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# *Reaching the Potential of Water-Quality Trading*

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In 2003 the US Environmental Protection Agency (USEPA) created a Water Quality Trading Policy consistent with the Clean Water Act of 1972. Building on the successes of the National Pollutant Discharge Elimination System (NPDES) permit program to address point-source discharges and the Total Maximum Daily Load (TMDL) program, which established watershed pollution loads, water-quality trading was created as a new rule to address the approximately 40% of the rivers, 45% of the streams and 50% of the lakes that had still not met their designated uses. Section 303(d) of the Clean Water Act mandates that states assess their waters every two years. Each state creates a list of waters that are impaired. TMDLs are then written for those impaired water bodies, allocating allowable pollutant loads from the various sources in the impaired watershed. Part of this is to set a load limit for point sources such as wastewater treatment plants (WWTPs) and industry. TMDLs were referenced in Section 303 of the 1972 Clean Water Act.

Water-quality trading is defined as (USEPA, 2003):

*...an approach that offers greater efficiency in achieving water-quality goals on a watershed basis. It allows one source to meet its regulatory obligations by using pollutant reductions created by another source that has lower pollution control costs.*

Presently there are 24 active water-quality-trading programs in the United States (Williamette Partnership, 2012) although, as noted by Mariola (2009), the actual figure may be somewhat less and even fewer are truly functioning. Currently, nine states have rules defining the local interpretation of the rules through statewide regulatory authority for trading via statute, regulation, policy, or guidance. This article reflects on the successes of one program, the Alpine Cheese Phosphorus Nutrient Trading Plan, and the reasons why it was successful. It is one of the few programs in the country to have fully met the

requirements of an NPDES permit. As a result, this permit was renewed in 2012 for a second five-year term. Additionally, the local popularity of the program led to the creation of a 21-county Muskingum Joint Board of Soil and Water Conservation District whose supervisors proposed a water-quality-trading plan that will cover nearly a quarter of Ohio. The reasons for the successes of the Alpine Plan can be categorized into the following sections:

- A clear regulatory framework,
- Economic framework,
- Organization of the program, and
- Ecological significance.

## BACKGROUND

The State of Ohio has the following water-quality-trading programs:

- The Alpine Cheese Nutrient Trading Plan,
- The Walnut Creek Water Quality Trading Plan,
- The Great Miami River Water Quality Credit Trading Program, and
- The Ohio Basin Trading Plan.

Ohio has been a national leader in experimenting with approaches to water-quality trading. Both the Alpine Cheese Phosphorus Nutrient Trading Plan and the Great Miami River Water Quality Trading Plan were the first programs approved by Ohio EPA (OEPA) before the Ohio water-quality-trading rules were formalized in 2007. Both plans were developed between 2005 and 2006 and are grandfathered in the Ohio rules. The Alpine Plan has a 4:1 trading ratio whereas the Miami Plan has a 2:1 ratio referring to the credits ratio between buyer and seller. Usually the buyer is a point source and the sellers are farmers. In both cases, the ratio favors improving the watershed water quality more than if the point source met the NPDES permit requirements through a complete facility upgrade. The Miami Plan ratio was based on the idea that there would be proactive trades before formal regulations were imposed by OEPA on the Dayton area wastewater-treatment plants. The Alpine Nutrient Trading Plan had a more conservative trading ratio and was conducted in an area where a TMDL was in place, so the cheese factory had a load limit. Load is calculated by multiplying concentration times flow. So when there is a TMDL in place, all point-source loads are documented and then a point source can increase its outflow only if it decreases its concentration of the pollutant or *vice versa*. Of course, the higher the ratio, the higher the cost to the point source. The Ohio rules decided on a midpoint of 3:1, but it is possible to request a lower ratio for pre-TMDL watersheds.

The Alpine and the Miami Plans also differ by the broker type and the credit-market instrument. The Alpine Plan is administered by a county Soil and Water Conservation District, which contracts individually with farmers in order to fill the necessary credits for the Alpine Cheese Company's NPDES five-year permit, which officially started January 1, 2007. The Miami Plan is administered by the Miami Watershed Conservancy District, which conducts a reverse auction (lowest price wins) with bids coming from the Soil and

Water Conservation Districts (SWCDs) in the 15 counties in the district. The county SWCDs prepare bids with their local farmers. The lowest bids are then selected by the Miami Watershed Conservancy District. This is in contrast to the approach of the Alpine program, which placed the county SWCD as the broker of the program. The success of the Alpine Cheese case led to the formation of a 21-county Muskingum River Watershed Joint Board of Soil and Water Conservation Districts on June 17, 2010. This group, approved by the Ohio Soil and Water Conservation Commission, has a water-quality-trading program pending with the OEPA. Approval is expected in late 2012. Like the Alpine case, this program favors trades at a more local level, while not ruling out trades across counties or states.

It is important to realize that while Ohio is a leader in the diversity of water-quality-trading programs, many other possibilities can be developed to create an appropriate program for any given set of environmental or cultural situations. Selman *et al.* (2009) has listed several market structures: bilateral negotiations, sole-source offsets, brokered trades, auction platforms, and exchange markets. It is also possible to use multiple exchange markets in the same program. According to a new manual by the Willamette Partnership (2012), there is the following breakdown of the 25 active programs using four types of market structure: 67% use bilateral trades, 46% use sole-source offsets, 21% use an auction platform, and 17% use an exchange market.

Finally, the Ohio Basin Plan, developed by the Electric Power Research Institute (EPRI), which is the research arm of the electric power industry and has numerous coal-burning power plants on the Ohio River, has experimented with interstate water-quality trading. Many watersheds—both large and small—cross state boundaries. In 2012, Ohio and Kentucky formally approved interstate water-quality trading. The Ohio Basin Project has favored reverse auctions and brokering trades using the American Farmland Trust, although it recently started exploring working with SWCDs.

## REGULATORY FRAMEWORK

Water-quality-trading programs require a regulatory driver to be effective. One of the reasons for the initial success of the Alpine case was that the factory wanted to expand its production, but was facing the fact that its phosphorus levels were out of compliance. Also, the factory phosphorus load had been set by the 2000 Sugar Creek TMDL. So, in order for a plant expansion, OEPA required the factory to lower the phosphorus levels from over 200 mg/L to about 3 mg/L before they would be allowed to trade. The calculations were also determined according to the TMDL so that, for expansion, the factory had to lower its concentration or outflow volume. Although the trading plan was formally ready to be implemented in 2006, OEPA required that the facility upgrades be completed so that the factory level would be lowered to at least 3.2 mg/L before trading could begin. Trading was aimed at the 2.2 mg/L remaining, to bring their concentration down to 1.0 mg/L as required by their NPDES permit issued in January 2007.

The renewal of the Alpine Nutrient Trading Plan in 2012 was also based on a pressing need. In this case, they were selling the company to a Scandinavian dairy cooperative and needed to have their regulatory papers in order for the sale to go through. This was

also the case with Ohio's fifth trading program, the Walnut Creek water-quality-trading program. The Walnut Creek trading project was located within the Alpine Trading area, so followed the same rules as Alpine and was formed as part of a NPDES permit when the county WWTP was under OEPA pressure for violations on their permit.

There are some cases where regulation is weak or nonexistent. The Miami Plan started at the same time as the Alpine Plan, but, since regulations were not in place, incentives were given to wastewater-treatment plants in anticipation of OEPA applying regulations on phosphorus and nitrogen discharge. The delay of regulations being applied made it difficult for the plan to continue without federal assistance, although they were able to accomplish the reverse auction-bidding process and implement a number of conservation practices. Even in the Muskingum Watershed, much of the northern half of the watershed has TMDLs, whereas the southern half is still working with OEPA to develop them. Because the Ohio rules do not allow banking of credits, it is difficult to find incentives for non-regulated areas to induce participation. The Ohio rules do allow a lower trading ratio for such areas, but that alone probably isn't enough incentive.

## ECONOMIC FRAMEWORK

Finding a balance between the cost of what farmers need to implement conservation measures and what the point sources need to balance their books is not an easy task. Stanton *et al.* (2010) noted the difficulty in comparing prices per pound across trading programs in the United States. A number of factors affect the price such as trading ratios, location, delivery, uncertainty, and retirement. For example, trading for reductions upstream is almost always more beneficial to the ecosystem than trades occurring downstream as a result of their cumulative effect. In some cases, it is economically beneficial for a downstream city to pay to have conservation measures installed upstream so that they don't have to pay the high cost of treating the water, such as the case for high nitrates in the spring for the City of Columbus in Ohio. Also in Ohio we can see the need for different conservation measures in different parts of the state affected by different ecoregions. For example, presently the algal blooms in Lake Erie in NW Ohio need conservation measures directed at soluble reactive phosphorus, whereas in SE Ohio the main environmental issue may be acid mine drainage. Northwest Ohio is flat, glaciated and in the eastern part of the corn belt, whereas SE Ohio is unglaciated and part of the Appalachian foothills, making a direct comparison difficult.

In the Alpine case, we also found that the duration of the conservation measure made pricing difficult. On the surface, the price per pound for the Alpine project looks astronomical compared to other programs. Alpine Cheese company paid \$800,000 to cover the payments to the farmers, compensation to the county SWCDs for administrative and technical support, and to OSU for writing the plan and conducting voluntary and mandatory water-quality sampling. But, unlike other programs, about 70% of the conservation practices had a 15–20-year lifespan so that the credits could be sold over that time. This was due to the fact that most of the Alpine Plan area farmers were dairy producers who had manure issues, so most of the pollution remedies addressed manure management and were long term. An example would be creating a manure-storage area.

This compares to the corn belt where a solution might be to start using no-till methods that are paid out to the farmer on a per-acre basis each year.

We have realized that one of the most important factors that affects price and the general structure of a trading plan is the load of an individual point source that might bid for credits. We realized this only after reflecting on why the Alpine case was so successful and why large city WWTPs were struggling with their programs. The reason is simple but fundamental: economy of scale plays a key role. The cost of a facility upgrade per gallon of outflow for a plant like Alpine, with only 0.14 mgd (million gallons per day), is about 4–6 times higher than for a medium-sized town. The cost of facility upgrades for a small town with a population of a few thousand people and a wastewater-treatment plant with outflow of 0.5 to 1 mgd is normally in the \$4 million to \$7 million range. The other factor to consider is how close the point source is to the target level. If a plant is fairly close to the target level, usually water-quality trading would be easier and cheaper than a facility upgrade. Hartman and Cleland (2007) have provided a useful comparison of WWTP methods and costs for phosphorus removal. For a plant to remove phosphorus down to a 1 mg/L level using AS plus alum, a common method used in the Muskingum Watershed, the cost for a plant with a capacity of 1 mgd was \$64,800, whereas the cost for a plant with a capacity of 50 mgd was \$1,540,000. The latter figure is slightly less than half on a per-gallon basis. The difference is even greater when the size of the plant drops below 1 mg/L as was the Alpine case. However, transaction costs are also higher for small-scale operations so they need to be factored into the price and are, no doubt, the reason why some of the larger trading plans have been attractive to large WWTPs and large farms to implement the conservation measures.

It is important to realize that ecological economics is based on adding ecological value in a way that complements social and economic values. An example of this is the conservation measure called “fencing exclusion” that was installed on dairy farms and resulted in improving the cheese niche in the area. This is because fencing cows out of the streams resulted in a lower somatic cell count (bacteria) in the milk, so that the local dairy wanted to buy more of their milk due to the higher quality. It also resulted in an increased premium of \$0.75/cwt (which amounts to about \$22.50/cow/year) that the farmers received for their milk.

The project worked with 25 farmers and installed 91 practices that resulted in 7,133 pounds although only 5,500 were needed for the permit. The cheese-factory expansion added 12 jobs to the local economy and over half of the milk purchased by the factory is local. In addition to phosphorus credits generated, about twice as much nitrogen was remediated through the same conservation practices, but these credits were not sold; the project aims to sell them in the future. In a sense, these were a “free” improvement for the watershed. The project is very popular in the community and a waiting list of farmers exists hoping for future projects, should the Muskingum Plan be approved. Ohio EPA and local residents can also point to the fact that there is a measureable improvement to the Middle Fork where the cheese factory is located. The stream is now in full biological attainment of OEPA standards according to a study of biological monitoring data independently assessed by the Midwest Biodiversity Institute.

## ORGANIZATION

Both the Alpine and the Muskingum Plans focus on the county SWCDs. A study conducted by Moore *et al.* (2008) showed that farmers trusted their local county SWCD more than any other agency in the watershed. Trust was also a focus of the study by Mariola (2009), who found that farmers liked the local SWCD, “Because they know agriculture and because their mission statements position them as farmer advocates, farmers trust that they will help guide them through the conservation process without the threat of increased regulation.” There is another reason why local SWCDs make sense when small-town WWTPs are the focus. Many county SWCDs and county WWTPs, such as was the Walnut Creek case, are financed and managed through the county commissioners. So, from a county level, it makes sense to save money on the WWTP upgrade and share that savings to finance the SWCD and also return tax savings to the citizens. We also found that most of the SWCD employees had farming backgrounds so that the technicians’ local knowledge was respected, and it was easy for them to communicate and advocate for the program.

## ECOLOGICAL APPROACH

The Alpine Project and the Sugar Creek Project, of which it is a part, are based on ecological science. As such, the emphasis is on understanding and bringing back ecological structure and function to headwaters. According to Alexander *et al.* (2007), first-order headwater streams contribute approximately 70% of the mean-annual water volume and 65% of the nitrogen flux in second-order streams. During the Alpine Project, the county SWCD technicians first ranked the possible conservation measures for each farm and the cost of phosphorus reduction. Next they consulted with the farm family about which of the conservation measures they preferred. Usually the final conservation measures that were selected represented a combination of those that produced the most phosphorus reduction per dollar and those that the farm family wanted but were not quite as cost effective, or had more ecological importance.

## CONCLUSION

The future of water-quality trading in Ohio will depend on the severity of the algal blooms and hypoxia in Lake Erie and the Gulf of Mexico, respectively. Ohio is a state with several contrasting water-quality-trading programs that differ in scale and approach. The Alpine Cheese Nutrient Trading Plan has for various reasons fully accomplished the goals of the Alpine Cheese Company NPDES permit. While it is likely that the renewal of the permit and trading plan for another five years will be equally successful and even carried out at a lower price, whether or not the Muskingum Plan can replicate the success at a much larger scale in 21 counties in Ohio remains unknown. Likewise, much of what happens with water-quality trading in Ohio depends on the extent to which the nutrients are regulated. For example, numeric nutrient criteria have been introduced in several states and Ohio EPA plans to adopt them within the next few years. The lower levels of phosphorus and new rules for nitrogen may encourage more water-quality-trading efforts to meet the new standards.

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