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Water Quality Credit Trading: General Principles[1]

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Introduction

Florida's 2008 Integrated Water Quality Assessment Report indicates that poor water quality was found in 28 percent of total assessed river miles, 25 percent of total assessed lake areas, and 59 percent of total assessed estuarine areas (for all causes except mercury). Most of the surface water quality problems in Florida are associated with mercury in fish, fecal coliform bacteria, excess nutrients, and low dissolved oxygen. Main sources of pollution are urban stormwater and agricultural runoff. Significant water quality problems (both surface and ground water) were found in highly urbanized areas and areas with intense agricultural and industrial use (FDEP 2008). Reducing pollution and improving water quality has become a public policy objective in Florida. Costs to implement Florida's water policy objective will be borne by Florida citizens and businesses. Water quality credit trading is one of several policy tools that have been proposed to improve the cost-efficiency of pollution control policy. In this document, we review the basic components of a water quality credit trading program and discuss opportunities and challenges associated with a water quality credit trading program design.

This publication is the first of two publications on water quality credit trading. The second publication will be focused on the pilot water quality credit trading program in the Lower St Johns River Basin, Florida. The content of this publication is largely based on Abdalla et al. (2007). Technical terms used in this publication are bolded, and a glossary is available at the end of the document.

Basics of Water Quality Credit Trading

Water quality credit trading (WQCT) is currently being tested in several states as a policy tool to stimulate provision of clean water. Water quality credit trading programs are designed with the objective to drive down the level of water pollutants, especially nutrients (Nitrogen and Phosphorus), by letting emitters in a watershed trade among themselves to find the most cost-efficient way of reducing pollution.

Traditional water pollution regulations in most U.S. states mandate pollution reduction from industrial and municipal sources and rely on voluntary programs to address agricultural pollution. In Florida, implementing agricultural **best**

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management practices (BMPs) is voluntary with one important exception. If an agricultural operation is located in the area where the Florida Department of Environmental Protection (FDEP) documented water quality problems, then the BMP implementation may be mandatory. Federal regulations require states to evaluate water bodies against relevant water quality standards. For water bodies that do not meet water quality standards, monitoring is conducted, and then, based on the monitoring results, a **Total Maximum Daily Load** (TMDL) target is established. The TMDL sets the maximum amount of pollution that a water body can receive (within a certain time period, usually one year) and still meet water quality standards. Implementation plans will be (or are being) developed for many of the TMDL targets. Such implementation plans are referred to as **Basin Management Action Plans** (BMAP), and they describe specific strategies that will be used to achieve TMDL pollution reduction goals. Agricultural BMPs are required by law in areas of the state where BMAPs include agriculture. The Florida Department of Agriculture and Consumer Services (FDACS) adopts BMPs by rule for different types of agricultural operations. More information about agricultural BMP implementation can be found online at http://www.floridaagwaterpolicy.com/AtaGlance.html (FDACS/OAWP 2004) and at http://edis.ifas.ufl.edu/AE388 (Migliaccio and Boman 2006).

Advantages of WQCT in comparison with traditional water pollution regulations can include:

- allowing individual entities flexibility in choosing pollution-abatement technologies and practices (e.g., flexibility for the farmers to choose which BMPs to implement).
- providing incentives to innovate within the pollution-abatement sphere.
- addressing future growth in the basin while meeting water quality goals.

The WQCT is based on the idea that pollution-control costs differ from source to source. The overall costs of achieving pollution-reduction goals in a watershed are minimized if sources are allowed to reallocate (trade) pollution reductions according to their pollution-abatement costs.

To illustrate the mechanics of water quality trading, consider a simplified example presented in Tables 1 and 2. Assume that there are two separate entities within a basin: a municipal wastewater treatment plant (MWTP) and a livestock farmer (LF). Each entity discharges water that contributes to phosphorus (P) pollution of a stream. The environmental goal is to reduce P loadings by two units. We further assume that reducing P load from either or both entities has equal value toward achieving the environmental goal. Without trading, the total cost of achieving the pollution reduction target (2 units of P reduced) is $50. As outlined in Table 1, each entity works independently to achieve its share of the environmental goal. Total cost of pollution reduction is simply the addition of costs across the two entities.

Now let us consider the possibility that the MWTP and the LF can interact and collaboratively achieve the environmental objective. Since the unit cost to reduce P loading is less for the LF, the MWTP manager proposes that the entire P reduction (2 units) be accomplished by the LF. The LF is willing to participate so long as he or she financially gains. In effect, the LF sells the MWTP manager a pollution reduction credit, thereby allowing the P load reductions to occur on the farm. The value of the credit has to be more than $20 but less than $30 for the system to produce a net economic gain. For the sake of the example, let's say that LF sells one credit to MWTP for $25. Table 2 summarizes the trading transaction. The same environmental goal of reducing phosphorus by two units is achieved but at a lower total cost of $40. Both parties share a portion of the saving, which in this case is a lower cost of compliance by $5 each.

Elements of a WQCT Program

Public water quality goals

First, policy makers (with public input) must determine the environmental goal to be achieved within a basin (e.g., fish propagation, safety for recreation, etc.). This goal should be translated into a maximum amount of pollution that a water body can receive (process similar to the TMDL), which is often a challenging task.

Baseline load for pollution sources

Industry, wastewater treatment plants, and agriculture typically represent major sources of water pollution. Wastewater treatment plants, industry, and some urban and agricultural sources that discharge through a well-defined outflow points are called **point sources**. The majority of agricultural and urban areas, however, contribute to water pollution through a diffuse runoff over land surface. These sources are called **nonpoint sources**. Because runoff from nonpoint sources is spread across areas like fields and pastures, the actual volume of pollution is difficult to measure.

Point sources are regulated under the federal Clean Water Act, and permits are required for pollution emission referred to as **National Pollution Discharge Elimination System (NPDES) permits**. In contrast, nonpoint sources are not required to obtain any pollution permits. The focus of many water quality credit trading programs is to promote transactions between point and nonpoint sources. The costs of pollution abatement from nonpoint sources are usually low, and since the point sources are legally liable for pollution reduction under their NPDES permits, the regulatory pressure on point sources usually drives the trading. In such transactions, point sources are usually buying pollution reduction from nonpoint sources. However, to sell pollution reduction, nonpoint sources need to reduce their pollution beyond some baseline level. Different WQCT programs approach the definition of baseline for agricultural and urban nonpoint sources differently, for example, by setting the baseline load to current loading (loading that was recorded at some time period in the past) or load reduction defined through TMDLs.

Credits

Credits are units of goods (pollution reduction) to be traded. They are generated for every unit of pollution reduction beyond a baseline level. Credits should be accurately measured or estimated using a computer model.

Willing buyers and sellers

For sellers, it should be profitable to generate the credit and sell it at the water quality credit markets. For buyers, it should be more profitable to buy credits from the market than to abate pollution themselves. If the credit sellers are agricultural producers, they should also be willing to allow agencies or other independent organizations to verify the credit generated.

Note that water quality credit trading focuses on a specific watershed. Unlike carbon credits for greenhouse gas emissions, a buyer of water quality credits must purchase credits for pollution reductions from the seller within the same watershed.

Credit price

Credit price is usually determined from negotiations between buyer and seller. It is usually bounded from below by the costs of load reductions to the seller (e.g., BMP implementation cost), and from above by the cost of an abatement alternative for the buyer (e.g., installation and maintenance cost for an abatement technology).

Trading ratios

A trading ratio is the number of load-reduction credits from one source that can be used to compensate excessive loads from another source. A *delivery* trading ratio is set to ensure that trading among distant sources (e.g., upstream and downstream) does not violate an overall watershed pollution cap. For example, if the delivery trading ratio for upstream and downstream sources is set to 2:1, the upstream source should generate two units of pollution reduction to offset one unit emitted by a downstream source. *Uncertainty* trading ratio specifies the number of pollution reduction credits generated by the nonpoint source that should be purchased by the point source to offset one unit of its own discharge. The ratio is set to account for seasonal and daily changes in nonpoint source loading, and can be set greater than, equal to, or less than one. For example, if the uncertainty trading ratio for municipal nonpoint sources and wastewater treatment plants is set to 3:1, the wastewater treatment plant would need to purchase three units of pollution reduction from the municipal nonpoint source to offset one unit of its own emission.

Regulation

The regulatory agency plays an important role in a WQCT program. It determines the water quality goals, establishes a cap for pollutants in a watershed, approves and administers the trading program, and monitors and enforces the trading rules. For a WQCT program to be successful, the state agencies must be willing to assume additional economic and regulatory responsibility associated with this innovative policy tool.

Can WQCT Work in My Watershed?

Based on U.S. EPA data (2009a), water quality trading will not work everywhere. Trading works best when:

1. There is a regulatory *driver* that motivates sources to seek pollution reductions. Such regulatory driver can be a Total Maximum Daily Load (TMDL) or a more stringent pollution discharge requirement in the National Pollution Discharge Elimination System (NPDES) permits held by point sources.

2. Pollution reduction requirements faced by some sources do not exhaust all the pollution reduction options available. In other words, the baseline load for nonpoint sources should be high enough to allow the sources to generate pollution reduction credits by reducing loads beyond the baseline. Similarly, to encourage credit supply by municipal or industrial point sources, emission levels allowed through NPDES should be high enough to leave the sources with the opportunity to reduce emissions beyond permit requirements and therefore generate credits. If this condition is not satisfied, there may not be enough surplus reductions to generate market activities.

3. Various sources within the watershed have significantly different costs to reduce pollutants of concern. In this case, there will be willing buyers and sellers in the water quality credit market. Additionally, the difference should be significant enough to cover transaction costs between trading partners (i.e., the costs of finding the trading partner and negotiating the trading agreement).

4. Watershed stakeholders and the state regulatory agency are willing to try an innovative approach and allow for adjustments in trading design and implementation as the market evolves with new buyers and sellers.

Challenges Facing a WQCT Program

There are challenges associated with almost every essential element of the WQCT program. It is difficult to link public water quality goals (such as fish restoration) with the amount of pollution that can be discharged into the water body by all sources in the watershed. Furthermore, it is challenging to establish the baseline load for agricultural and urban nonpoint sources. Nonpoint pollution is spread over large areas and varies by site-specific factors and weather events. It is difficult to establish the baseline limit for nonpoint source pollution that cannot be easily measured or estimated. Baselines also raise the question of responsibility for pollution cleanup, property rights of landowners, and fairness. A liberal baseline that allows nonpoint sources to contribute a significant pollution load to a water body would not satisfy environmentalists. In turn, a stringent baseline would not allow nonpoint sources to participate in trading since no pollution reductions would be possible beyond the baseline. Establishing a baseline equal to the current estimated pollution load would punish agricultural producers who have implemented best management practices to reduce their pollution runoff in the past.

Similar to the challenges of establishing a pollution baseline, it is difficult to measure pollution reduction achieved by the sources (i.e., verify credits), which leads to uncertainty about the magnitude of water quality improvement from a trade. It is difficult to measure pollution reduction from an agricultural or urban BMP implementation. The effectiveness of a BMP depends on site-specific conditions, and BMP age, implementation, and maintenance. Scientific models used to estimate load reduction from BMPs are imperfect, and the estimated reductions from a BMP will likely differ from actual loadings. There is also ongoing debate about whether credits generated from BMPs installed using public (cost-share) funds should be eligible for trades.

There can be significant **transaction costs** associated with water quality credit trading. Examples of transaction costs include the efforts associated with locating buyers and sellers and the costs of negotiating the agreement. Transaction costs are almost always higher when a nonpoint source is involved in trading because of the complexity of measuring and verifying credits generated by the nonpoint source. Nonpoint sources often offer only a few credits so that the point source buyer must find and negotiate trades with multiple nonpoint sources to acquire sufficient credits. Methods to lower these transaction costs include (1) setting up a credit bank or a clearinghouse that can simplify the process of searching for the trading partner, (2) developing a standardized language in regulatory compliance documents, and (3) using *model* contracts for sales.

Industrial and municipal point sources are legally liable for achieving contractual pollution reductions via NPDES permits. In contrast, most agricultural and urban nonpoint sources do not have such permits. Therefore the only document binding nonpoint sources in the transaction is the contract with point sources. This makes the point source (the buyer) responsible for enforcing the contract. Many point sources would rather reduce their liability and pay for expensive upgrades that are under their control than leave themselves dependent on the performance of a third party from whom they have purchased credits. Some mechanisms to address this liability issue include (1) marketable insurance fund or program to back up the credits; (2) regulated credit trading banks that guarantee credit availability over a 20- to 30-year time period at a fixed cost; (3) private unregulated aggregators and private entities that purchase credits for the purpose of re-sale to interested buyers (aggregators generally purchase large quantities of credits from nonpoint sources, and they are usually able to accept and manage the risks inherent in the water quality market).

Conclusions

Public policy goals such as improving water quality will impose costs on people and businesses within the watershed. A water quality credit trading system offers a way to minimize compliance costs across the region. This document reviews the basic components of a water quality credit trading program and discusses the opportunities and challenges associated with such a program.

Additional Information

You can learn more about water quality credit trading from the following online resources:

- Free U.S. EPA audio-video seminar at http://www.cluin.org/conf/tio/owWQTrading_121405/
- U.S. EPA (2004) *Water Quality Trading Assessment Handbook* (EPA 841-B-04-001, November) at http://www.epa.gov/owow/watershed/trading/handbook/
- U.S. EPA (2009) *Water Quality Trading* at http://www.epa.gov/owow/watershed/trading.htm
- U.S. EPA (2008) *Report: EPA Water Quality Trading Evaluation* at http://web.epa.ohio.gov/dsw/WQ_trading/usepa_wqt_evaluation_report_10-08.pdf
- Marc Ribaudo (2008) Summary, *Agriculture and Water Quality Trading: Exploring the Possibilities* at http://www.ers.usda.gov/AmberWaves/March09/Findings/AgWaterQuality.htm
- Conservation Technology Information Center (2006) *Getting Paid for Stewardship: An Agricultural Community Water Quality Trading Guide* at http://www.conservationinformation.org/?action=learningcenter_publications_waterqualitytrading

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Glossary

- **Basin Management Action Plan (BMAP)**: BMAP summarizes pollution reduction strategies (such as permit limits on wastewater facilities, and urban and agricultural best management practices) for restoring impaired waters and meeting the allowable loadings established in a Total Maximum Daily Load (TMDL) (FDEP 2009)

- **Best Available Technology (BAT)**: Best Available Technology Economically Achievable (BAT) is "the best available economically achievable performance of plants" (U.S. EPA 2009b). BAT is based on "the cost of achieving BAT effluent reductions; the age of the equipment and facilities involved; the process employed; ... non-water quality environmental impacts, including energy requirements; and other factors as the [US Environmental Protection Agency] EPA Administrator deems appropriate" (U.S. EPA 2009b)

- **Best Management Practice (BMP)**: "Agricultural BMPs are practical, cost-effective actions that agricultural producers can take to reduce the amount of pesticides, fertilizers, animal waste, and other pollutants entering our water resources" (FDACS 2004).

- **National Pollution Discharge Elimination System (NPDES) permits**: The National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources (i.e., sources that discharge through a pipe or a well-defined discharge point). "[I]ndustrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. In most cases, the NPDES permit program is administered by authorized states " (US. EPA 2009c).

- **Nonpoint Sources (NPS)**: NPS are diffuse sources, and "NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and underground sources of drinking water. These pollutants include excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas; oil, grease, and toxic chemicals from urban runoff and energy production; sediment from improperly managed construction sites, crop and forest lands, and eroding stream banks; salt from irrigation practices and acid drainage from abandoned mines; bacteria and nutrients from livestock, pet wastes, and faulty septic systems; atmospheric deposition; and hydromodification" (U.S. EPA 2008b).

- **Point Sources**: "Point sources are discrete conveyances such as pipes or manmade ditches" (U.S. EPA 2009c).

- **Total Maximum Daily Load (TMDL)**: "A Total Maximum Daily Load, or TMDL, is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards" (U.S. EPA 2009d).

- **Transaction Costs**: The costs of finding and contacting trading partner, negotiating and completing the trade, and monitoring end enforcing the contract. For in-depth discussion see McCann et al. (2005).

Table 1. No trading allowed.

Municipal Wastewater Treatment Plant (MWTP)	**Livestock Farmer (LF)**
$30 to remove one unit of P from the discharge using best available technology (BAT) (BAT Example: An enhanced biological phosphorus removal system)	$20 to remove one unit of P from the discharge using best management practices (BMP) (BMP Example: Establish a forested riparian buffer adjacent to a stream)
Environmental Goal: Reduce P discharge into the water by two units. Since there is no trading, each entity must reduce its individual discharge by one unit.	
Total cost to achieve environmental goal: $50 = (MWTP) (1 x $30) + (LF) (1 x $20)	
Cost incurred by the sources: MWTP: $30 x 1 unit = $30 LF: $20 x 1 unit = $20	

Table 2. Trading allowed.

Municipal Wastewater Treatment Plant (MWTP)	**Livestock Farmer (LF)**
$30 to remove one unit of P from the discharge using best available technology (BAT)	$20 to remove one unit of P from the discharge using best management practices (BMP)
LF sells one credit to MWPT for $25 and reduces P by two units.	
Total cost to achieve environmental goal: $40 = (LF) (2 x $20)	
Cost incurred by the sources: MWTP: $30 x 0 unit + $25 (credit price) = $25 LF: $20 x 2 units – $25 (credit price) = $15	