

# GLOBAL PARTNERSHIP ON NUTRIENT MANAGEMENT

## BMP Case Study

### Overview

**Name:** Demonstrating Pay-for-Performance Conservation on Working Lands

**Location/Terrain:** This work takes places in various locations throughout the United States.

**Crop(s):** Corn, Soybeans, Wheat, Hay

**Nutrient(s):** Primarily P, but also N and sediments.

**Rationale:** Improve producer motivation for reducing nutrient loss and to increase the technical- and cost-effectiveness of conservation activities.

### Issue(s) of Concern/Challenges:

Maintaining and increasing the productivity of agricultural land is of paramount importance to address the issue of global food security in the long-term. Agriculture is the dominant land use in many regions of the U.S. However, agriculture remains the leading contributor of nonpoint source (NPS) pollution to ground and surface waters in the US (US EPA 2009). Reducing phosphorus (P) loss is of particular importance to address eutrophication of fresh water bodies (Sharpley and Beegle 1999).

Current programs for controlling NPS pollution in the U.S. consist, in large part, of cost-sharing best management practices and compensating farmers for idling selected tracks of working land. Over US\$5 billion is spent annually on these programs (Claassen and Ribaudo 2007). However, improvement in water quality in agricultural areas is not universally evident. Although these programs are important, they do not often encourage farmers to utilize the most cost-effective actions or inspire new and innovative solutions to reduce NPS pollution from their farming operations (Ribaudo et al. 1999; Shortle et al. 2001). Winrock International implemented a project titled Pilot-testing Performance-based Incentives for Agricultural Pollution Control, which provided flexible incentives to participating farmers in Iowa and Vermont for reducing P loss from their farms. Phosphorus loss from each farm was estimated using each state's P Index. These performance-based incentives were designed to induce the most appropriate and cost-effective solutions for each farm business.

### Practice Objectives:

The long-term goal of this work has been to improve the quality of surface and ground water without constraining the viability of U.S. agriculture. The objectives of the project were to determine if and how performance-based incentives could increase producer motivation and the cost-effectiveness of conservation spending.

### Outcomes:

This project pilot-tested a unique and innovative approach to reduce nutrient losses from agricultural land, which can help farmers and reduce the burden on taxpayers. Flexible (or performance-based) incentives

were offered to participating farmers in Iowa and Vermont for reducing phosphorus (P) loss from their farms in any way that they choose. The P loss from each farm and the potential reductions were estimated using the science-based P Index for each state. These performance-based incentives are designed to induce the most appropriate and cost-effective solutions for each farm.

The project worked with participating farmers to (1) calculate their baseline level of P loss using the respective state's P Index, (2) brainstorm actions that are amenable to the producers and effective for their fields, (3) calculate the technical- and cost-effectiveness of each action, (4) enroll producers in the pilot program to implement the actions of their choice. In Iowa, the actions were generally more cost-effective (See Figure 1) and an incentive payment of \$10 per pound of P loss reduction was offered. In Vermont, this payment was set at \$25 per pound, based on the cost-effectiveness of the actions analyzed. As can be seen in Figure 1, just over 50% (32 of 62) of the specific farm actions to reduce P loss in the Iowa watershed cost less than \$10 per lb. of P loss reduction. Hence, \$10 per lb. of P loss reduction was set as the incentive payment level. These thirty-two actions are considered good business decisions to be implemented for the respective farms. Similarly in Figure 2, approximately 40% of the specific actions (22 of 54) on Vermont farms were estimated to be "profitable" at a payment level of \$25 per lb. of P loss reduction; hence, this was set as the payment level for the Vermont farms.

It is important to note that approximately 10-20% of the actions analyzed are estimated to have a zero or negative cost to the farmer; these actions are the "low-hanging fruit". Actions with negative costs represent win-win solutions for the farm and the environment. These include actions such as reducing fertilizer applications, reducing supplemental P feeding, and reduced tillage operations. When the savings are very small, the farmer is not always motivated to implement the change. However, when the change reduces the estimated P loss and results in an incentive payment, the motivation for implementing the change can be greatly increased.

Upon examination of the results of each action, there are several very interesting observations to note. These observations include large variation in cost-effectiveness across and within categories of BMPs and that many of the most cost-effective actions are things for which our current programs do not offer any significant incentive for farmers to do.

If these participating farmers were to implement the "good business decision" actions, the average reduction in P loss from the entire farm is estimated to be 2.18 lbs/ha/year for an average cost of \$-0.61/lb P (Table 1). Additionally, the sediment loss reduction from these changes is estimated to be 1.58 tons per acre per year. Results from Vermont are also shown in Table 1. The average of the good business decisions resulted in a P loss reduction of 0.26 lbs/acre/year and incurred an average cost of \$4.86/lb P. In both states, the incentive payments created a profit for the farmers, which induces them to find the most cost-effective actions and reduce P loss up to the point where the cost is equal to the payment rate.

## **Highlights from Iowa**

In Iowa, the most dramatic reductions resulted on a 74-acre crop farm. During the 2007 crop year, this farm's estimated P loss was 4.02 lbs per acre per year, as predicted by the Iowa P Index. The project worked with the farm to identify and analyze 8 different scenarios (i.e. an action or set of actions) for reducing P loss. For each scenario, in addition to the estimated P loss, we calculated the total cost to the farm, the cost per pound of P loss reduced, the incentive payment to the farm, and the resulting profit or loss from each scenario. For this farm, the most profitable scenario was to adopt no-till planting on all 4 of their fields and renovate the grassed waterways in 3 of the fields.

These simple actions resulted in an average reduction of estimated P loss from 4.02 to 1.40 pounds per acre per year, which is a reduction of 65%. The cost to the farm for implementing these actions is estimated to be less than \$0, as no-till production has been shown to reduce costs which more than offset the costs of renovating the grassed waterways. The estimated reduction in P loss of 193 pounds per year is aggregated

across the fields and is rewarded with an incentive payment of \$1,930 (\$10 per pound of P loss reduction), which is also the resulting profit to the farm for these actions. The no-till and waterways also result in a whopping decrease in soil loss of over 5 tons per acre per year or 394 tons across the farm; this is a 75% reduction in soil loss. Although this is the most notable change in environmental performance of the 13 participating Coffee Creek farms, the changes induced on several other farms are worth mentioning.

The project also worked with a 187-acre corn and soybean farm that raises hogs to discover that adopting no-till and changing the crop rotation from corn-corn-beans to corn-beans would result in an estimated reduction of P loss from the farm of 104.6 pounds per year, 17% of the farm's total. For this, they receive an incentive payment of \$1,046. Additionally, these changes are estimated to reduce production costs by \$1,140 per year, which results in an annual profit to the farm of \$2,186. These changes also result in an estimated reduction of 349 tons of soil loss per year from the farm.

Another farm producing corn and soybeans found that by strategically putting grassed filter strips on 4 of their 8 fields, the farm was able to reduce estimated P loss by 99.4 pounds per year, or 18%. The opportunity cost (foregone net income from cropping) of the filter strips is estimated to be \$894 per year. This cost includes the foregone profit from the corn and soybean production and establishing the grass cover for the filter strips. The total cost is lessened by allowing the farmer to harvest forage from the filter strips. The estimated reduction of 99.4 pounds of P loss is rewarded with a \$994 payment and leaves the farm with a slender \$100 profit from these actions.

### **Highlights from Vermont**

The results in the Missisquoi River watershed are less dramatic than those seen in Iowa, but very noteworthy nonetheless. One farm is implementing 4 of the 8 changes that the project identified with the farmer. These include using winter cover crops, changing crop rotations, establishing buffers, and changing fertilization practices. Of these, the changes to fertilization practices provide the best example of the type of innovation that performance-based incentives can induce. Project staff suggested to the farmer that the 200 pounds of 20-10-10 (N-P-K) fertilizer being applied was not necessary on fields with high soil P levels. It was suggested that for these fields only 50 pounds of 20-10-10 be applied and the remaining nitrogen needs of the corn be met using urea (46-0-0). This change alone saves the farm \$244 in fertilizer costs and reduces the estimated P loss by 4.5 pounds per year. The \$113 incentive payment (Vermont farmers receive \$25 per pound of P loss reduced) for this P loss reduction results in \$357 profit for the farm. Although it is a minor reward, performance-based incentives are capable of inducing these types of win-win solutions. Overall, this farm reduced estimated P loss by 21% or 53 pounds per year.

On another farm, increasing the width of riparian buffers on 3 fields from 10 to 50 feet resulted in an estimated P loss reduction of 35 pounds per year (16%). A total of 3.3 acres of land are removed from tillage, but the buffers are wide enough for hay to be cut from them. By allowing hay harvesting (no manure or fertilizer is applied and wheel ruts are not allowed), this reduces the cost of foregone corn production and puts permanent vegetative cover on crucial riparian land. The performance-based incentive payment for this change was \$880 and the estimated net cost was \$210, providing a modest profit to the producer.

### **Significance:**

Finding appropriate ways to quantify nutrient losses from agricultural land allows the use of performance-based incentives, which can improve the technical- and cost-effectiveness of conservation funding, as well as increase producer motivation for reducing nutrient loss. Measurement of nutrient loss at the field- or farm-level is not likely to be practical in the near future. However, user-friendly, science-based models can be employed to estimate nutrient losses in places where adequate data exist. Information systems are advancing at a very rapid rate and such models will become much more widely available in the coming years. The advantages of using models to estimate performance include allowing producers to

run scenarios and know the outcome before implementing changes and make good business decisions. The downside is that model estimates are based on average weather patterns and not likely to be highly precise. However, if sound science and good data are used, acceptable accuracy over the long-term should be achievable.

## Data/Graphs:

Figure 1. Cost-effectiveness of Specific P Loss Reduction Actions on Iowa Farms

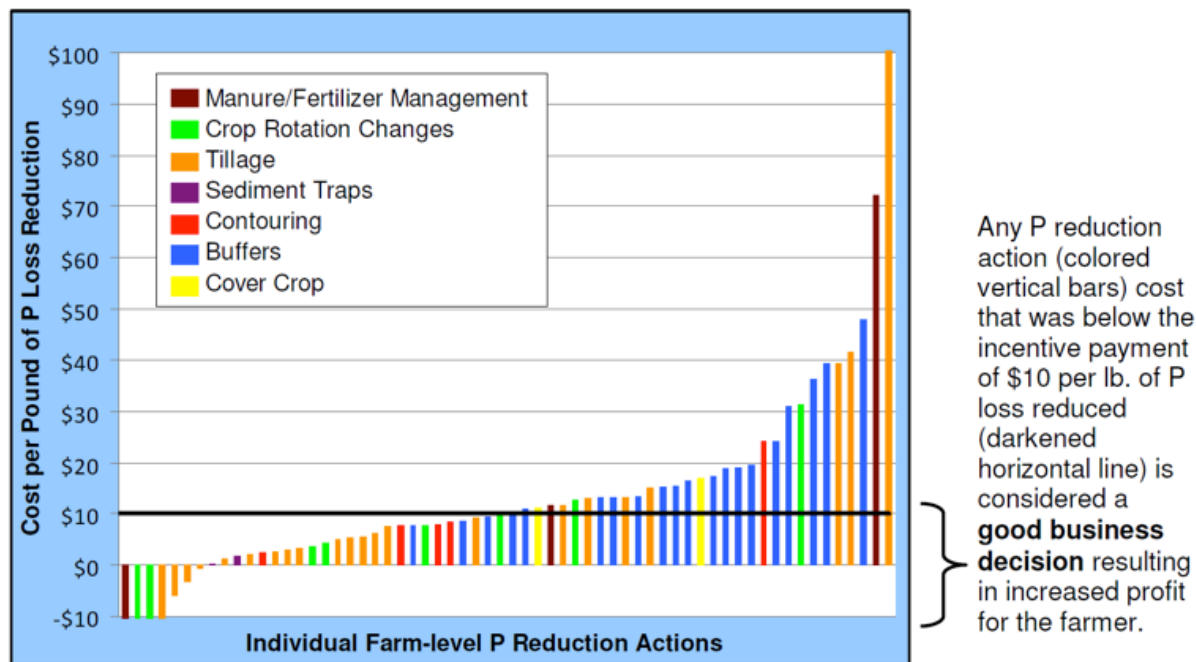
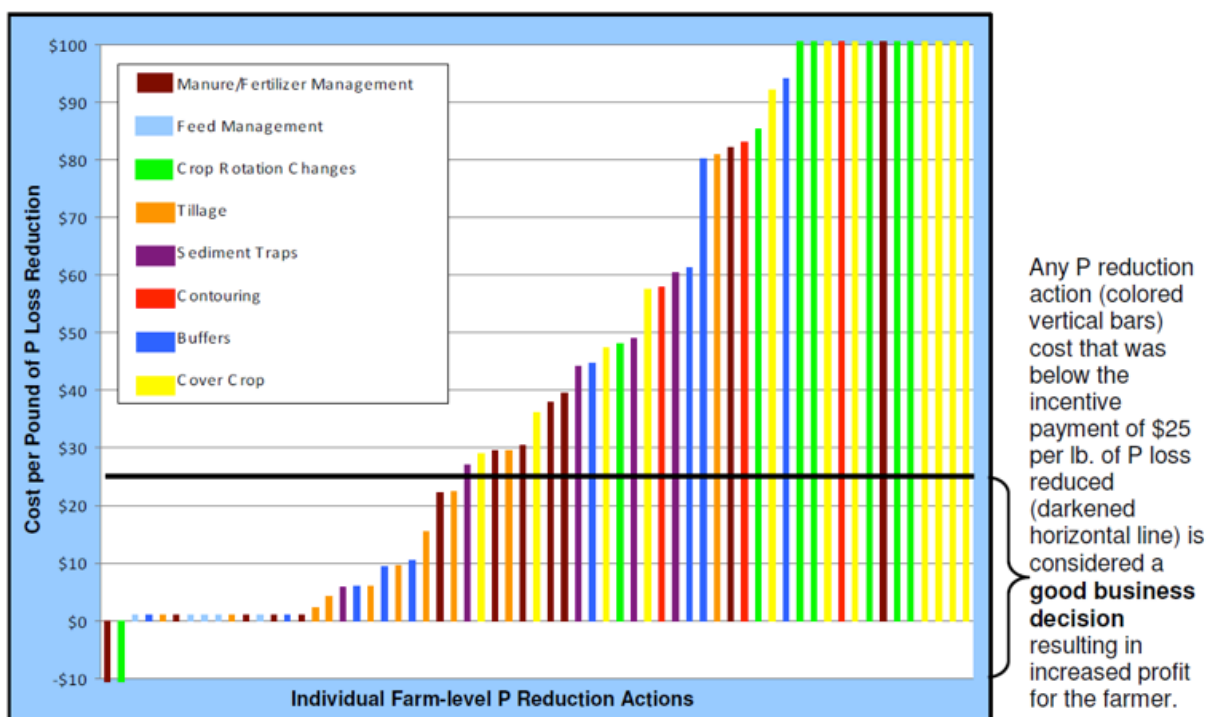


Figure 2. Cost-effectiveness of Specific P Loss Reduction Actions on Vermont Farms



**Table 1. Average Phosphorus and Sediment Loss Reduction from “Good Business Decisions”**

Watershed	P Loss Reduced (lbs/acre/yr)	Cost (\$/lb P)	Profit (\$/lb P)	Sediment Loss Reduced (tons/acre/yr)
Vermont	0.26	\$4.86	\$20.14	1.01
Iowa	0.88	-\$0.61	\$10.61	1.58



Winrock International and its partners are continuing to develop and pilot-test approaches using performance-based incentives for agricultural pollution control. For further information, please contact Dr. Jonathan Winsten at [jwinsten@winrock.org](mailto:jwinsten@winrock.org).

## References

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