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How Baywide Nutrient Trading Could Benefit Virginia Farms

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SUMMARY

The largest estuary in the United States, the Chesapeake Bay is a vital economic, cultural, and ecological resource for the region and the nation. Excess runoff and discharges of nutrients—particularly nitrogen and phosphorus—from farms, pavement, wastewater treatment plants (WWTPs), and other sources is responsible for creating excess algal growth that degrades water quality and harms the ecology of the bay.

Congress is considering proposals to improve the health of the Chesapeake Bay Watershed. The "Chesapeake Clean Water and Ecosystem Restoration Act of 2009" (S. 1816, H.R. 3852) would provide significant new resources and tools to help restore the bay, including a baywide (interstate and inter-basin) nutrient trading program. Nutrient trading provides a cost-effective market-based mechanism for accelerating achievement of the upcoming baywide clean-up goals. With nutrient trading, entities that are able to reduce runoff of nutrients such as nitrogen below target levels are able to sell their surplus reductions as "credits" to entities facing higher nutrient reduction costs.

Agricultural sources typically have lower nutrient reduction costs per pound than other sources of nutrients such as wastewater treatment plants and municipal stormwater systems.[1] This cost advantage opens a window of economic opportunity for farms—selling nutrient credits to sources facing more expensive nutrient control options.

The combination of existing government agricultural best management practice cost-share programs and the proposed baywide nutrient trading market could yield benefits to Virginia farms. First, existing government cost-share programs and conservation payments could cover many of the costs associated with practices that are required before trading can occur.

Second, nutrient trading could be a source of new revenue and profit for many (but not all) farms, with the benefits likely varying among farms based on location, pre-existing implementation of best management practices (BMPs), and other factors. Third, a baywide nutrient trading program could increase demand for credits generated from Virginia farms beyond the demand from a nutrient trading program restricted only to Virginia.

GOVERNMENT COST-SHARE FUNDS COULD HELP FARMS MEET BASELINE REQUIREMENTS

Existing trading programs in Pennsylvania, Maryland, and Virginia have established "baseline" requirements for best management practices that must be implemented before trading can occur. Baseline definitions vary by state, but all are designed to approximate an individual farm's share of the state's Agricultural Tributary Strategy goals to restore the Chesapeake Bay. In Virginia, baseline requirements are defined as the implementation of four BMPs and achievement of one performance standard. The Virginia baseline requirements for all farms are to:

- Develop and implement a state-certified nutrient management plan;
- Plant cover crops (for cropland only);
- Install 35-foot riparian buffers (tree or grass) along streams;
- Exclude livestock from streams (for pastures only); and
- Achieve the soil loss tolerance rate (also known as "T") for all cropland and pasture.

To achieve the soil loss tolerance rate, several practices are available including—but not limited to—no-till and buffer strip cropping on cropland and tree planting on erodible soils on pastures.

Each of the baseline practices that are required in Virginia is eligible for federal and state cost-share funding. Depending on the program and the practice, government cost-share programs typically cover between 50 and 100 percent of the costs to implement BMPs; the most common cost-share rate is 75 percent. In fiscal year 2008, the USDA Natural Resource Conservation Service authorized approximately $94 million for financial and technical assistance programs to help install BMPs in the Chesapeake Bay watershed. Of this amount, approximately $16 million was for Virginia farms.[2] In addition, the Commonwealth of Virginia provided $11 million for agricultural BMPs in the Chesapeake Bay watershed in 2008.[3]

The World Resources Institute (WRI) estimated potential net costs to farms for meeting the baseline requirements in Virginia, taking into account cost-share assistance and conservation payments a farm could receive from participation in Virginia's Agricultural BMP Cost-Share Program (VACS) and the U.S. Department of Agriculture's Conservation Reserve Enhancement Program (CREP). Cost elements include initial capital costs, annual maintenance costs, forgone revenues from production, and transaction costs farms incur to participate in the various programs. For each element, cost estimates were derived from a variety of federal, state, and university sources.[4]

For some practices—such as cover crops, conservation tillage, and nutrient management planning—costs are fairly constant each year. For others, such as forest and grass buffers, most costs are fairly constant each year. Cost-share revenues are typically paid on an annual basis. Because of the disparity in timing of costs, net costs in this analysis are annualized or "spread out evenly" over the typical life of a cropland conversion contract (such as forest buffers), which is 15 years.

Table 1 summarizes annualized net costs per acre for a select group of baseline BMPs that might be used to achieve baseline requirements. Actual costs may be less if a farm is already implementing some or all of Virginia's baseline practices. For example, if a farm has already excluded livestock from streams, then the actual cost of meeting baseline requirements would only include annual maintenance costs and forgone revenues from land taken out of production.

Table 1 | **Government Cost-Share Programs Could Offset Much of the Cost to Meet Virginia's Baseline Requirements**

Practice	Annualized Costs per Acre	Effective Cost-Share	Government Share per Acre	Farmer Share per Acre
Nutrient management plan	$8	75%	$6	$2
T-continuous no till	$27	75%	$20	$7
Cover crops	$30	90%	$27	$3
T-buffer strip cropping	$42	75%	$31	$11
Animal exclusion	$151	75%	$113	$38
Riparian buffers (grass)	$182	75%	$136	$46
T-tree planting on erodible soils	$214	75%	$162	$52
Riparian buffers (tree)	$214	75%	$162	$52

Sources: Practice costs based on studies reported in note 4. Effective cost-share rates are generalized estimates that take into account various federal and state programs and various rates applicable to capital, maintenance, and land rental cost components.

NUTRIENT TRADING COULD GENERATE NEW REVENUE AND PROFIT FOR FARMS

Once a farm meets and maintains Virginia's baseline requirements, it is eligible to generate nutrient credits by implementing additional nutrient reduction practices. These credits could then be sold in a nutrient trading market and generate revenue for the farm. To estimate the potential benefits, WRI analyzed the economics of nutrient trading for farms of different types and locations in Virginia, assuming the same (or similar) baseline requirements currently required for Virginia's nutrient trading program would also be required for participation in a baywide program. The analysis utilized a farm profit calculator that considers potential economic impacts to farms from a long-term investment perspective. The analysis only considers the incremental effects of participation in nutrient trading markets. As such, the analysis does not include profits from the agricultural operation of the farm as a whole.

First, the analysis estimated the potential revenue to farms from selling nitrogen credits. Practices vary in terms of how many credits they can generate and how much land the practices require. Note that Virginia's trading policy does not allow farms to receive government cost-share funding for implementing credit-generating practices. In addition, practices to generate credits must be separate and distinct from practices used to meet and maintain baseline requirements. Thus, a farm that switches from "regular" cover crops to meet baseline requirements to "early planted" cover crops to generate credits will only receive credits for the difference in nutrient reduction between the two practices. Likewise, buffers implemented to generate nutrient credits must be additional to the buffers that are required to meet baseline requirements.

Table 2 summarizes the potential credits and credit revenue on a single-practice basis that could be generated on a 200-acre farm using statewide average nutrient reduction factors. This farm size, 200 acres, approximates the Virginia state-wide average of 171 acres.[5] Annual revenue estimates reflect an assumed credit price of $20 per pound of nitrogen (lb/ N) in a mature baywide nutrient trading market. This credit price reflects a WRI scenario analysis indicating that $20/lb N may be an average minimum credit price farms would be willing to accept for selling credits.[6] Depending on relative demand and supply, credit prices in a mature market could be higher given the higher nutrient reduction costs faced by stormwater systems and some wastewater treatment plants.

Table 2 | **Potential Gross Revenues from Single Practices to Generate Nutrient Credits in Virginia**

Credit Generating Options (After Meeting Baseline)	Nitrogen Reduction (lbs/ac/yr)	Single Practice Acres on 200 Acre Farm	Potential Credits per Year	Annual Gross Revenues at $20/lb
Early plant cover crops	0.83	196	163	$3,260
Pasture conversion to conservation cover	3.13	5	16	$320
Pasture conversion to forest buffer (upland)	3.53	3	11	$220
Crop conversion to conservation cover	5.79	3	17	$340
Crop conversion to forest buffer (upland)	9.02	3	27	$540
Restored wetland	38.12	5	191	$3,820

Note: Nutrient reduction factors are statewide averages for each practice published in Virginia's nutrient trading manual. Practices that could be implemented in concentrated animal production areas are not addressed in the manual, and so the list of practices here only considers those applicable to crop or pasture production areas.
Source: Nutrient Net, 2010. Figures may not add up precisely due to rounding.

The application of uncertainty, reserve, and retirement ratios would affect the economics of nutrient trading under both individual state programs and a baywide program. The potential impact of trading ratios on this Virginia farm analysis is discussed following presentation of model results.

Next, the analysis estimated the net effect of costs associated with meeting baseline requirements and generating credits, the revenues from government cost-share funds to maintain baseline requirements, and the revenues from credit sales. Cost elements for credit-generating practices include capital costs, annual maintenance costs, forgone revenues from production, and transaction costs farms incur to participate in credit trading markets.

The net impact for two farm scenarios is illustrated by Figures 1 and 2. Figure 1 summarizes the net impact of meeting baseline requirements and then generating credits for 200 acres of pasture in the Potomac-Shenandoah River Basin with an assumed credit price of $20/lb N.

Figure 2 summarizes the net economic benefits of meeting baseline requirements and then generating credits on a farm with 200 acres of cropland in the Potomac-Shenandoah Basin, also with an assumed credit price of $20/lb N. Both scenarios assume the farm has not already implemented any baseline practices; that is, the farm is starting "from scratch." Since most farms in Virginia have already implemented one or more of these baseline practices, this analysis represents the most conservative cost estimate. The analysis is not necessarily scalable, since as farm size increases, the acreage of certain practices such as constructing wetlands would not necessarily increase at the same rate.

POTENTIAL BENEFITS TO FARMS WILL DEPEND ON MANY FACTORS

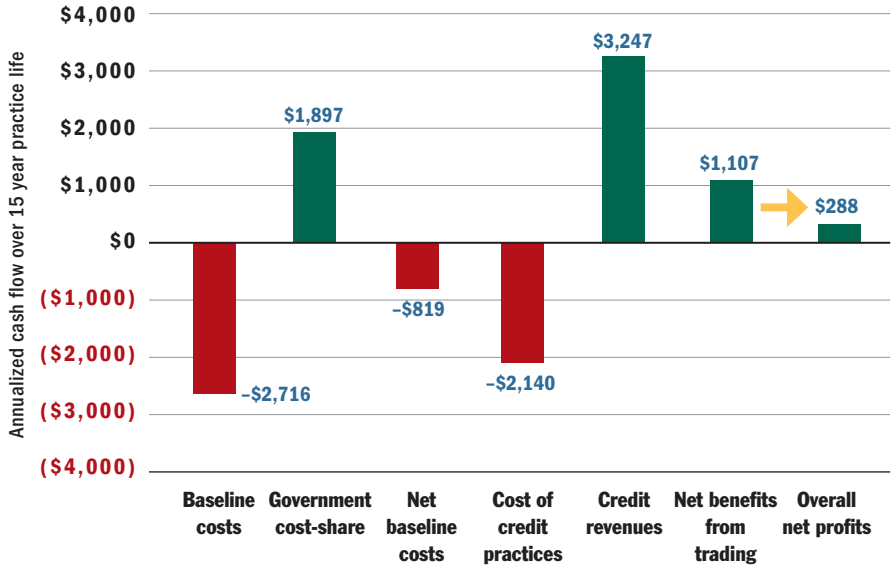
Farms in Virginia will experience different potential economic benefits of nutrient trading depending on a variety of factors, including:

Current On-Farm Practices. The cost and time required to get to baseline requirements on average will be less if the farm has already implemented some or all baseline practices as opposed to starting "from scratch." Thus, net economic benefits would be higher for farms who are already on their way to achieving baseline requirements. For example, over a range of 200-acre farm scenarios considered by WRI in each Virginia basin, farm profits would likely increase by $500 to $2,500 if farms have already achieved 50 percent of their required baseline practices. Indeed, many farms in Virginia and around the bay have already implemented conservation practices.

Figure 1 | **Potential Economic Benefit of Nutrient Trading to a Farm with 200 Acres of Pasture in the Potomac-Shenandoah River Basin**

Key assumptions
(practice acres):

- Credit price: $20/lb N.
- Practices to meet baseline include riparian buffer (3.4), nutrient plan (197), livestock exclusion (3.4), and tree planting on erodible soils to meet "T" (1).
- Credit-generating practices include upland forest buffer (3), conservation cover (3), and wetland restoration (5).

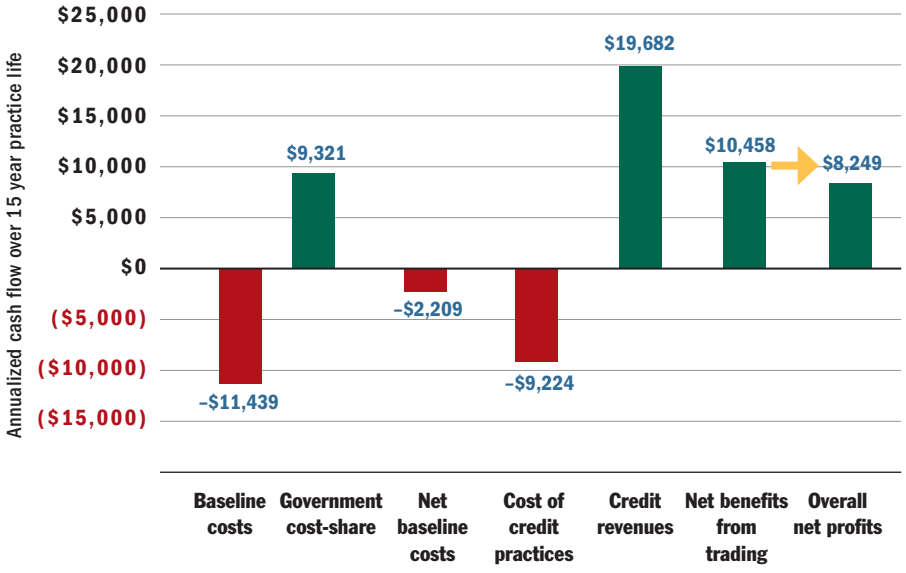


Source: WRI analysis.

Figure 2 | **Potential Economic Benefit of Nutrient Trading to a Farm with 200 Acres of Cropland in the Potomac-Shenandoah River Basin**

Key assumptions
(practice acres):

- Credit price: $20/lb N.
- Practices to meet baseline include cover crops (197), riparian buffer (3.4), nutrient management plan (197), and conservation tillage (197) plus buffer strip cropping (10) to meet "T".
- Credit-generating practices include early planting of cover crops (186), upland forest buffer (3), conservation cover (3), 15% nutrient reduction (186), and wetland restoration (5).



Source: WRI analysis.

Location. The amount of nitrogen reduced by BMPs will vary by farm location due to differences in proximity to the bay, soil hydrology, and other factors. Thus, economic benefits of trading will vary between river basins and within river basins. Generally, farms located closer to the bay have greater nitrogen reduction potential than farms further from the bay.

Type of farm. Crop- and pasture-based operations have different suites of credit-generating practices that may apply. For example, reducing fertilizer use is only applicable to cropland, while animal exclusion zones are generally only relevant to pastures. Crop and pasture-based operations also have different nutrient reduction factors. In general, pasture operations have fewer credit generating options, lower nutrient reduction factors, and more limited revenue potential than similar sized crop farms in the same watershed.

Cost-share funding availability. Availability or use of cost-share funding for achieving baseline requirements will impact the economics, as well. The scenarios in this analysis are based on average effective cost-share rates of 75 to 90 percent (Table 1).[7] If cost-share availability or use were to be capped at lower rates, net economic benefits to farms would decline. Therefore, having adequately funded government agricultural conservation cost-share programs is an important complement to nutrient trading markets and is important for achieving bay restoration goals, irrespective of trading.

Credit price. Credit price will have a significant impact on the profitability of nutrient trading to farms, with higher credit prices driving higher net profit.

Trading ratios. Trading ratios are another factor that will affect the costs and benefits to farms participating in the trading program. Trading ratios are factors used to adjust nutrient credits in order to account for factors such as uncertainty, overall environmental benefits, and risk. Trading ratio policies in the existing state-level programs vary widely. For instance, Pennsylvania and West Virginia require a 10 percent and 20 percent reserve ratio respectively to hedge against risk related to BMP failure. Maryland has a 10 percent retirement ratio to ensure an overall water quality benefit, and Virginia has a 2:1 trading ratio for point-to-nonpoint-source trades to account for uncertainty (that is, buyers must purchase 2 credits for every pound of nutrient offset needed).

While an interstate program would allow existing state programs to continue operating in their current form, it is likely that policy makers would choose to harmonize some aspects of the state trading programs in the context of a baywide trading program. Trading ratios are likely to be re-examined because they have the potential to create comparative advantages for buyers and sellers in states with low trading ratios and comparative disadvantages for buyers and sellers in states with high trading ratios. For this reason, the analysis does not model the impact of existing trading ratios. Instead, we simply assume that a pound of nutrient reduction equals one nutrient credit available for sale or purchase.

A BAYWIDE NUTRIENT TRADING PROGRAM COULD INCREASE DEMAND FOR CREDITS FROM VIRGINIA FARMS

The Chesapeake Clean Water and Ecosystem Restoration Act of 2009 would establish a baywide nutrient trading program, thereby allowing generators of nutrient credits to sell credits to buyers throughout the Chesapeake Bay watershed.

In summary, a baywide nutrient trading market—combined with other programs—has the potential to benefit Virginia farms. Existing government agricultural conservation cost-share programs could cover many of the costs associated with meeting baseline requirements. Nutrient trading could be a source of new revenue and profit for many (but not all) farms. Baywide nutrient trading could increase demand for credits generated from Virginia farms beyond the demand a Virginia-only trading market could generate.

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NOTES AND SOURCES

1. For details, see World Resources Institute. 2010. *How Nutrient Trading Could Help Restore the Chesapeake Bay*. Working paper. Washington, DC: World Resources Institute. Online at: www.wri.org; Chesapeake Bay Commission. 2004. *Cost-effective Strategies for the Bay: 6 Smart Investments for Nutrient and Sediment Reduction*. Annapolis, MD: Chesapeake Bay Commission; Office of Inspector Generals of the United States Environmental Protection Agency and the United States Department of Agriculture. 2006. "Saving the Chesapeake Bay Watershed Requires Better Coordination of Environmental and Agricultural Resources." Available online at http://www.epa.gov/oig/reports/2007/20061120-2007-P-00004.pdf.
2. U.S. Department of Agriculture Natural Resources Conservation Service. 2009. "Conserving Natural Resources in the Chesapeake Bay." Available online at http://www.nrcs.usda.gov/news/pdf/chesapeake_bay_regional_accomplishments_report_2008.pdf. Funding estimate includes spending from the following programs: Agricultural Management Assistance, Conservation Reserve Program, Conservation Security Program, Conservation Technical Assistance, Environmental Quality Incentives Program, Farm and Ranchlands Protection Program, Wildlife Habitat Incentives Program, and Wetlands Reserve Program.
3. Chesapeake Bay Foundation. (Beth McGee, Senior Regional Water Quality Scientist, personal communication, November 30, 2009). Estimate of FY2009 state agricultural best management practice cost-share spending within the Chesapeake Bay watershed.
4. Sources include: Commonwealth of Virginia. 2005. "Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy;" Natural Resource Conservation Service. 2009. "Average Cost Estimates for Conservation Practices for FY2010: Average Cost/ Unit and Estimated Total Costs;" Commonwealth of Virginia. 2008. *Agricultural BMP Cost Share Manual*; University of Delaware, Christina Basin Tributary Action Team. 2006. *Agriculture BMP Cost Calculations Handbook*; Wieland, Robert, Doug Parker, Will Gans, and Andrew Martin. 2009. *Costs and Cost Efficiencies for Some Nutrient Reduction Practices in Maryland*.
5. Virginia state-wide average farm size is 171 acres (USDA Census 2009). This size is representative of farms within Virginia's Chesapeake Bay watershed (Gary Moore, Virginia Department of Conservation and Recreation's Agricultural Incentives Program Manager, personal communication, January 15, 2010).
6. $20/lb N is based on annualized implementation, operations and maintenance, and opportunity costs for four agricultural practices that are implemented after a farm's baseline has been met. This estimate reflects the average of these costs and practices across five bay states. WRI acknowledges that credit prices for recent nitrogen trades between WWTPs and farms in Pennsylvania's nascent state trading program were in the range of $8/lb N. However, the Pennsylvania market is a pre-TMDL market whereas WRI is modeling future mature market prices after a TMDL is in place. A baywide TMDL would require higher baseline requirements, raising costs for WWTPs and MS4s, which will likely drive demand for nonpoint source credits. For additional details, see World Resources Institute. 2010. *How Nutrient Trading Could Help Restore the Chesapeake Bay*. Working paper. Washington, DC: World Resources Institute. Online at www.wri.org.
7. 90 percent for cover crops.