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omparing the Environmental and Socio-Economic/Energy Implications of Fertilizer Practices for hree Crops grown in the Chesapeake Bay Watershed

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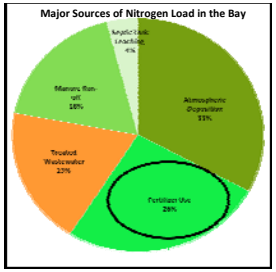
ct: The Chesapeake Bay watershed saw an increase in the growth of corn crops ally due to the interest in biofuels . Typically, analyses are limited to single es whether environmental (such as nitrogen loading), economic (such as energy ion), or social (such as impacts to recreation and the Bay culture and economy). e study is a demonstration of the feasibility of more sophisticated analyses but llustration of the difficulties in obtaining relevant agricultural and other data. In nty-based case study, three crops (corn, wheat, and soybeans) are examined for ntribution to the environmental impact to the Chesapeake Bay watershed, and phosphorus fertilizer requirements for each of these crops are translated to rgy costs for manufacture, transport and application of these fertilizers, and ed with crop revenues and the carbon footprint of energy use required by the rs. This case study demonstrates how different policy scenarios can be explored is approach. When adding socio-economic considerations to the assessment of an complex environmental issue, such factors influencing the choice of nitrogen practices in the Chesapeake Bay watershed can be overwhelming. However, e Multi-criteria Integrated Resource Assessment (MIRA) approach to frame the provided a manageable means to describe the impacts of nitrogen fertilizer s.

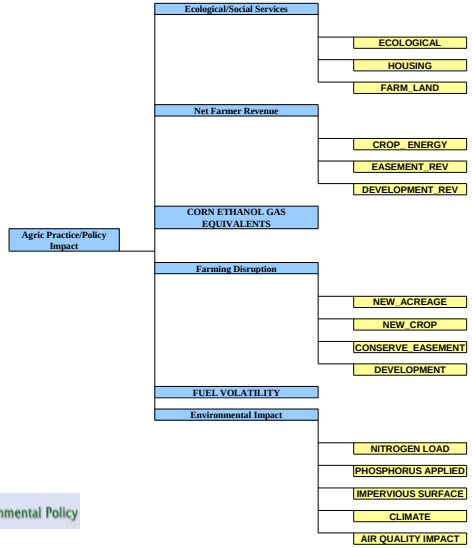
The Environment: The Chesapeake Bay watershed is the largest estuary in the United States (64,000 acres and 6 states) and home to more than 3,600 species of plants and animals. The total nitrogen load to the Bay is 286 million lbs of nitrogen with approximately 74 million lbs from agricultural fertilizer use.
The Society: The Chesapeake Bay watershed is home to more than 16.6 million people who enjoy the recreational opportunities afforded by the Bay ecosystems: fishing, boating, hiking.
The Economy: The Chesapeake Bay watershed contains finfish and shellfish with a dockside value of $219 million to the commercial fishing industry. The Bay watershed also provides states and counties revenue from agricultural crops worth $1.7 billion.
The Problem: All these stakeholders currently compete for watershed resources and all of their interests are being threatened by pollution, overfishing, and overdevelopment. Is there a workable sustainable solution?



ethodology: Using indicators nting environmental, economic and social s, a decision hierarchy was developed to he question "How can the issues ed with nitrogen fertilizer use be ed from environmental, energy, and ic perspectives in order to inform mental policy decision making in the eake Bay Watershed?" By using the MIRA it is possible to help stakeholders discern t attractive scenario options from their well as others' perspectives. This process es discussion-based learning and us building when issues are complex. one demonstration scenarios were run g baseline) but only 5 are illustrated ozens of valuesets were run but only 3 wn here.

RA Approach: MIRA is a multi-criteria analytic approach that organizes k science and social science data using udgment and engages stakeholders a learning process about the ship between their values and different options. For more information, see: www.epa.gov/reg3esd1/data/mira.htm

The Decision Hierarchy: What are the relative environmental, economic and social impacts among the agricultural practice policies examined in this demonstration?



Indicators

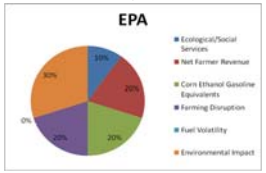
Environmental: 1. Ecological Services, 2. Impacts: Nitrogen Load, Phosphorus Applied, Impervious Surface, Climate, Air Quality.

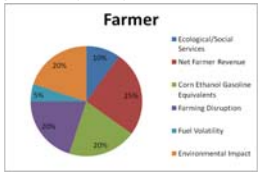
Economic: 1. Crop/Energy costs to farmer (crop revenue, $ equivalent of energy to produce, transport, apply nitrogen (N), phosphorus (P), potassium (K) fertilizers), 2. cover crop costs, 3. Income from selling lands to conservation easement or development, 4. Price volatility of natural gas, diesel and coal fuels required to produce, transport, apply N, P, K fertilizers.

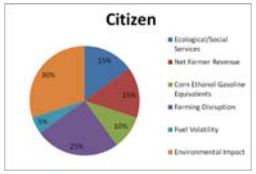
Social: 1. Social services provided by housing/commercial development and farming, 2. Disruption due to selling land for conservation easement or development, 3. Disruption of policy scenarios that require new agricultural acreage or different crop planted in the same acreage.

Option	Description of Agricultural Practice/Policy Scenario	General Direction of Key Indicators
A	Convert 1% of current agricultural lands to conservation easement	Reduces all fertilizer pollution and energy, climate and air quality costs/impacts (due to less fuels used)
B	Apply cover crop to all areas currently growing corn or wheat	Reduces N and P loads for crops with heaviest N and P growing requirements but energy, climate and air quality remains same as baseline
C	Apply cover crop to soils with conducive hydrogeomorphic characteristics (coastal plain/piedmont-crystalline karst)	Compare with Option B; Reduces N and P loads in those areas where cover crop application is most effective.
D	Convert 10% of agric lands to development, increase corn acreage in areas with good nitrogen retention, apply cover crop to all acreage of corn and wheat	Conversion to development reduces fertilizer requirements but increase in corn acreage selectively in areas of good N retention allows for greater corn ethanol production while cover crops reduce N and P loading.
E	Hypothetical sensitivity run: Substitute non-manufactured nitrogen fertilizer for synthetic nitrogen fertilizer	Reduces all energy costs to farmer, climate indicator, and air quality impacts (due to fuels required for synthetic N use)

Sample Value sets, Showing values at primary level in decision hierarchy: EPA, Farmer, Citizen

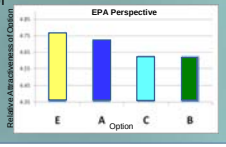


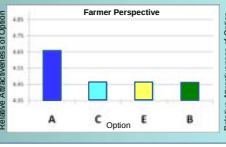


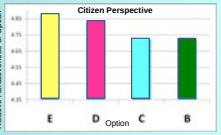


Results showing the relative attractiveness of the top four policy options for the each of the sample value sets representing EPA, Farmer and Citizen stakeholders, at right.

Conclusion: So What? This represents just three possible value sets and five agricultural practice policy options. In order to work toward identification of underlying agreements and disagreements, the analysts and stakeholders experiment and determine how close they can get to the same/similar views of the available options or use these initial policy options to develop new alternatives.







What's Next: Using these initials results as a guide, examine why the current policy options rank the way they do based on each of the stakeholder perspectives. As each set of stakeholders experiments with alternative acceptable values, examine how the policy option ranks change (or not) when these alternative values are applied, seek to understand why, build new policy options to test, discuss with other stakeholders, learn which data/indicators/issues are key, and work toward better understanding of the science, state of the science, and stakeholder perspectives with respect to policy options. Learn how context, science and values affect the attractiveness of the potential policy options.

Center for Energy and Environmental Policy