Fundamentals of Nutrient Trading
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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
Other trading programs

• **Air quality trading**
  – Sulfur dioxide (SO2) trading program
  – Kyoto protocol for trading CO2 and other greenhouse gases

• **Market-based approaches for land conservation**
  – Transferable development rights (TDR) programs
    • Calvert County
    • Montgomery County
  – Forest mitigation banking
    • Maryland’s Forest Conservation Act (FCA)
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 → Buyer facility
   trading partners found independently

2. Seller farm → Broker → Buyer facility
   trading partners found using a broker

3. Seller farm → Aggregators → Buyer facility
   trading conducted through an aggregator

4. Seller farm → Central Exchange
   trading conducted through a central exchange

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

Western Shore, Eastern Shore and Susquehanna combined into single trading zone.
Delivery ratios

• Accounts for differential delivery to the Bay between two sources located in different river segments
  – Example: Subwatershed A is located farther from the Bay than Subwatershed B, leading to differential loading rate

• Delivery ratio used to assess equivalence between sources
  – 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

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