Economic Fundamentals of Nutrient Trading

David Newburn

Department of Agricultural & Resource Economics

University of Maryland
Estimated costs of TMDL compliance in Maryland

• **Watershed implementation plans (WIPs)**
  – MDE estimates that compliance with total maximum daily load (TMDL) in 2025 will cost $14.4 billion in Maryland
  – Urban stormwater management = $7.4 billion
    • Local government covers the majority of this expense
  – Municipal wastewater treatment = $2.4 billion
  – Septic systems = $3.7 billion
  – Agriculture = $0.9 billion
Variation in abatement cost per pound N

Source: Brainard, Chesapeake Bay Quarterly; World Resources Institute
Urban stormwater BMPs

- Bioretention pond
- Bioswale
- Green roof
- Permeable pavement
Agricultural best management practices (BMPs)

Cover crops

Conservation tillage
Regulated sources

• **Clean Water Act (CWA)**
  – Focus mainly on point sources (PS) that discharge from pipe
    • Wastewater treatment plants (WWTPs)
    • Municipal separate stormwater sewer systems (MS4s) starting in 1987
  – National Pollution Discharge Elimination System
    • NPDES permits set regulated baseline for each entity

• **Pollution standards do not allow flexibility**
  – Each entity must meet the pollution standard
  – Some entities have higher abatement costs than others
Nutrient trading

- **Cost-effectiveness**
  - Lower overall cost of meeting the same environmental goal
  - Variation in abatement costs needed to create potential gains from trading

- **Voluntary participation and flexibility**
  - **Without trading**: Internal options only
  - **With trading**: Combination of internal options or offset credits allowed

- **Incentives**
  - Provides incentives for entities that already meet regulatory baseline to reduce pollution even further and sell offset credits
  - May spur innovative technologies
SO2 trading program

• **Sulfur dioxide (SO2) trading program**
  – Clean Air Act Amendments (1990)
  – Allowed large coal-fired power plants to trade SO2 pollution credits
  – Meet goal to reduce SO2 (and acid rain) at lower cost

• **PS-PS trading**
  – Within sector trading between regulated point sources (PS)
  – Allows trading in time and smooth upgrading schedule

• **Why did SO2 trading program work?**
  – Air emissions mixed broadly (large markets)
  – Easier to monitor and verify emissions at large point sources
  – Lower transaction costs
Cross sector (PS-NPS) trading

Treatment plant (point source)
Farm (non-point source)

Source: Brainard, Chesapeake Bay Quarterly
Example on PS-NPS trading

• **Without trading**
  – Point source (PS): wastewater treatment plant
    • Permit requires annual reduction of 1000 pounds of N
    • Annualized abatement cost = $30 per pound N
  – Total costs **without** trading = $30,000

• **With trading**
  – Assume agriculture adopts best management practice (BMP)
    • Agriculture sells offset credits at annualized cost = $10 per pound N
  – Assume treatment plant uses mixed strategy
    • Internal upgrade costs (50%) = 500 pounds N * $30 per pound = $15,000
    • Purchase offsets (50%) = 500 pounds N * $10 per pound = $5,000
  – Total costs **with** trading = $20,000

• **Potential gains from trading** = $10,000
Agriculture

- **Agricultural best management practices (BMPs)**
  - Cost-share programs to incentivize BMP adoption
    - Federal programs (EQIP, CRP, CREP, CSP)
    - State program (MACS)

- **Baselines for agricultural operations**
  - Agriculture does not require NPDES permit (except CAFOs)
  - Baseline level of pollution load must be achieved before eligible to participate
  - Only reductions below the baseline can be traded as pollution credits

- **Tradeoff setting the baseline**
  - Strict baseline can generate additional reductions that would not occur otherwise but also discourages participation
  - Farmers far from baseline need to adopt more practices at their own costs before being eligible to participate
Market structures

1. Seller farm trading partners found independently
   ![Diagram of market structure 1]

2. Seller farm trading partners found using a broker
   ![Diagram of market structure 2]

3. Aggregators trading conducted through an aggregator
   ![Diagram of market structure 3]

4. Central Exchange trading conducted through a central exchange
   ![Diagram of market structure 4]

Source: Payne, MDA
Market structures

- **Bilateral negotiation**
  - Individual buyers and sellers make contracts
  - Price set through negotiation (like used car market)
    - May likely involve brokers or aggregators

- **Reverse auction**
  - Clearinghouse ranks all bids based on lowest cost per pound nutrient reduction
  - Bidding behavior
    - Higher bid leads to higher payment but lower chance of being awarded funding
  - Cost-effective mechanism to reveal BMP cost
Challenges for nutrient trading

• **Transaction costs**
  – Finding and negotiating with trading partners
  – Monitoring and verification costs

• **Estimating pollution reductions for agricultural BMPs**
  – Average BMP efficiencies calculated based on expert panels and site-specific conditions (soil, slope, management)
  – Actual nutrient reductions may vary from average BMP efficiencies temporally and spatially

• **Liability for buyers**

• **Pollution hotspots**
Trading ratios

• **Safety factor to address uncertainty in load estimates**
  - Example with trading ratio at 2:1
  - 2 credits from seller (agriculture) = 1 credit for buyer (treatment plant)

• **Insurance pool for buyer**
  - NPDES permit requires buyer to be liable if purchased credits from individual agricultural BMP fail
  - Additional credits from high trading ratio creates insurance pool to reduce risk of buyer liability

• **But high trading ratio or strict baseline may reduce market activity**
Trading basins

- Geographic restrictions on trading with the same basin or watershed
  - Trades between sources only in same basin or watershed
  - Reduces pollution hotspots
Why nutrient trading can play role in MD

• **Maryland has large urban sectors**
  – Large cost of compliance with TMDL in urban sectors
  – Urban stormwater management = $7.4 billion
  – Municipal wastewater treatment = $2.4 billion
  – Septic systems = $3.7 billion

• **Population growth in urbanized areas**

• **Significant variation in abatement costs between sectors**
  – Potential gains from trading
Variation in abatement cost per pound N

Source: Brainard, Chesapeake Bay Quarterly; World Resources Institute