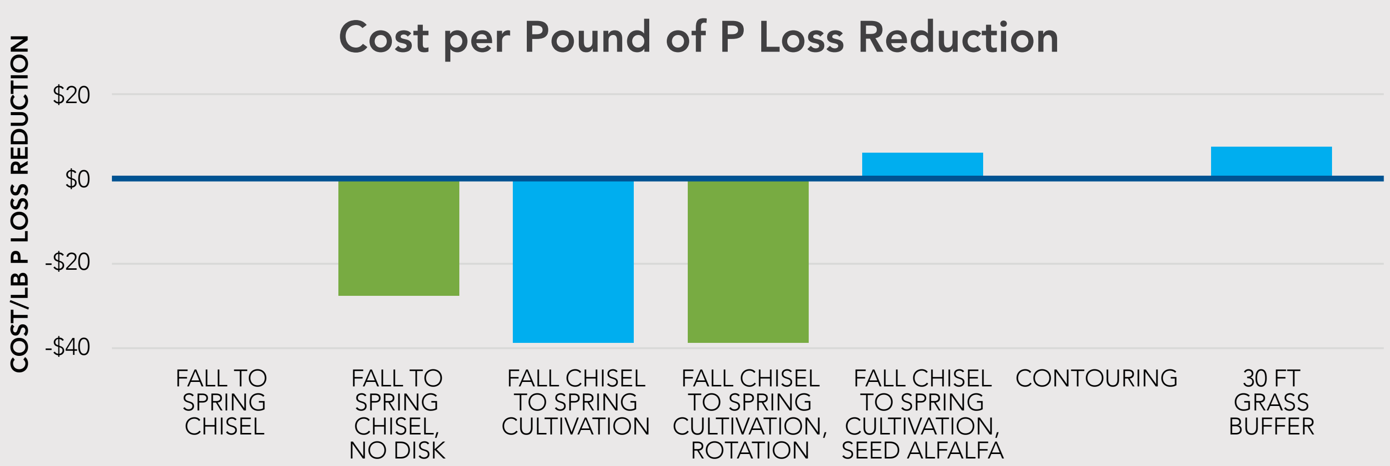


Figure 6. Cost of P Loss Reduction per Pound for Various Conservation Activities

4. **Consider the term of the baseline for each farm.** A program could hold the baseline constant over the long-term and reward farmers each year relative to a static baseline. Another approach would be to design the program so each farm's baseline is updated every 3-5 years. This would require participating farmers to continue to improve their conservation in order to continue to receive performance-based payments.

Developing farmer agreements

Farmer agreements are necessary to ensure that expectations of practice implementation and maintenance are clear, to provide farmers with a guarantee on issues such as privacy concerns, and to document the installation of BMPs that are enrolled in the program and receive incentive payments. Our experience has shown that a two-phase approach to farmer sign-up may be most beneficial, followed by verification. The first phase includes information-gathering and whole-farm modeling, after which the farmer sees possible payments and costs of each management change but is not bound to make any changes. The agreement for this phase should include any guarantees related to privacy of the information collected. The second phase is when farmers choose and sign up for modeled practices at the associated incentive payment rate. The second phase sign-up details the actions, pollutant reductions, and payments, as well as the process for verifying the practices during or after implementation.

Privacy concerns

Many farmers cite cumbersome program paperwork as one of the reasons they do not participate in current conservation programs. Recognizing this, we have used a simple sign-up form as our agreement with each participating farmer in our PfP pilot projects. The agreement needs to clearly list what changes will be made as well as the corresponding nutrient loss reductions and associated payments. Other details to consider adding to the agreement include the following:

- the farmer is not obligated to make the listed changes and that they do so voluntarily;
- the project is not responsible for paying for nutrient loss reductions from any actions that are not listed;
- other changes that increase losses will need to be disclosed and counted in the final quantification and payment.

Maintaining confidentiality of all information is important. Farmers will be much more likely to participate if they feel confident that their farm's information is protected. Some farmers are concerned that their

Pay-for-Performance Sign-up Form

A one-page sign-up form with tables that list the changes and reductions has worked well for our pilot-testing.

PfP OPTIONS SIGN UP FORM

Year: 2016
Farm: PfP1
Option #: 3
Description of option: Rye/radish cover crop
Category: Cover crop

IMPORTANT NOTE: Final payment will be based on a whole-farm assessment of P loss abatement. Payment estimates on this form are only for the practice(s) described in the option. Options are not always additive on P loss abatement. Negative action will be accounted for in final payment.

Field	Acres	Lbs P loss abated using option	Potential Payment based on this option only	Check if you plan to implement this option
2	3	0.2	$5.83	
4	4.5	0.6	$13.92	
6	4.5	0.5	$13.58	
8	4.1	0.5	$12.90	
11	3.7	0.4	$10.55	
12	6.1	0.7	$17.36	
14	5	0.7	$17.51	
31	4.8	0.9	$21.58	
35	2.3	0.2	$4.36	
37	1.9	0.0	$0.30	
48B	2.8	1.8	$44.23	

SIGNATURE ____________________ DATE __________ information could be used against them in a future regulatory program. If a PfP program is funded by government, it is particularly important for the program implementers to make sure that participating farmers can be guaranteed confidentiality of their information.

The PfP process is very information-intensive; some of the actions taken are visible (e.g. tillage changes) and some are not (e.g. fertilizer rate reductions). A degree of trust will be required, but an adequate verification process is needed. The old Russian proverb made famous by President Reagan, "trust, but verify," is applicable here.

Accuracy in constructing each farm's baseline is crucially important. The moral hazard mentioned above acknowledges that it's possible for farmers to provide inaccurate information regarding their baseline practices and application rates. The baseline practices should be verified to the greatest extent possible using farm records. However, these are not always available and are often not very comprehensive.

It's also important that, before signing up, farmers clearly understand the verification process, what will be required of them, and the consequences regarding failed verification. Therefore, before a PfP program goes live, you should determine the specific details of the verification process and make sure those details are made available to potential participants.

Form for Verifying Management Changes

An example verification form, with room for certification of activities, notes, and receipts, where applicable, is seen below.

PfP OPTIONS SIGN UP FORM

Year: 2016
Farm: PfP8
Option #: 1
Description of option: Install filter strip
Category: Filter strip

Field	Acres	Lbs P loss abated using option	Potential Payment based on this option only	Farmer certification	Verifier certification	Acres under this option	Lbs P loss abated using option	Payment based on this option only
10	11.9	14.2	$356.19	1	1	11.9	14.20	$356.19
B-5A	4.4	1.2	$30.42	1	1	4.4	1.20	$30.42
B-5B	4.4	2.5	$63.54	1	1	4.4	2.50	$65.54
B-6	3.5	2	$50.10	1	1	3.5	2.00	$50.10
B-7	9.8	501	$127.27	1	1	9.8	5.10	$127.27
B-8	5.5	2.6	$64.93	1	1	5.5	2.60	$64.93
TOTAL	39.50	27.60	692.45	6.00	6.00	36.50	27.60	$692.45

Specific description of changes made on these fields: Grass filter areas, primarily grassed waterways in highly concentrated flow areas were installed in 2015 through recommendations determined by the PfP process.

Field management records: Greg Olson of Sand County Foundation personally verified the practice on all the fields right after planting in May 2015. Greg had done a short field visit in May of 2016 to verify that the strips were still in place.

Verification of management changes

After farmers have implemented management changes, your program staff must verify them before incentive payments can be issued. This provides the necessary quality assurance that practices were implemented as modeled and that the resulting reduction in nonpoint source pollution was accurately estimated by the model. The verification process should document the management change, the pollution reduction, and the payment associated with implementing the scenario. Supporting documentation should accompany the verification to illustrate that the change occurred. Acceptable documentation may include farmer self-certification, visual certification by program staff, fertilizer or cover crop seed purchase records, photographs, or other materials deemed appropriate by project staff.

Ideally, you should use an independent third party to conduct the on-farm verifications. This is preferred over having verifications conducted by the same person who conducted the analysis and arranged for the farm's enrollment in the program. However, it may not always be possible to have third-party verifiers; in this case, using program staff is sufficient.

You should aim for verification of actions to occur as soon as possible after the action has been completed. Most actions taken to reduce nutrient loss will be done in the spring and the fall, during the time of most field operations. As an example, if a tillage operation is moved from fall to spring, it would be valuable for the verifier to get a date-stamped picture of the relevant fields in the late fall or winter showing that they had not been tilled. A date-stamped picture of winter cover crops shortly after they have established to a height of 4-6" is another example. Actions that are less observable include changes in manure or fertilizer application rates or timing; sometimes the method of application will be very hard to document if you are not on the farm at the time. For unobservable actions, the verification process should require adequate field records accompanied by a farmer-signed affidavit declaring that all the information in the records are correct and accurate. To be successful and complete, program staff and participating farmers should work together to complete the verification process so that it is possible to obtain appropriate documentation and take advantage of opportunities to view management changes when they occur in the field.

SECTION 4

LESSONS LEARNED

In the more than ten years of experience that Winrock International and Delta Institute have accumulated in the administration of PfP programs in the U.S. and Canada, we have learned a number of lessons that may be useful to you. Because PfP programs are multifaceted and consist of partners who carry out both program development and implementation as well as participating farmers, this section will provide lessons learned from each of these perspectives to help new programs avoid pitfalls, streamline program roll-out, and maximize the success of new PfP efforts.

Lessons learned from program developers

Program developers are responsible for getting a PfP program up and running successfully and meeting goals. Before you get started, review our lessons learned so you can avoid common pitfalls.

1. Your project timeline needs to be realistic

No matter how good your plan is, your project will encounter unexpected barriers and challenges. Contingencies in the form of time should be built in, especially during the first year when the program is being designed. Front-end administration tasks often take longer than anticipated and should not be underestimated, as everything moving forward will hinge on this process. To successfully show positive environmental outcomes from agricultural BMP implementation, we recommend conducting a PfP program for a period longer than 3 years, with the expectation of 2 or more years of on-the-ground BMP implementation.

2. Having "boots on the ground" with existing farmer relationships is critical

Make sure your program has enough technical staff to work with farmers and to handle time-consuming aspects of the program, including farmer outreach, information-gathering, modeling, farmer sign-ups, and verification. These staff members are integral to program success, and they should have existing relationships with farmers in the community and be trusted sources of information. If you expect to develop those relationships during a PfP program, you should set aside at least 6-12 months for establishing relationships with farmers before starting farmer signups. Have contingency plans developed for handling staff shortages so program deliverables do not suffer.

CALCULATING TIME NEEDED AT THE FARM SCALE

The time it will take for technicians to work with farmers in a PfP program depends upon whether they have positive existing relationships with farmers in the watershed, if they are already trained on using the model selected for the program, and characteristics of the farms in the watershed, such as farm and field size. In a watershed where there are existing farmer relationships, staff are ready to use the model, and farms are about 300 acres in size consisting of 8-10 fields, a technician can expect to spend a minimum of 16 hours working with each farmer in each year of the project:

- 4 hours for farm outreach and information gathering
- 8 hours to calculate a farm's baseline management losses and develop conservation scenarios
- 2 hours for follow-up and contracting
- 2 hours for verification

If relationships with farmers must be established first, staff need to be trained on using the model, or farms in the watershed have many small fields to analyze, the time needed can increase significantly.

3. Outreach and enrollment processes will take longer than you think

Even when staff have existing relationships with farmers, it can take significant time and effort to reach farmers and convince them of the merits of joining a PfP program. Farmers may need time to become familiar with PfP and ask questions before they are ready to participate. For example, the PfP project in Ohio's Old Woman Creek watershed was funded by the EPA, and farmers there wanted information in writing specifying who would have access to their personal and farm information, such as nutrient management records, and how it would be used. This required extra time to coordinate with EPA and produce language acceptable to all parties. Most farmers will want to know exactly how a PfP program will be structured and what the incentive payment will be per pound of nutrient or sediment loss reduction. Plan your PfP rollout to account for the time necessary for outreach and enrollment, possibly as much as a year ahead of anticipated sign-ups.

4. Staying within your budget while setting a payment threshold that encourages adoption

One challenge associated with program start-up is collecting all the information you need to set the price per pound of nutrient or sediment loss reduction. Running conservation scenarios and calculating the cost of changes helps to set a reasonable incentive price that stays within the program's budget, but is time-consuming and requires that some farmers participate before all program components are finalized. Most watersheds have at least a few forward-thinking producers who are willing to serve in this capacity and help guide the development of the program. Nevertheless, plan on at least 6 months to find willing farmers, run scenarios, and calculate cost-effectiveness before having this price finalized and ready to advertise to the rest of the farming community.

5. Your program timeline should account for farm planting and harvest schedules

Farmers have varying availability throughout the season, so you should plan to reach them at appropriate times for farm decision-making. Ideally, this outreach should correspond with lulls in farm activity for best producer engagement and should take place well ahead of any anticipated farm management changes to allow time for farmer decision-making about program participation. For example, reach out to grain farmers in the winter months to discuss changes they may be interested in making the following fall and beyond. Many farmers purchase seed and fertilizer 6-12 months ahead of time, so they are not likely to make quick changes to crop rotations and farm management.

LOOKING OUTSIDE THE PROJECT TEAM FOR A MODELER

A PfP program that is currently operating in Michigan's Saginaw Bay watershed is using the Great Lakes Watershed Management System (GLWMS) to calculate loading and reduction of sediment from a suite of BMPs at a field-level scale. The developer, Michigan State University's Institute of Water Resources, is involved in team meetings and provides updates to the tool when changes are made. The developer is responsive to questions and provides troubleshooting when needed. This results in little downtime when running the tool and generates more accurate results.

6. Your choice of modeling tool should be made carefully

When choosing a model, make sure it's calibrated for the region or watershed in which you are working. Make sure that the model is updated frequently and is using current data to analyze scenarios and compute estimates. It's helpful to create a working relationship with the model developer for open dialog and suggestions for model improvement. Developers truly appreciate feedback, and this allows them to streamline changes and user improvements.

It's also helpful to have someone with previous modeling and monitoring expertise on your team, as it significantly reduces the likelihood of problems and delays. Most staff at local conservation districts and conservation-oriented nonprofits have used some type of model or analysis tool, so they would be able to flag unrealistic results and move the program forward according to the timeline. If staff are unfamiliar with models and are willing to learn, factor in a minimum of 6 months for staff training, running example farms, and troubleshooting.

Sometimes the modeler might not be the person who works directly with farmers. If this is the case, it's important to develop a plan for interacting with the farmer, gathering all necessary data, and transferring the data to the modeler without losing time or information in the process.

7. Relying on a pending water quality regulation can be problematic

As our team found in the Milwaukee River watershed, structuring a PfP program around the anticipated release of a TMDL is a tenuous proposition. The TMDL may not come out on schedule, and that may reduce the motivation of some partners to work on a PfP program before a regulation is set. It is better to wait for the release of the TMDL, or otherwise structure the PfP program such that it does not rely on a pending regulation. If a TMDL is anticipated in the near future, piloting a PfP program so that it is ready to implement within the framework of a future water quality credit trading program may be a good option.

8. Whole-farm modeling is important for capturing the net effect

Modeling the whole farming operation is important to make sure that changes implemented on one field are not offset, intentionally or unintentionally, by changes made on other fields. For example, farmers may be able to reduce the manure application rate on a field with high P losses to improve the water quality in that field's runoff. However, the manure not applied to that field must be accounted for elsewhere on the farm, or have documentation of how it was used. This will ensure that the manure is transferred to a field where the environmental impact of its application is lower, and the net effect of that transfer is summed across the whole farm.

9. Set realistic pollution abatement goals, or be willing to adjust expectations as field-specific data becomes available

The program comparison table (Table 5) lists the nutrient and/or sediment reduction goals set by each PfP pilot program implemented so far. Of the six projects listed, only two have been completed to-date. In the initial PfP pilot testing projects in Iowa and Vermont, PfP was such a new concept that initial nutrient reduction goals were not set; rather, the goal of the program was to test what could be achieved by using a PfP approach in these watersheds. In Wisconsin, an initial goal of reducing one pound of P per acre from participating farms was set. The table, below summarizes these goals and the reductions that were ultimately achieved.

Table 5. Comparison of Existing Pay-for-Performance Programs

PfP Project	Partners	Project Start and End Date	First Project Implemented	Water-shed(s)	Watershed Size (Acres)
Ohio River Basin Trading Project	Electrical Power Research Institute, American Farmland Trust, Markit, ORSANCO, Ohio Farm Bureau Federation, Troutman Sanders, U.C. Santa Barbara, Delta Institute, Coalition on Agricultural Greenhouse Gases	2011-Present	2013	Ohio River Basin	130,500,000
Milwaukee River Pay-for-Performance Program	Winrock International, Delta Institute, Sandy County Foundation	2013-2017	2014	West Branch of the Milwaukee River	41,029
Saginaw Bay Pay-for Performance Program	The Nature Conservancy, Delta Institute, Sanilac Conservation District, Great Lakes Commission, Michigan State University	2015-Present	2016	Saginaw Bay	2,200,000
River Rasin Pay-for-Performance Program	Winrock International, Michigan State University Extension, The Stewardship Network, Graham Sustainability Institute at University of Michigan, Ohio State University	2015-Present	2016	South Branch of the River Raisin	121,372
Iowa and Vermont Initial Pilot-Testing	Winrock International, Iowa State University, University of Vermont	2006-2010	2007	Sub-watersheds of Maquoketa River and Lake Champlain	152,639
Old Woman Creek Pay-for-Performance Program	Winrock International, SWCDs, Heidelberg University, Old Woman Creek National Estuarine Research Reserve	2016-Present	2017	Old Woman Creek, tributary to Lake Erie	17,280

PfP Project	Initial Performance Goal	Performance Achieved
Iowa and Vermont Initial Pilot-Testing	None set; first experimental watersheds where PfP was pilot-tested	Iowa: 0.88 lbs P/acre/year Vermont: 0.26 lbs P/acre/year
Milwaukee Pay-for-Performance Program	1 lbs P reduced/acre/year from participating farms	0.54 lbs P reduced/acre year

Just the results from these two projects show that the average P reductions achieved ranged from 0.25 to 0.88 pounds per acre per year. This reflects the complexity inherent in both agricultural management and land characteristics. Therefore, it is important to build this potential variability into your estimates for what a project can achieve, or, be flexible with your goals as you learn more about how much nutrient or sediment reduction can be achieved by the farms in your watershed. Preliminary modeling of a few farms can help gauge where to set your goals.

Model/Decision Making Tool Used	Regulatory Incentive/Driver	Farmer Outreach/ Engagement Method	Type of Loading (tied to incentive payment)	Incentive Payment Rate	Nutrient Reduction Goals	Example of BMPs Implemented	Grants and In-Kind Support Total
EPA Region 5 Model, WARMF, ALMANAC	Power plant and POTW NPDES permit compliance, potential TMDL requirements	Newsletters, state agency and SWCD outreach to farmers, workshops, conferences, on-farm visits, agricultural stakeholder committee	Nitrogen (N) and phosphorus (P)	$10/lb (bundled) for pilot period	100,000 lbs of N (edge of field), 50,000 lbs of P (edge of field)	Animal heavy use areas, drainage management, cover crops, feedlot improvements, tree planting	$900,000
SPARROW, SWAT, Snap-Plus	Pending TMDL	Discussion groups, workshops, on farm visits	Phosphorus (P)	$25/ pound	1 lb P reduced/ acre/year	Nutrient management, cover crops, reduced tillage	$957,000
GLWMS, EPA Region 5 Model	Saginaw River is an EPA priority watershed	Workshops, conferences, on-farm visits, newsletters	Sediment	$150/ton	6,200 tons of sediment reduced	Cover crops, filter strips, conservation cover	$2,558,853
SWAT, GLWMS	River Raisin Watershed Management Plan (not regulatory); potential TMDL	SWCD outreach, MSU Extension mailings	Phosphorus (P)	$20/ pound	8,000 lbs TP, 500 lbs SRP, 7,300 lbs N, and 3,400 tons sediment	TBD	$745,000
Iowa and Vermont P Indices	None at the time	Direct farmer outreach and farmer-led watershed councils (Iowa only)	Phosphorus (P)	$10/lb Iowa $25/ lb Vermont	As much as budget would allow	Multiple options (e.g. spread manure on outlying fields, change fertilizer type, expand buffers for hay)	$500,000
NTT	Approved TMDL	SWCD outreach - one-on-one meetings, farmer breakfasts	Phosphorus (P)	$30/ pound	3,700 lbs TP, 1,850 lbs SRP, 2,200 tons sediment, 100,000 lbs N	TBD	$500,000

Lessons learned from program implementers

Program implementers, like Soil and Water Conservation Districts or other on-the-ground technicians, are invaluable to the success of a PfP program. Here we highlight some lessons these partners have learned during the implementation of a PfP project. Taking time to work and talk with farmers, explain program goals, and explore how PfP is different from traditional conservation programs can help farmers understand how PfP works and set realistic expectations.

1. Farmers' interest in customized information can be used to attract initial participation

Modeling baseline farm management and conservation scenarios can be a great way to provide producers with information that is customized to their farming operation. It can be validating for producers to see that their time and effort is advancing the goal of reducing farm nutrient or sediment runoff, and customized information can also identify the location of remaining "hot spots" on their farm that need extra attention or management to reduce losses. Appealing to farmers' interest in getting customized information on their farms can be a useful strategy to encourage initial participation in a PfP program. Informing them that implementing BMPs is not required at this stage can help reduce initial reluctance to get involved and get farmers in the door. The results they receive may be motivation enough to take the next step in the program and select BMPs to implement.

2. Farmers aren't used to relying on models to inform them about their operations

Models are not perfect, and farmers are usually able to quickly identify the ways in which a model may not provide information that supports their understanding of their own farm management and the impact of adopting BMPs. Whether it is the farmer or the model that has the incorrect information, care must be taken to avoid a stalemate in which a farmer thinks, "I know what's happening on my farm, I don't need a model to tell me that." Take time to translate the results of the model and explain how the results were derived and what they mean. For example, while cover crops may reduce sediment losses, they may increase soluble reactive P losses, and this can be frustrating to a farmer who believes in the benefits of cover crops but can't get paid for installing them if the PfP program is looking at dissolved reactive P loss reductions. If your PfP program is focused on one nutrient, make sure you acknowledge the beneficial effects that BMPs can have on other water quality parameters, even if they are outside the incentive structure of your project.

3. Pilot-test the program with a few selected farmers before moving forward with full implementation

The rollout of any new program requires some adaptive management, which should be anticipated and planned for in a new PfP program. We have found that it is best to choose a handful of farmers with whom to initially work who are enthusiastic about the program and are willing to be the first participants. Taking the time to explain the program's goals, strengths, and weaknesses, as well as the importance of having willing participants with whom to work through the initial kinks can engender goodwill, buy-in from farmers, and save the project from challenges later in the process when more farmers are involved. Allow time for this in your project timeline and make sure you address all aspects of the program in this initial trial phase: work out privacy language, contracting forms, modeling issues, the process for verifying BMP implementation, payment procedures and watershed-specific issues that may come up as you begin to implement your PfP program.

4. Allocate appropriate resources and technical staff to work with farmers

Pay-for-performance conservation is time-intensive, especially at the initial stages of contacting farmers, collecting information, modeling farm baselines, and estimating loss reductions possible with various conservation scenarios. Make sure you have planned to have sufficient technical staff time available (i.e. those trained to work with farmers, use the chosen modeling tool, and brainstorm new and innovative conservation scenarios) to devote to the program during these times. Know if your organization will have the flexibility to prioritize PfP when the need exists, or hire temporary, part-time, or full-time employees in anticipation of the work load. The success of a PfP program hinges on the availability of adequate technical staff to work closely with farmer participants, so this need should not be overlooked or underemphasized.

Lessons learned from farmer participants

The farmers who have participated in PfP programs have helped to distill the advantages and drawbacks of this approach and keep program administrators and implementers focused on some of the practical realities of PfP. Here, we share farmer input on PfP pilot programs we have implemented.

1. Farmers like the performance and economic focus of PfP.

Farmers tend to appreciate the PfP approach because of its focus on the economics of the farm and the performance of the conservation activity. In practice-driven cost-share programs, farm economics are not typically considered in the process of encouraging the adoption of BMPs. Farmers are eligible for cost-share money to implement practices, but whether their share of the cost is worthwhile in terms of their ongoing business management is not formally evaluated. Many farmers make decisions to implement practices because they feel it is the right thing to do. When conservation can be implemented in a manner that meets or improves their agronomic and economic potential, it's a win-win. PfP lets farmers know which practices are most cost-effective for a given resource concern, which ones can be implemented at no net cost to them, and which ones will have their implementation cost only partially covered by the incentive payment. With this information, farmers can make informed business decisions and understand what their efforts have achieved in terms of improved nutrient or sediment retention on the farm.

2. Keep the administrative process simple and straightforward

Farmers appreciate the PfP approach when it is simple, straightforward, and succeeds in minimizing contract language and paperwork. Many farmers have spent a lot of time applying to practice-driven federal programs, and year after year they were told that they missed being funded by one or two spots on the application queue. The outcome-based focus of PfP makes more sense to them; funding those who can reduce the most at the lowest cost seems more fair than the laborious federal competitive system that, in their estimation, seems to keep giving funding to the same farms year after year. However, when the PfP process gets complicated by modeling issues, contracting mistakes, or lengthy wait times to receive payments, farmers understandably become frustrated with the process and see less of an advantage of PfP over traditional conservation programs.

3. Time and consideration is required to shift from a practice-based mindset to a performance-based mindset

Farmers are used to thinking about conservation in terms of cost-share on a per-practice or per-acre basis. The per-pound incentive payment for PfP, therefore, is not always clear or easy to relate to farm management decisions. This is usually not an issue when the economic costs of management changes are calculated for farmers, and they can look at what the practice costs versus what it will pay in performance incentives. However, having some examples handy to help explain the program before farmers enroll can be useful. For example, if the PfP incentive is $25 per pound, you could tell the farmer that an average of a half-pound reduction per acre in phosphorus will generate a payment equivalent to $12.50 per acre. This will give farmers a sense for the reductions that would need to be achieved for more expensive practices (e.g. cover crops) versus those that might be achieved by low-cost or cost-saving changes (e.g. fertilizer rate reduction or reduced tillage).

4. It's frustrating when PfP payments are lower than federal program payments

If the goal of a PfP program is to reduce P losses and incentive payments are tied to this metric, the possibility exists that certain practices that farmers believe in will not receive the same incentive payment that they would be eligible for under existing federal programs. For example, on a given field, a cover crop may have sediment and nitrogen retention benefits, but it achieves comparably small reductions in P losses. When this happens, the PfP incentive payment may be lower than the cost to plant cover crops on that field, and farmers may become frustrated. One way to overcome this issue is to reiterate the goals of the PfP program and its limitations, so farmers understand how the incentive payments are calculated. Another alternative is to design a PfP program that calculates incentive payments for the additive benefits that practices have on reducing more than one pollutant.

SECTION 5

CONCLUSIONS AND NEXT STEPS

Pay-for-performance conservation has the potential to improve water quality conditions, benefit farmers who participate, and provide accountability and value to taxpayers. However, moving toward a PfP approach requires focus and energy. The process is information- and time-intensive, so a successful PfP program needs to allocate adequate time from trained staff to correctly estimate the specific performance for each field under a range of field management changes. This also requires that accurate and user-friendly quantification tools are available for the focal watershed. Despite the challenges inherent in adopting this new approach to agricultural conservation, the flexibility for farmers to choose the most appropriate and cost-effective actions for their fields, combined with performance-based incentives, creates a powerful new approach to incorporate into the future of conservation delivery.

Scaling up PfP conservation from the pilot stage to a larger-scale program requires careful consideration of the lessons learned thus far by all stakeholders involved, including program administrators, implementers, and farmers. One salient message from our pilot projects is that the transaction costs for PfP are high, even if the dollars spent on conservation are cost-effective. A careful cost comparison of the whole conservation delivery system in a traditional versus PfP approach needs to be completed to understand whether the high transaction costs associated with pilot-testing PfP are likely to be reflective of larger-scale PfP, and whether they are higher than those associated with existing traditional programs. A second key message is that farmers are busy and want to participate in programs that are easy to understand and implement. Traditional conservation programs have been designed this way; farmers can choose to implement BMPs where they seem to make sense on their farms based on specific practices selected by USDA or another program administrator for their expected benefits. The compromise with this approach is that it's impossible to know exactly how beneficial they are, how much nutrient or sediment retention is achieved by their implementation, or where one practice will exceed another's performance on a given field. The time spent accounting for this field-to-field variability and quantifying practice performance in PfP makes it more complex and adds time to the implementation process.

How then do we achieve a balance of convenience and technical and cost accountability? The answer may be to take the best characteristics from traditional and PfP conservation programs and develop a hybrid approach. For example, the USDA Conservation Stewardship Program (CSP) allows farmers to pick from a menu of conservation practices that interest them and earn greater payments as more conservation practices are implemented. PfP could be incorporated into CSP by taking the choices that farmers select, evaluating them for their performance in specific fields, and returning to the farmer a list of BMPs ranked by their performance and matched with a commensurate performance-based incentive payment. In this way, farmers would have the convenience of traditional conservation programs, staff time would be reduced by focusing only on conservation options available under CSP, and performance would be quantified and rewarded. Other strengths of PfP would be eliminated, particularly the innovative ideas that can be generated between technician and farmer when looking more broadly at field-specific information, but performance-based metrics would begin to be incorporated into mainstream conservation programs. Whether this or another mechanism becomes the way to pursue broader implementation of PfP conservation, it is likely that mounting water quality concerns and regulatory drivers like TMDLs will make measuring conservation performance attractive to both farmers and conservation organizations in the future.

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