WORKING PAPER

WORLD RESOURCES INSTITUTE

How Baywide Nutrient Trading Could Benefit Maryland Farms

JOHN TALBERTH, CY JONES, MICHELLE PEREZ, MINDY SELMAN, EVAN BRANOSKY

Suggested citation: Talberth, John, et al. 2010. "How Baywide Nutrient Trading Could Benefit Maryland Farms." WRI Working Paper. World Resources Institute, Washington, DC.

CONTENTS

June 2010

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 Maryland 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 Maryland farms beyond the demand from a nutrient trading program restricted only to Maryland.

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.

Maryland's Point Source-Nonpoint Source Trading Policy establishes a nutrient runoff performance standard as its baseline requirement for all farms interested in trading.[2] The performance standard is expressed as the per acre phosphorus and nitrogen loads that must be achieved for a farm to meet its individual share of the Agricultural Tributary Strategy goal.

In order to meet this baseline requirement, farms will generally have to implement a suite of BMPs that reduce nutrient runoff from their farms. The number and type of BMPs that a farm installs to meet and maintain its baseline will depend on current on-farm management, location within the watershed, and the current level of BMP implementation.

Maryland also requires farms interested in trading to implement both a nutrient management plan and an updated soil conservation and water quality plan, and to be compliant with any applicable federal and state regulations in order to qualify to generate credits. The nutrient reductions generated by these plans are counted toward the farm's nutrient runoff performance standard.

Many of the BMPs that farms are likely to use to achieve Maryland's baseline requirement are 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.[3] 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 $27 million was for Maryland farms.[4] In addition, the state of Maryland provided approximately $14 million to implement agricultural BMPs in 2008.[5]

The World Resources Institute (WRI) estimated potential net costs to farms for meeting the baseline in Maryland, taking into account cost-share assistance and conservation payments a farm could receive from participation in Maryland's Agricultural BMP Cost-Share Program (MACS), the U.S. Department of Agriculture's Conservation Reserve Enhancement Program (CREP), and a variety of other programs. 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.[6]

For some practices-such as cover crops, no-till, buffer strip-cropping, and nutrient management planning-costs are fairly constant each year. For others, such as riparian buffers, most costs are incurred once up front and again when re-installment is necessary. 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 BMPs that might be used to achieve the baseline. Except for the nutrient management plan and the soil

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

Potential Practices to Achieve Maryland's Baseline Requirements	Annualized Costs per Acre	Effective Cost-Share	Government Share per Acre	Farmer Share per Acre
Nutrient management plan	$11	58%	$7	$4
Manure export	$15	90%	$13	$2
Conservation tillage	$22	84%	$18	$4
Soil and water conservation plan – contour strip cropping	$27	75%	$20	$7
Cover crops	$52	72%	$37	$15
Grass buffer	$213	88%	$186	$27
Forest buffer	$268	88%	$235	$33

Sources: Practice costs based on studies reported in note 6. 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.

conservation and water quality plan Maryland does not prescribe specific types of practices for meeting the baseline; instead, a farm is free to choose the BMPs that make the most sense for it, as long as they cumulatively result in achieving the baseline nutrient runoff performance standard.

NUTRIENT TRADING COULD GENERATE NEW REVENUE AND PROFIT FOR FARMS

Once a farm meets and maintains Maryland'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 Maryland. 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 Maryland'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. Thus, a farm that switches from "regular" cover crops to meet baseline 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.

Table 2 summarizes the potential credits and credit revenue on a single-practice basis that could be generated on a 200-acre farm using nutrient reduction factors[7] from the Upper Potomac Basin. This farm size, 200 acres, approximates the Maryland state-wide average of 160 acres.[8] 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.[9] 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.

Next, the analysis estimated the net effect of costs associated with meeting baseline requirements and generating

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

Credit Generating Practice (after meeting baseline)	N-Reduction (lbs/ac/yr)	Acres on Typical Farm	Potential Credits	Annual Gross Revenues at $20/lb
Early plant cover crops	0.29	100	29	$580
Crop to conservation cover	5.00	1	5	$100
Nitrogen reduction (15%) on crops	5.87	185	1,086	$21,719
Grass buffer	53.00	1	53	$1,060
Wetland restoration	56.00	5	280	$5,600
Forest buffer	75.00	3	225	$4,500

Note: Nutrient reduction factors are from a sample in the Upper Potomac Basin.
Source: Nutrient Net, 2010.

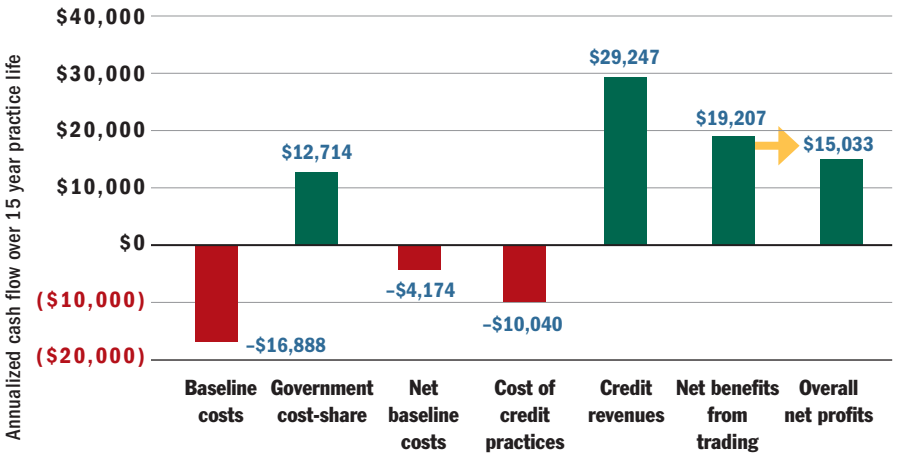
credits, the revenues from government cost-share funds to maintain baseline requirements, and the revenues from credit sales. Cost elements for credit-generating practices include capital costs, annual maintenance costs, forgone revenues from production, and transaction costs farms incur to participate 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 a 200-acre poultry and crop farm in the Lower Eastern Shore Basin using poultry manure and commercial fertilizer and with an assumed credit price of $20/lb N. The analysis is limited to the farm's crop production area since Maryland is still developing its approach for the animal production portion of such farms.

Figure 1 | **Potential Economic Benefits of Baywide Nutrient Trading to a Crop and Poultry Farm with 200 Acres in the Lower Eastern Shore Basin**

Key assumptions
(practice acres):

- Credit price: $20/lb N.
- Practices to meet baseline include cover crops (196), nutrient management plan (196), conservation tillage (196), soil and water conservation plan – buffer strip cropping (10), manure export (196 tons) and forest buffer (4).
- Credit-generating practices include extended forest buffer (3), early plant cover crops (100), conversion to mixed open space (3), 15% fertilizer reduction (185), and wetland restoration (5).
- Cost share at existing program rates.

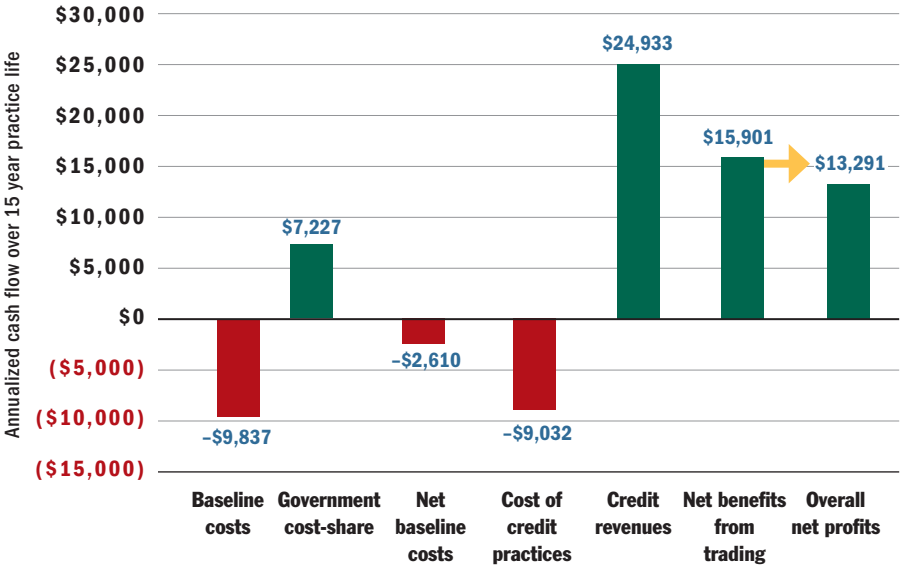


Source: WRI analysis.

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

Figure 2 summarizes the net economic benefits of meeting baseline requirements and then generating credits on a farm with 200 acres of cropland using only commercial fertilizer in the Upper Potomac Basin, also with an assumed credit price of $20/lb N. The scenarios reflect the varying degrees of effort needed to achieve baseline requirements depending on current on-farm practices.

Both scenarios assume the farm has not already implemented any baseline practices; that is, the farm is starting "from scratch." Since most farms in Maryland already implement 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.

In an expanded baywide nutrient trading program it is possible that existing federal and state cost-share programs will face significant new demands from farms. This may have an impact on the availability of cost-share funds. To account for this, WRI modeled the effects of a cost-share cap of 50 percent for baseline BMP practices. Figures 3 and 4 show the results.

POTENTIAL BENEFITS TO FARMS WILL DEPEND ON MANY FACTORS

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

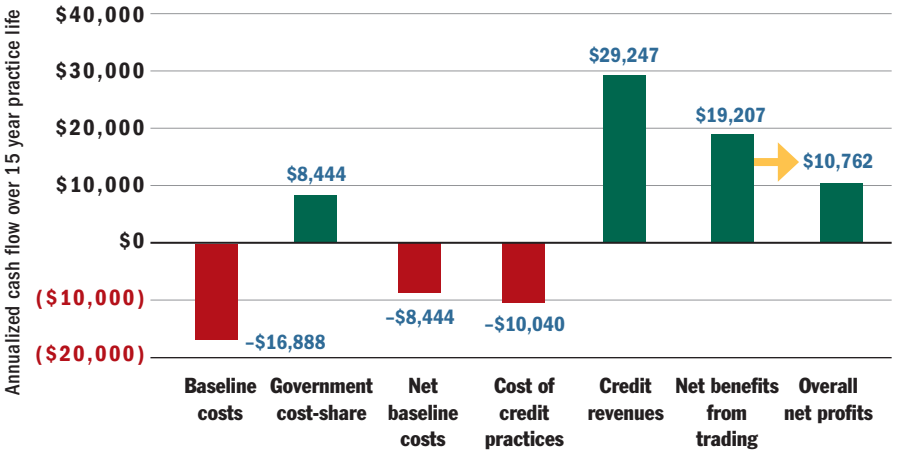
Location. The amount of nitrogen reduced by BMPs will vary by farm location due to differences in proximity to the bay, soil hydrology, and other factors. Thus, economic benefits of trading will vary between and within river basins. Generally, farms located closer to the bay have greater nitrogen reduction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

Figure 3 | **Potential Economic Benefit of a Baywide Nutrient Trading Program to a Crop and Poultry Farm with 200 Acres in the Lower Eastern Shore Basin (50% cost-share cap)**

Key assumptions
(practice acres):

- Credit price: $20/lb N.
- Practices to meet baseline include cover crops (196), nutrient management plan (196), conservation tillage (196), soil and water conservation plan — buffer strip cropping (10), manure export (196) and forest buffer (4).
- Credit-generating practices include extended forest buffer (3), early plant cover crops (100), conversion to mixed open space (3), 15% fertilizer reduction (185), and wetland restoration (5).
- Cost share capped at 50%.

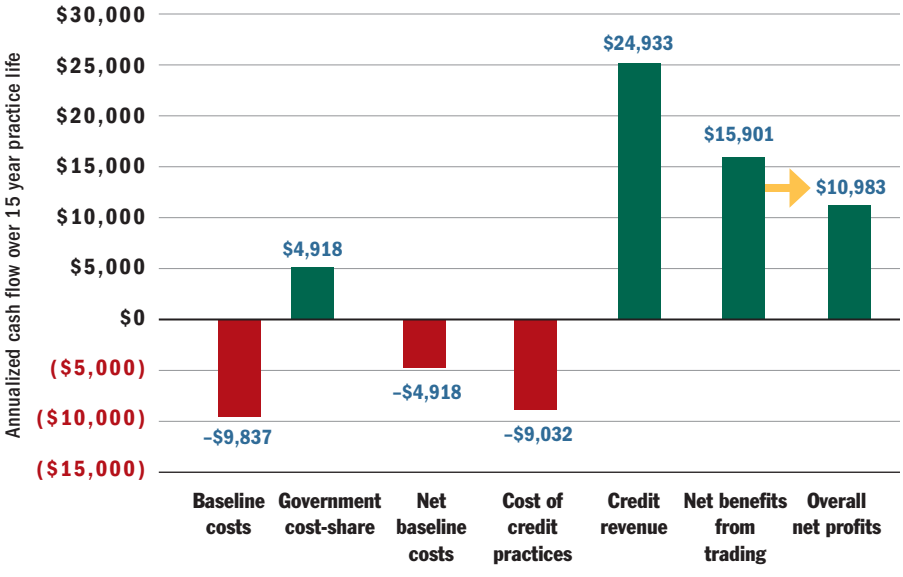


Source: WRI analysis.

Figure 4 | **Potential Economic Benefit of a Baywide Nutrient Trading Program to a Farm with 200 Acres of Cropland in the Upper Potomac Basin (50% cost-share cap)**

Key assumptions
(practice acres):

- Credit price: $20/lb N.
- Practices to meet baseline include cover crops (105), nutrient management plan (196), conservation tillage (196), soil and water conservation plan — buffer strip cropping (10).
- Credit-generating practices include forest buffer (1), grass buffer (1), early plant cover crops (88), 15% fertilizer reduction (193), and wetland restoration (5).
- Cost share capped at 50%.



Source: WRI analysis.

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.

Current On-Farm Practices. The cost and time required to get to baseline for a particular farm will depend heavily on current on-farm practices, including crop types, application rates, incorporation methods, type of fertilizer used (commercial/organic), and current best management practices that are implemented on the farm. Farms that are already implementing BMPs will have lower nitrogen baselines loads and associated costs than farms that have not implemented any BMPs and are "starting from scratch." Many farms in Maryland and around the bay have already implemented conservation practices.

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 existing programs, which range between 50 and 90 percent (Table 1). If cost-share availability or use were to be capped at lower levels, net economic benefits to farms would decline (Figures 3 and 4). 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 MARYLAND 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 Maryland 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 Maryland farms beyond the demand a Maryland-only trading market could generate.

ACKNOWLEDGMENTS

WRI thanks the following for their generous financial support of this working paper: Linden Trust for Conservation, David and Lucile Packard Foundation, Red Crane Foundation, and David Blood.

WRI thanks the following for reviewing and providing constructive suggestions on the farm profit calculator model, which underpins the economic analysis in this paper: Roger Claassen (USDA Economic Research Service), Marc Ribaudo (USDA Economic Research Service), and Kurt Stephenson (Virginia Tech).

WRI thanks the following for their review and comments on this working paper's text: Jimmy Daukas (American Farmland Trust); Vasco Bilbao-Bastida and Roger Ullman (Linden Trust for Conservation); Polly Ghazi, Craig Hanson, Alexia Kelly, Janet Ranganathan, and Lydia Weiss (WRI); Jim Lyons (Yale School of Forestry and Environmental Studies); and Beth McGee (Chesapeake Bay Foundation).

Financial contributions and/or reviews do not constitute acceptance or endorsement of WRI's findings. The authors are solely responsible for any omissions or errors.

NOTES AND SOURCES

1. For details, see Jones, Cy, et al. 2010. "How Nutrient Trading Could Help Restore the Chesapeake Bay." WRI Working Paper. World Resources Institute. Washington DC. 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. Maryland Department of Agriculture, 2008. "Maryland Policy for Nutrient Cap Management and Trading in Maryland's Chesapeake Bay Watershed. Phase II-A Guidelines for the Generation of Agricultural Non-Point Nutrient Credits."
3. University of Maryland, Environmental Finance Center (EFC). "Agriculture Tributary Strategy Reductions and Associated Costs." Available online at: http://www.efc.umd.edu/pdf/AgAppendix1.pdf.
4. 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.
5. Maryland Department of Agriculture Office of Resource Conservation. 2010. "Maryland Agricultural Water Quality Cost-Share (MACS) Program 2009 Annual Report." Annapolis, MD. Available online at: http://www.mda.state.md.us/pdf/macsar09.pdf
6. Costs represent annualized costs taking into account capital, maintenance, land, and transaction costs. Sources include: Maryland Department of Natural Resources. 2004. "2004 Tributary Strategy Executive Summary;" 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;" 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*; University of Maryland Environmental Finance Center (EFC). "Agriculture Tributary Strategy Reductions and Associated Costs." Available online at: http://www.efc.umd.edu/pdf/AgAppendix1.pdf.
7. Nutrient reduction factors represent the pounds of nitrogen per acre reduced for each best management practice based on location of the farm.
8. Maryland statewide average farm size is 160 acres (USDA Census 2009).
9. $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 Jones, Cy, et al. 2010. "How Nutrient Trading Could Help Restore the Chesapeake Bay." WRI Working Paper. World Resources Institute. Washington DC. Online at www.wri.org.

ABOUT THE AUTHORS

John Talberth is a Senior Economist in the People and Ecosystems Program at WRI. Contact: jtalberth@wri.org.

Cy Jones is a Senior Associate in the People Ecosystems Program at WRI. In this capacity, he directs the water quality team. Contact: cjones@wri.org.

Michelle Perez is a Senior Associate in the People and Ecosystems Program at WRI.

Mindy Selman is a Senior Associate in the People and Ecosystems Program at WRI.

Evan Branosky is a Research Analyst in the People and Ecosystems Program at WRI.

ABOUT WRI

The World Resources Institute is an environmental think tank that goes beyond research to find practical ways to protect the earth and improve people's lives. Our mission is to move human society to live in ways that protect Earth's environment for current and future generations.