Lecture # 11 –Policy Instrument Choice: Water

I. Regulating Water

- Compared to air pollution, water quality has received less attention from economists
    - Air pollution health effects are direct and easier to monetize.
        - In contrast, many of the benefits from controlling surface water pollution are for recreation or ecosystem health, rather than human health
    - Drinking water standards have existed for a long time, so less demand for analysis of them.
    - Market-based polices have been used less frequently
- Water policy focuses on two goals:
    - Clean drinking water
        - This is primarily a question about infrastructure
        - Public provision (or regulation) justified by natural monopoly for water provision
    - Regulating ambient water quality regulation
        - When water not directly consumed, low benefits due to human health
            - Rather, benefits relate to recreational use and ecosystem health
        - More significant externalities than drinking water
            - May cross jurisdictions
                - Thus, transboundary issues are a concern

- Federal Clean Water Policy
    - 1965 Water Quality Act required states to set ambient standards for water quality
    - States had primary responsibility until 1972 Water Pollution Control Act Amendments
        - Set a goal of zero discharges by 1985
            - These goals were postponed through later amendments
        - Increased the amount of money for municipal waste treatment plants.
        - Water bodies are classified into potential designated uses
            - Examples include: public water supply; protection and propagation of fish, shellfish, and wildlife; recreation; agricultural; industrial; navigation
            - Goal is to have fishable/swimmable uses
    - Set specific federal standards
        - **Performance**: Used technology based effluent standards (TBES)
        - National Pollutant Discharge Elimination System (NPDES) specifies effluent limits for each pollutant and each point source
        - Based on available control technologies
            - For enforcement, polluters must have a discharge permit issued by an EPA-backed state permitting program.
            - Phase I: EPA determines the "best practicable technology" and sets standards assuming that firms are using that standard.
            - By 1983 (Phase II), firms were to use "best available technology."
                - The 1977 Clean Water Act changed this to "Best Conventional Technology" by 1984
                - Places more emphasis on costs when judging technologies.
        - **Ambient**: states must develop Total Maximum Daily Loads (TMDLs) for water bodies that do not meet certain ambient concentration goals
            - Must identify all point and nonpoint sources polluting the water body
            - Allocate a total daily load among the relevant sources
        - Focuses on point sources, so little attention paid to pollution from agriculture
            - Non-point sources are a big concern. These include:
                - Runoff from agriculture, urban uses, forests, and mines, as well as atmospheric deposition
                - Non-point pollution from agriculture is the primary source of damages in US rivers and streams

- Efficiency of the TBES
    - Early studies suggested significant net benefits, but by 1990, studies showed marginal costs began to exceed marginal benefits
    - Studies find that benefits and costs of water regulations lower than other environmental regulations
        - (Keiser and Shapiro, 2019) review cost-benefit studies of major pollutants
        - For all except surface water, benefits exceed costs.
            - Might these studies underestimate benefits?
                - Non-use values difficult to measure
                - Many studies ignore health benefits
                    - Studies assume treatment plants purify drinking water anyway
    - Why might water standards be inefficient?
        - Standards were uniform for the entire nation
        - Same standards applied to all firms
        - Technology standards lowered the presence of some pollutants, but not others.
        - Chosen technology typically costs 1.5-3 times more than the least cost system available
        - Moreover, by focusing on end-of-pipe solutions, discourages firms from generating less pollution through recycling
        - Little incentive for innovation, since standards are technology based.
    - Allocation of pollution across sources
        - Focuses on point sources, so little attention paid to pollution from agriculture
        - Gains from further reductions at point sources are low
        - 2005 Energy Policy Act exempted fracking from some portions of the Safe Drinking Water Act, but fracking is still subject to the Clean Water Act
    - Surface waters may be more substitutable (e.g. can go fish or swim at another lake)

- The Safe Drinking Water Act (SDWA), passed in 1974, established the first set of federally enforceable standards for drinking water (to be discussed Monday)
    - Before, the Public Health service published standards, but compliance was voluntary.
    - Congress strengthened the SDWA in 1986
        - The EPA now issues standards for 86 contaminants, and has specific treatment requirements,
    - 1996 amendments to the SDWA provide the EPA with more flexibility to consider costs and benefits in setting standards and allow for exceptions for localities that find it costly to meet the standards.
    - Setting the standards
        - The EPA sets maximum contaminant level goals (MCLGs) that are non-enforceable, but represent the level at which no known or anticipated health affects occur.
        - Then, the EPA sets the maximum contaminant level (MCL), which is an enforceable standard set as close to the MCLG as is affordable to large water systems with relatively clean water.
            - Systems serving 10,000 people or less eligible for variances if unable to afford to meet MCLs and health will still be adequately protected.
            - Some variances also allowed for places with very dirty water, if not able to meet standards even with best technology available
            - Considering costs was not allowed until 1996.
            - In practice, variances rarely used.
    - How treatment methods are chosen:
        - Least-cost method varies by system. Factors include:
            - Size of system
            - Initial level of contamination
            - Existing equipment
        - EPA only judges compliance based on whether standards are met. Treatment method does not matter.
        - However, local water systems need state approval for control technology, which often limits the use of less conventional technologies.
            - To help alleviate this problem, the 1996 amendments require the EPA to list feasible and affordable treatment technologies for four sizes of systems, not just large ones. This provides state regulators with more information.

- Example: Per- and Polyfluoroalkyl Substances (PFAS)
    - In April 2024, the EPA announced drinking water standards for six PFAS
        - Public water systems must complete initial monitoring and inform public by 2027
        - Systems in violation must begin treating water by 2029
        - Standards developed in response to new evidence linking "forever chemicals" (PFAS) to health risks, including cancer
            - 2022: EPA found PFAS could cause harm at levels "much lower than previously understood"
            - 2023: PFAS detected in nearly half of US tap water
    - Costs and benefits
        - EPA estimates:
            - $1.5 billion annual benefits
            - $1.5 billion annual compliance costs
        - Utilities argue costs could be twice as high
        - ***Question**:* why are costs so high?
    - Who pays?
        - EPA announced $1 billion in funding to help local governments implement testing and treatment
        - Small systems allowed to test less frequently
- This will lead into a general question about setting drinking water standards. *Should drinking water standards be set at national or local level?*
    - Some issues to consider
        - Does the federal government have additional information for setting standards?
        - How do costs vary across communities? Are uniform standards efficient?
        - Who should pay?
        - What alternatives are available?

II. Instrument Choice for Water Quality Regulation

- Command and control is the dominate instrument for water regulation
- Fisher-Vanden and Olmstead (2013) review 21 active water pollution permit trading programs in place at the time of their article
  - Two categories:
    - Trading programs (13): include multiple recipients and sources
    - Offset programs (8): involve a single recipient of water quality credits from one or multiple sources
      - The offset recipient typically invests directly in the credit-generating projects, rather than buying permits
  - Trading programs
    - Most started since 2000
    - Except for Hunter River program, all trade nutrients (nitrogen and/or phosphorous) or a combination of nutrients and sediment
    - Three market structures
      - Bilateral: participants engage in individual negotiations to arrange trades or offsets
        - Higher transaction costs
          - E.g. Pennsylvania Nutrient Trading program used bilateral and exchange markets. Per-pound transaction costs were twice as high for bilateral trades
      - Clearinghouse: A single broker or intermediary generates credits
        - E.g. in Neuse River, NC program, can buy into a state wetland restoration fund
        - Intermediary may also generate credits that can be purchased by point sources
          - E.g. In Great Miami River program in Ohio, farmers submit BMP applications. A reverse auction is used to fund the cheapest (NOTE: sounds like PA example)
      - Exchange markets: Buyers and sellers trade uniform credits at transparent prices
        - Used in just two programs
- Characteristics of trading programs
  - Participants
    - All but one include a municipal wastewater treatment plant
    - Several also include industrial point sources
    - Non-point sources are almost always agriculture

- The Pennsylvania water trading article is a good example of offsets, and also illustrates these implementation issues
    - The problem: nitrogen from manure and phosphorus from fertilizer lead to algae growth, with blocks sunlight and kills underwater grasses.
        - Because the runoff is a non-point pollutant, it is difficult to track runoff from specific farms.
    - Pollution control options:
        - Farmers can adopt best practice methods (BPM), such as
            - Barriers to contain runoff
            - Planting crops year-round, so that storms don't wash soil away
        - In urban areas, waste from sewage treatment plants can be filtered
    - Pennsylvania has established a trading system where farmers receive credits for adopting BPM
        - The value of the credit is based on a formula that considers the impact of improvement and the distance of the farm from Chesapeake Bay
            - The BPM must be certified by the state to receive credit.
                - This provides uncertainty for farmers.
            - A typical credit is worth \$2 - \$9, and reduces about 1.6 pounds of pollution.
        - Developers need to purchase credits to offset new sewage treatment plants.
            - A 100 house development would require about 700 credits.
                - So far, there has been only one trade between farmers and developers in the first three months.

- Conestoga Reserve Auction
    - Used in Pennsylvania's Conestoga Watershed in 2005 & 2006
    - Rather than the government providing funds to support agricultural best management practices (BMP), farmers sell credits that can be purchased by other regulated polluters
        - Via the reverse auction, they are first sold to individual credit aggregators or credit banks who then sell these to third party polluters
    - How the reverse auction works
        - Rather than bidding to buy, bidding to sell
        - Farmers offer to implement a BMP to reduce phosphorus (P) for a specific price.
        - Projects are ranked on the cost per pound of P reduced.
        - Options for choosing projects
            - Spend a specified budget
                - In this case, the cutoff price determined by the state, which allocated a budget of $490,000
                - Few projects in first auction, so a second auction held to exhaust the budget.
            - Set a break-even price and only select projects below that price
                - Helps to ensure cost-effectiveness, but means there cannot be a time limit on the budget.
    - Results
        - Reverse auction awarded $486,000 to farmers to reduce over 92,000 pounds of phosphorus
        - There was a wide variation in bids
            - Ranged from $2.36/lb-$157.49/lb
        - Auction is useful to help reveal what farmers are willing to accept to implement BMPs
- Minnesota River Basin Trading
    - Began in 2005
    - Minnesota Pollution Control Agency issued a single National Pollutant Discharge Elimination System permit for phosphorous discharges in the Minnesota River
        - Applies to 47 permitted sources (mostly wastewater treatment plants and industrial point sources)
        - Sources can trade – bilateral negotiation
        - Trading rations are applied
        - In 2011, 17 facilities participated in trades

- *Question:* Why is trading used less frequently for water?
    - Physical characteristics of water pollution
        - Damages vary by location
            - Makes trading programs more complicated
        - Trading takes place in specific watersheds
            - Thus, the scope of many programs is small
        - Non-point pollution difficult to measure
    - Because not all runoff would have reach the monitored source, trading ratios are typically not 1:1
        - Point sources must reduce more than one unit of non-point pollution to receive a credit
        - However, this reduces demand
    - Implied rights to pollute under current regulation
        - Agricultural non-point sources are excluded from water regulation
        - Thus, they must be offered incentives to participate
            - Even then, many farmers mistrust regulators
            - Believe monitoring required for trading is a first step towards regulation
        - Dept. of Agriculture provides some subsidies for improving water quality, limiting need to participate in offset trading
            - Lowers the supply of potential offsets
            - *Note interaction of multiple regulations here. Would it be better to remove some of these other programs to encourage trading (and reduce compliance costs for point sources), or would the transaction costs be too high?*
    - High transaction costs
        - Unlike air pollution credits, each trade must be approved by regulators
    - Point sources are responsible for permit violations
        - "Buyer beware" policy suppresses demand

- *Question:* When is trading likely to be successful?
    - Two key criteria for any trading program:
        - Uniform mixing to avoid hot spots
            - Marginal damages from water pollution vary dramatically by location
                - Location-based trading ratios often used as a result
                - Trading ratios reduce potential cost savings (e.g. they are constraints on trade) but also increase potential environmental benefits of water quality regulation compared to trading with no ratios
        - The pollutant can be easily measured and monitored
            - Effluent from point sources can be easily monitored
            - But largest potential gains occur when non-point sources involved, since these are “low-hanging fruit”
            - Measuring non-point emissions more difficult. Uncertainties include:
                - Depends on weather conditions such as rainfall and temperature
                - Technical uncertainty regarding effectiveness of abatement projects
                - Even if the technical estimation of expected abatement is correct, flaws in project implementation or operation may reduce actual abatement
            - Regulators usually address uncertainty by requiring more than one unit of non-point abatement for each unit credit of point source pollution
                - Consistent with regulators being risk-averse, but optimal trading ratio need not be greater than 1:1
                    - E.g. reducing more non-point pollution may also have unexpected benefits
                - Generating a pre-approved list of best practices can help
            - Because only point sources are regulated, point sources end up liable if non-point reductions are not fully realized

- Cost-effectiveness best achieved if three additional conditions met:
    - Sources have significant cost differentials
        - Successful programs had point source polluters with significant cost differences.
        - Unsuccessful ones often had few trades because costs were similar.
        - Biggest cost differences are between point and non-point sources
    - Both the number of polluters and the stringency of the regulation are sufficient to generate enough trading volume
        - Most programs started in response to changes in the Total Maximum Daily Load for the regulated water body.
            - But these changes are often delayed by litigation
        - Compared to air markets, generally not a large number of buyers and sellers
        - In the future, comprehensive TMDL requirements for large watersheds, such as the Chesapeake Bay may make larger markets possible
    - Flexibility in when, where, and how reductions are made is possible
        - Two types of flexibility:
            - Waste control flexibility: how reductions are made
                - Possible with water trading
            - Exchange flexibility: trading across time and location
                - Limited in water trading
                - For example, some problems are worse in warm weather, so trading across time not viable