



Reducing phosphorus emissions: Why voluntary programs struggle and market- based instruments are likely to work best

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For most of the last 50 years, society has known that phosphorus emissions pose risks to aquatic ecosystems and humans. This is particularly true in Lake Erie, where there long has been a focus on reducing phosphorus attached to soil via conservation tillage and the conservation reserve program. Society has bought into the vision that soil erosion could be controlled. Payments through the federal Farm Bill to implement conservation programs have expanded handsomely from practically nothing in Ohio in the 1980s to \$80 million per year. Payments have increased 10% per year over the last decade.

The focus on soil erosion appears to have paid off, with attached phosphorus declining by 30-40% in the Lake Erie basin since the 1970s. Under most circumstances this would be considered a monumental success story, but in the case of phosphorus and Lake Erie, it is not. Why not? Although attached phosphorus declined, total phosphorus emissions due to agriculture have actually increased. Despite an enormous influx of funding, visits from Vice-Presidents, large bonus payments for set-asides, nutrient management planning, and now cover-crops, we have not solved the phosphorus problem.

Part of our failure stems from the use of voluntary approaches, which struggle to reduce pollution even under the best circumstances. If it's risky to forgo an important nutrient like phosphorus, why would a farmer voluntarily reduce their phosphorus applications? Not surprisingly, farmers only implement voluntary conservation practices when the costs are low or the subsidies are high enough to offset the costs. Most farmers do not engage in long-term conservation tillage because the yield consequence for corn is too great, and corn is worth more than soybeans. Farmers will forgo tilling in certain circumstances, such as when they plan to plant soybeans, because there is not a large yield penalty with soybeans. Most farmers will not plant cover crops because they are a costly, but more will be installed when subsidized.

We have achieved a lot of conservation tillage, but mostly because the costs of plowing are high. Grass waterways, riparian zones, and cover crops have been installed, but mainly due to subsidies. Despite the expenditures on these practices, phosphorus remains a problem, and soluble phosphorus has gotten worse. It will not be cheaper to now go after soluble phosphorus. In fact, it will be more expensive, particularly if we use the old approach of subsidized conservation programs. The next units of pollution abatement are always more expensive. Our past efforts also have made future phosphorus reductions even more costly because we have trapped so much phosphorus on the landscape. Some of it is now leaking out (so-called legacy phosphorus), and thwarting our current efforts.

So, what do we do? The 4-Rs (right source, right rate, right place, right time) provide a nice starting point. As a voluntary program, they will not reduce soluble phosphorus. With some regulatory oversight, and the use of market-based instruments, the 4-R program could be wildly successful. Specifically, a strict limit on the rate of phosphorus applied to farms (e.g., 0.2 lbs P₂O₅ per bushel corn), would increase the incentive farmers have to use the right source at the right place and time. This proposal can be broadened to allow farmers to buy additional levels of phosphorus application permission from other farmers who are willing to reduce their inputs even further. Alternatively, a phosphorus tax would work to increase the emphasis on the source, place, and time.

How much would a market-based program cost? Surprisingly, a market-based program could cost less than the costs of the current suite of voluntary conservation programs (the ones that are not solving the problem). Our estimates place these costs at about \$6 per acre per year, or about half of what we currently spend on conservation programs. It would be a large step for policy makers to eliminate subsidy programs and instead use market-based incentives, but if we want affordable reductions in phosphorus, it may be the only way to go.