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Voluntary Cost-Share Programs: Lessons from Economic Theory and Their Application to Rural Water Quality Programs

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The Issue

Inducing farmers to adopt alternative, more environmentally friendly production practices has been attempted in a variety of ways ranging from moral suasion to direct regulation to economic instruments. Among the most common instruments are voluntary cost-share programs that involve taxpayers sharing in the cost of production practices that generate fewer pollutants. These programs increase the attractiveness of alternative practices to farmers because they either compensate the farmer for any loss in profits or they offset the capital costs of adopting the new technology. Voluntary cost-share programs are a common policy tool because of their political viability, but their effectiveness has been limited largely due to the blanket approach used to distribute funds (Weersink et al., 1998). Since such programs continue to be a popular policy tool, as evidenced by the Environmental Quality Incentive Program (EQIP) in the United States and the National Heritage Trust in Australia, regulators need to know how to improve their effectiveness.

This paper examines whether voluntary cost-share programs can succeed in achieving environmental objectives efficiently. The paper begins by developing a conceptual model of a typical cost-share program in which the regulator subsidizes the cost incurred for a set of preapproved abatement practices. The paper then examines the cost-share program—the Rural Water Quality Program (RWQP) implemented in the Grand River Watershed by the Regional Municipality of Waterloo, Ontario.

Implications and Conclusions

The analysis of the conceptual model and the RWQP results in a number of conclusions. First, in designing a cost-share program it is important to consider the impact that an abatement practice has on both the level of off-farm damages and on-farm costs and benefits. The goal of the program should be to minimize the sum of program costs and off-farm damages. The on-farm costs and benefits, however, determine the degree to which an abatement practice needs to be cost-shared. Choosing abatement practices that minimize the degree of cost sharing required is unlikely to result in the most effective and efficient abatement practices being encouraged.

Second, the program would be most effective if the producers that voluntarily participate in the program are the ones whose practices create the greatest damage. However, the relationship between control practices by producers and total loadings, and then between loadings and damages, is not known in most regions, making it difficult to establish target emission levels and the abatement practices that should be encouraged. Such is the case for phosphorus levels in the Grand River.

Third, the RWQP requires any applicant to have completed an Environmental Farm Plan (EFP)—a confidential audit of the farmer's impact on the environment along with suggested means to reduce that impact. The EFP requirement reduces the number of eligible program participants significantly. However, the EFP does help farmers recognize the extent to which agriculture in general and their operation in particular is contributing to the problem, which is a necessary requirement for producer involvement and the subsequent success of any voluntary cost-share program (Ribuado, 1997). Such an understanding can reduce the necessary compensation costs to encourage adoption by a producer.

Finally, one of the significant improvements of the Rural Water Quality Program over previous voluntary cost-share approaches is that it focuses on a specific watershed rather than being universally available for all producers within a broad geographic area. Further gains in efficiency could be achieved by targeting individual producers. However, the difficulty with targeting is political feasibility. Programs available only to a select group of producers are deemed unfair by some farm organizations who now recognize that government support must increasingly be justified through its environmental value (Potter, 1998). The problem for regulators is to find a compromise where the efficiency gains from targeting individual producers within a specific area are balanced against the desire for equity and support across a wider group of producers.

Previous Research

Previous studies have examined empirically the factors affecting enrolment in cost-share programs (Lichenberg, Strand and Lessely, 1991), the relationship between incentive payments and the adoption of best management practices (Cooper and Kiem, 1996), and the rates of government subsidies for alternative pollution abatement solutions (Houston and Sun, 1999). Several studies have looked at the design of cost-share programs. Malik and Shoemaker (1993) develop a model of technology adoption to examine the level of subsidies on variable inputs for a less-polluting technology and the amount of land cultivated by that new technology in order to maximize farm profits while achieving an exogenously specified pollution goal.

Wu and Babcock (1995) use a principal-agent model to determine the optimal level of "green" government payments for a set of production practices that maximize social welfare. They assume the regulator does not know whether a producer is a low or high productivity farmer, so the producer has a subsequent incentive to misrepresent her resource base in order to maximize government and market returns. Norton, Phipps and Fletcher (1994) and Weaver (1996) introduce the notion that for farmers who value environmental quality as well as profits, cost-share programs need not cover the full abatement costs in order to induce adoption of best management practices.

Conceptual Framework

Most cost-share programs subsidize a given set of abatement activities for which audited expense claims must be submitted. Thus, the payment is geared toward a fixed set of observable practices rather than unobservable, variable inputs. The only decision controlled by the regulator in most voluntary cost-share programs is participation. The level of effluent, for instance, is unregulated within a given practice or technology. The question facing regulators is whether voluntary cost-share programs can succeed when the only mechanism available to them is to encourage participation by producers.

To better understand the problem facing regulators, a model is developed in which farmers' production practices negatively affect water quality through residuals from livestock production. We assume that a farmer has a choice of four technologies for controlling manure-related effluent: *o* denotes no controls, *b* denotes creation of buffer strips along watercourses, *m* denotes construction and use of a manure storage shed, and *bm* denotes use of both buffer strips and manure storage. Associated with each technology choice is a schedule of on-farm marginal benefits associated with the production of livestock, and consequently, manure. Each technology choice also has an off-farm marginal damage curve associated with it.

The marginal benefit (*MB*) curves for the four technology choices are illustrated figure 1. The horizontal axis shows manure (or livestock) production, denoted by *E*. The marginal benefit curves for each technology are assumed to be downward sloping and steep. The intuition

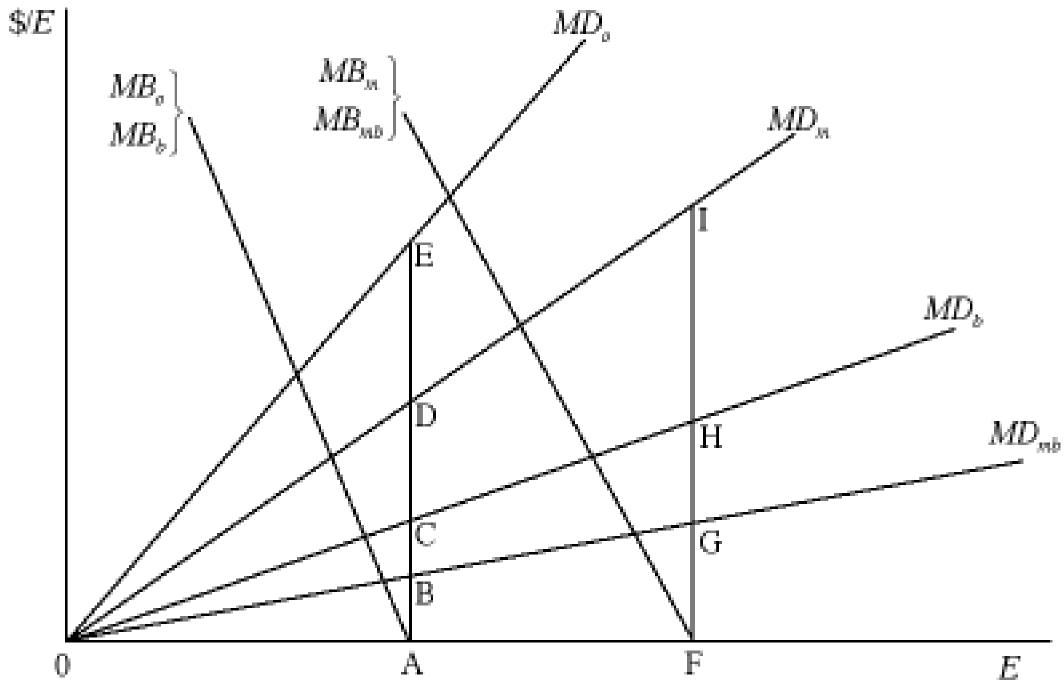

Figure 1 Comparison of benefits and damages of different manure-handling options

for this shape is that the primary way for farmers to reduce manure production (without switching technologies) is to reduce livestock output; foregone profits rise quickly as *E* falls.

Buffer strips are assumed to not affect the marginal benefit of manure production, as only a small amount of land is generally taken away from cropland. The cost of creating buffer strips is assumed to be fixed and to have no bearing on the rate of return to production once in place. Hence MB_o and MB_b lie on top of each other.

Figure 1 also illustrates that the farmer gets higher marginal benefits from manure production in the presence of a storage facility than without. The storage allows use of manure as fertilizer at the time of the year when it is of maximum benefit, thereby increasing its marginal value product. There may also be labour-saving efficiencies associated with manure handling from a storage facility and related barn flooring, particularly for larger livestock operations. The higher marginal benefits are reflected in MB_m and MB_{mb} lying above MB_o and MB_b. MB_m and MB_{mb} lie on top of each other.

The schedule of marginal damages (*MD*), which reflects the impact of the expected runoff associated with each abatement activity, is also illustrated in figure 1. A fixed relationship is assumed between manure production and runoff impairing water quality, implying that there is a *MD* curve for each management practice. For a given level of manure, the extent of the effect of effluent on environmental quality will be greatest for no abatement. Thus, marginal damages are highest with no runoff controls (option *o*). Marginal damages decline somewhat if a manure storage facility (*m*) is built, as runoff from stored manure is limited and the manure can be applied during periods of plant uptake. Even more runoff is controlled if buffer strips (*b*) are used, as the vegetation traps the effluent before it reaches the watercourse. The smallest level of damages is associated with use of both *m* and *b*.

In the absence of taxes or other costs for manure production, a profit-maximing farmer always operates at the point where, given the installed technology, marginal benefits are zero. Therefore the relevant comparisons are between the manure production levels labeled *A* for no runoff controls (*o)* or a manure storage facility (*m)* and *F* for buffer strips with and without a manure storage facility (*bm* and *b* respectively). The areas emphasized in figure 1 are the total damages associated with each of the four privately optimal operating levels. The total damages from technology *i*, TD_i, are graphed as the area under the corresponding marginal damages curve.

The four relevant areas are as follows. TD_o is the damage level from operating with no effluent controls, and equals area *OAE*. TD_b results from creating buffer strips, and equals area *OAC*. TD_m results from using a manure storage facility and equals *OFI*. TD_{bm} results from using both buffer strips and a manure storage and results in damages (*OFG*).

Three unambiguous comparisons with regard to the total damages associated with the four technology choices can be illustrated using figure 1. First, buffer strips (*b*) are better than nothing, since $TD_o > TD_b$ (or *OAE* > *OAC*). Likewise, buffer strips plus manure storage result in lower external damages than manure storage alone. Third, buffer strips are preferred to manure storage, because *OFI* > *OAC*. In understanding the comparisons it is important to note that the implementation of the manure storage system creates an incentive to expand livestock (manure) production, because it increases the marginal benefit associated with each level of output. Buffer strips create no such incentive. Of course the actual size of such an incentive need not be as large as shown.

There are three ambiguous comparisons regarding the level of external damages associated with each technology. These comparisons depend on the position and angles of the relevant marginal damage curves. First, manure storage is better than nothing only if *ODE* > *AFID*. The term *ODE* represents the additional damages resulting from higher levels of runoff for a given level of production if there is no storage facility. The term *AFID* represents the additional damages created by the incentive to expand manure (livestock) production. As drawn, a manure storage facility actually increases total damages, but this may not hold in general.

Second, manure storage plus buffer strips are better than buffer strips alone only if *OBD* > *AFGB*. The extra runoff prevented by both abatement practices is valued along the MD_{bm} curve, which lies below the MD_b line. However, there is an offsetting effect of increasing production (*AFGB*) associated with the manure storage facility. Again, the particular ranking depends on the incentives to increase manure production in the presence of a storage system, and the area sizes shown here are not necessarily general. Third, manure storage and buffer strips produce less total damage than no abatement provided *OBE* > *AFGB*. Note that if $TD_{bm} < TD_b$ then $TD_{bm} < TD_o$.

Designers of a voluntary cost-share program must decide upon several components before implementation. The program must determine what practices are to be subsidized and to what extent the producers will be paid in order to encourage the adoption of these practices. In addition, a choice must be made regarding which producers are eligible for participation. How will inevitable budget constraints affect the type of technologies and the producers that are targeted? The conceptual model provides guidance in addressing these issues.

The first point of guidance involves the level of subsidy required to alter pollution levels. The level of subsidization must be sufficient to cover the private abatement costs of the producer. For example, the regulator would prefer the use of buffer strips to no abatement technology since off-farm damages are less with buffer strips. However, profit-maximizing farmers have no reason to install buffer strips, since this technology has no effect on the marginal private benefits of production ($MB_b = MB_o$). The level of assistance will have to be equal to or greater than the fixed costs of installing the buffer strips in order for the farmer to adopt.

While a 100 percent cost-share arrangement is necessary to induce many producers to participate, a farmer who values environmental stewardship will be willing to accept less than this amount [see Norton, Phipps and Fletcher (1994) and Weaver (1996)]. If a farmer does have a strong private preference for environmental quality, she may voluntarily implement technologies *m* or *b*, so the MD_o curve in figure 1 may be removed from the comparison in some cases.

In addition, a 100 percent cost share may not be necessary to encourage participation for farmers considering construction of manure storage facilities. Farmers do have an incentive to adopt these facilities, which increase the marginal private benefits of livestock production. Some form of financial support may be sufficient to alter the private cost-benefits of the adoption decision, particularly for farmers considering expansion.

The second point of guidance is that the choice of which technologies to support should depend upon the level of damages that can be avoided. The extent of external damages becomes the basis for choice, as the level of assistance provided to farmers is assumed to be directly offset by the burden imposed on taxpayers. (In making this calculation, the social loss associated with the marginal excess burden of taxation (Alston and Hurd, 1990) is not considered.) Thus, the management practice with the lowest total damages is the practice that should be targeted. For example, the comparison of total damages in figure 1 indicated that buffer strips would be preferred to either a manure storage facility or no abatement. However, the choice depends upon individual farm characteristics that influence the position of the MD and MB curves. For instance, the reduction in damages associated with the abatement practices relative to not installing either option will be larger for those farmers adjacent to the main river in an area.

The third point of guidance is that the objectives of the program (environmental quality) need to be clearly stated as guiding principles. Supporting all possible abatement practices can defeat the objectives of the program. To illustrate, note that the bigger the difference in marginal benefits between no abatement or buffer strips and a manure storage facility, the greater the likelihood of private adoption of manure storage facilities. Subsidization through the cost-share program might remove any financial constraints and increase the probability of adoption. The net result is that the cost-share program builds in an advantage to options that increase private returns, such as manure storage facilities. However, the impact of increased livestock production, and consequently manure, can work against the objective of the program to reduce environmental damages and improve water quality.

Analysis of the Rural Water Quality Program (RWQP)

The points of guidance derived above can be used to aid in the design of an effective voluntary cost-share program to improve environmental quality. The implied guidelines are compared to an actual cost-share program to describe its current performance and assess how it can be improved. The case study is the Rural Water Quality Program, which is an initiative of the Regional Municipality of Waterloo along with several farm organizations to address water quality problems of the Grand River and its tributaries. The key problem is reduced oxygen levels, depressed by excessive algae growth associated with high levels of phosphorus. It is estimated that 145 tonnes of phosphorus are generated annually from agricultural land, and this represents 70 percent of the total loadings in the region (Draper and Weatherbee, 1995). The region has committed $1.5 million to the program, to be used in a cost-share arrangement with farmers to implement best management practices that will reduce phosphorus loadings in targeted upstream areas. The program began in April of 1998 and runs through December 2002.

Cost-share grants are available to reduce the impact on water quality of manure handling and storage facilities, milkhouse wastewater, chemical, fertilizer, and fuel storage and handling facilities, livestock access to watercourses, inadequately maintained and constructed water wells, and field erosion. New operations, new buildings, additions to homes, or building expansions to increase herd capacity are not eligible. Financial assistance ranges from 50 percent to 100 percent of the actual cost of the investment, depending on the project. In addition to cost-share grants for capital costs, performance incentives are available for up to three years after establishment for the following practices: strip cropping, nutrient management plans, stream buffer strips, and fragile agricultural land retirement. Costs which are eligible for grant assistance include required permits, purchased materials and supplies, professional fees, and fees for design, construction, and supervision. Grants are limited to eligible farmers within the identified priority areas and to projects that will improve and protect water quality. Eligible farmers can receive up to $25,000 per farm.

There are a variety of eligibility requirements with the Rural Water Quality Program. Financial assistance is available only to farmers with agricultural land located in the targeted areas, the Lower Conestogo River, Upper Nith River, and the Canagagigue Creeks. Projects from this targeted group of producers must exhibit a potential to protect and improve water quality. In order to receive a grant, the applicant must have a completed and approved Environmental Farm Plan (EFP). An EFP is a voluntary environmental management system in which the producer undertakes an external but confidential audit of the operation's impact on the environment.

Program Participation

The Rural Water Quality Program received 59 applications in 1998, its initial year of operation. Application numbers increased significantly, to 93, in 1999 (see table 1). Approximately one-third of these applications have been for manure storage facilities, with clean water diversion programs or the establishment of nutrient management plans the next most common projects seeking funding.

Table 1 Project Applications, Approvals, and Grant Levels for RWQP in 1998–1999

Practice	Total applications		Denied		Approved		Completed	
	98	99	98	99	98	99	98	99
Clean water diversion	7	16	1	1	6	15	4	5
Manure storage	20	24	6	7	14	17	9	14
Nutrient mgt. plan	14	16	0	0	14	16	9	14
Milkhouse wastewater	7	8	0	1	7	7	5	4
Livestock access to watercourses	2	5	0	0	2	5	0	1
Erosion control	2	5	0	0	2	5	1	0
Buffer strips	5	6	4	1	1	5	0	3
Tillage	0	8	0	0	0	8	0	8
Fuel storage	1	8	0	0	1	0	1	0
Well projects	0	3	0	0	0	3	0	0
Cover crops	1	2	0	0	1	2	0	2
Total	59	93	11	10	48	83	29	52

Of the 59 applications in 1998, 11 were rejected, with 6 of the denials associated with manure storage projects and four with buffer strips. Applications were denied on the basis that they were intended for livestock housing or they failed to adequately address a water quality concern. The rejection rate was significantly reduced in 1999 as landowners became more familiar with the eligibility requirements of the program. Of the 131 projects that had been approved for funding over the first two years, 81 had been completed by the end of 1999.

Table 2 Grant Levels and Capital Costs for Completed Projects of RWQP in 1998–1999

Practice	Completed projects (#)	RWQP grant	Capital cost	Average capital cost	Grant as % of capital cost
Clean water diversion	9	9,178	42,652	4,739	0.22
Manure storage	23	300,008	926,165	40,268	0.32
Nutrient mgt. plan	23	3,787	10,729	466	0.35
Milkhouse wastewater	9	38,196	100,152	11,128	0.38
Livestock access to watercourses	1	6,081	11,315	11,315	0.54
Erosion control	2	6,688	18,771	9,386	0.36
Buffer strips	3	5,243	7,686	2,562	0.68
Tillage	8	7,472	7,687	961	0.97
Fuel storage	1	750	10,298	10,298	0.07
Cover crops	2	320	320	160	1.00
Total	81	377,723	1,135,776	14,022	0.33

The 81 completed projects over 1998–1999 have received $377,723 from the Rural Water Quality Program in the form of grants or annual performance incentives (see table 2). The allocated funds represent approximately two-thirds of the projected expenditures of the RWQP. However, there has been a significant change over the two years, as only 35 percent of the budgeted incentive dollars were spent in 1998 as opposed to 75 percent of the projected budget being spent in 1999. The 23 manure storage projects, although representing less than one-third of all funded projects, received 80 percent of the total amount awarded over the two years. The majority of the remaining total was given as grants for nine projects to reduce milkhouse wastewater. The other 49 projects together received approximately $40,000.

In addition to the grant dollars provided, the fourth column of table 2 lists the direct capital investment costs to the farmer for the completed projects. The total is the sum of the RWQP grants/incentives plus the remaining expenses paid by the producer including any in-kind contributions. The most expensive projects on average are manure storage facilities ($40,268) and are approximately four times as costly as the next most expensive abatement practices. The least expensive projects are for the development of nutrient management plans

($466) or the establishment of cover crops. The program grant covers the smallest percentage of actual costs for improving water wells (22 percent) and fuel storage facilities (7 percent). As discussed further below, both are projects for which the benefits accrue largely to the farm family as opposed to those off-farm.

Lessons from the Model and Suggestions for Program Improvement

The Rural Water Quality Program is available to over 1500 farmers but less than one-tenth of them have participated and around two-thirds of the project funds have been allocated. Using the lessons generated from our conceptual framework in the previous section, the following suggestions can be made for improvement.

The first focuses on the level of financial support provided to encourage adoption of each of the abatement practices. The limited participation is a result of the low level of financial assistance, which is capped at $25,000 per farm and generally limited to 50 percent of actual expenses for most capital expenditures. It was noted in the conceptual framework that full subsidization is required if the desired result is adoption of a practice such as buffer strips for which there are no private marginal net benefits to production.

The performance incentives for the installation of buffer strips are insufficient for many producers to convert productive farmland. As an example, a farmer who installs a buffer strip is eligible to receive a performance incentive of $250 per acre per year for three years. The present value of this incentive at a 5 percent discount rate is $681 per acre. Producers must sign a 15-year contract that ensures the land where the stream buffer is installed remains uncultivated.

When the incentive payments are applied over the 15 years of the contract, the value of the program is calculated to be $65.61 per acre per year. Assuming $4 per bushel corn and a cost of production of $250 per acre, the break-even yield at which the producer is indifferent to enrolling in the program or growing corn is 79 bushels per acre. It would increase to 105 bushels per acre with a corn price of $3 per bushel. Corn yields in the area typically average 120 bushels per acre, implying only producers with marginal land would find it profitable to install a buffer strip.

Despite the fact that RWQP covers less than 100 percent of the capital costs for water quality improvements, a number of producers have opted to participate. Two reasons for their participation are suggested by the conceptual framework. First, there are positive private marginal benefits for some practices and, consequently, less than full subsization is required to prompt adoption. Of the producers who applied for funding under the cost-share program, the majority applied for manure storage facilities, while relatively few applied to receive cost-shares for installing buffer strips. Adequate holding capacity and design features for manure storage facilities are now part of the nutrient management plan required in many areas before building permits are issued for new livestock facilities. Producers planning to expand may thus view the program as an opportunity to cover the costs of future building expenses. Nutrient management plans are being required in many municipalities before a building permit is issued for the construction of new livestock facilities. Thus, the relatively high number of nutrient management plans funded under the program may also be viewed as a means to reduce future expansion costs.

Another reason for participation across all projects is the value producers place on environmental stewardship. It is evident there is utility for this group in reducing emissions; in order to participate in the program, they have met the requirement of completing an Environmental Farm Plan (EFP). An EFP is a time-consuming exercise that identifies means by which an operation can reduce its environmental impact. The small incentive ($1,500) received for completing a plan is less than the cost involved, suggesting that those who have completed the EFP do include environmental quality within their utility function. While the EFP requirement can reduce the level of financial assistance required to secure participation, it also significantly reduces the potential number of applicants. Within the targeted area of Waterloo County there are approximately 1500 farmers, of which less than 20 percent (250) have attended an EFP workshop. Of those who attended an EFP workshop, less than half have competed their workbook; completion is a requirement to receive funding under the Rural Water Quality Program. Thus, there are fewer than 125 farmers in the priority area who presently qualify for the program. This number is approximately 50 percent higher than it was a year earlier, suggesting the RWQP has heightened awareness of environmental impacts associated with agriculture and subsequently increased the number of potential participants.

The second lesson from the conceptual framework that can be used to suggest improvements to the RWQP deals with defining which of the possible abatement activities should be funded. The choice of abatement activity should be determined on the basis of minimizing the sum of program costs and pollution damages. The preference for buffer strips in the conceptual model was based on the assumed relative positions of the marginal damage curves across practices. Damage costs as a function of phosphorus levels are not known. Also unknown is the effect of alternative control practices on phosphorus concentration levels in the Grand River. Ideally, these levels should not exceed 0.08 mg/L, in order to prevent large amounts of aquatic weed growth (Draper and Weatherbee, 1995).

A comparison of manure storage and buffer strips shows the relative costs of these two abatement practices. There are 302 livestock operations with the potential to pollute in the region; 238 of these require manure storages (Ryan, 1990). The enhanced and proper storage of animal waste would permit producers to restrict manure application to the growing season. The estimated reduction in P loadings if the required storage were built is approximately 8,200 kg annually (Draper and Weatherbee, 1995). Construction costs vary significantly depending on the type of manure system, but assuming an average present value of $20,000 per farm [based on a survey by DeVos et al. (1998)], the resulting annual abatement cost is approximately $580/kg P. Buffer strips have potential to be used over an estimated area of 500 acres and would reduce P loadings over the region by 1,000 kg annually. Assuming the buffer strips use productive corn land generating 110 bushels per acre and the price is $3/bu corn, the annual net profits from this land would be $110 per acre received at the end of the year. Discounting over the 15 year life span of the commitment to keep the land in buffer strips, the average annual abatement cost will be approximately $38/kg P ((500 acres • $76.12/acre)/1000 kg P). These costs represent an upper bound and will undoubtedly differ between operations. The rough calculations, however, indicate that buffer strips are the cheapest abatement activity for the initial reduction in P loadings. The optimal reduction in agricultural P loadings from the present 145 tonnes is not known without an assessment of damages, yet the high abatement costs for manure storages suggest that damages would have to be large for storages to be justified.

The optimal level of P loading depends on comparing the damages from the loading to the costs of abatement; the latter have been the focus of this study. Assessing the damage costs involves determining the value people place on the environmental and human health improvements associated with a reduction in loading. Given the difficulties and resource requirements for valuing these nonmarket attributes, most regulators set a desired reduction in pollutants and seek the strategies that meet the target at the least cost. The differences in average abatement costs in the Grand River suggest regulators should focus their efforts on encouraging the use of buffer strips and then move towards other abatement practices to obtain further reductions in P loading if the damages are sufficiently high.

Another lesson is that the group of producers involved in the program must be carefully selected. The RWQP is targeted to a select group of producers within the Grand River watershed and, within that area, available only to those who can demonstrate their project will improve water quality. Thus, the program does recognise that different producers will cause different damages depending on their location. As an example of the effort to target, 50 landowners were ruled ineligible for the program in 1999 due to their locations in the watershed. This targeting represents a significant improvement to previous voluntary, universally available, cost-share programs in the province. However, the program does not permit the level of financial assistance to vary among the targeted farmers in accordance with the extent of the potential to reduce phosphate levels or with the level of abatement costs.

A final lesson relates to matching the objectives of the program to the implementation issues just discussed (level of support, which practices to support, and which farmers should be eligible). Support for the program was garnered by providing financial assistance to a variety of abatement activities for the farmers within the watershed. While the RWQP has done a good job of targeting potential polluters, supporting all possible abatement practices can defeat the objectives of the program. The most numerous applications have been for manure storage facilities, and these are by far the most costly of the abatement activities. As discussed above, the increase in private returns from these facilities encourages their adoption. The RWQP would do better to support fully the practices that most cost-effectively reduce damages rather than to support partially a variety of practices. Otherwise, it's likely that the practices that are adopted will be those for which there are marginal private benefits and not necessarily those that efficiently improve water quality.

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