

Measuring Nutrient Reduction Benefits for Policy Analysis^Δ

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Background and Motivation

Nutrient pollution is among top 5 sources of designated use impairments...

- State charged with selecting nutrient concentration criteria
- EPA is encouraging *quantitative* (numeric) ambient criteria
 - How to set? Use costs and benefits?
- Many states require assessment of costs/benefits for criteria selection
 - How to measure?
 - Apparent and concentrated costs, subtle and diffuse benefits

EPA solicited proposals to help states with benefits measurement

Funded Projects

EPA Office of Water:

'Measuring nutrient reduction benefits for policy analysis using lined non-market valuation and environmental assessment models'

Daniel J. Phaneuf, PI, NCSU
Roger von Haefen, co-PI, NCSU
Carol Mansfield, co-PI, RTI International
George Van Houtven, co-PI, RTI International
Ken Reckhow, co-PI, Duke University
Melissa Kenney, co-PI, Johns Hopkins University

Funded Projects

NC WRRRI:

'Measuring the benefits of nutrient management strategies at NC reservoirs using linked non-market valuation and environmental assessment models'

Roger von Haefen, PI, NCSU

Relationship of Projects

EPA project is *methods*-oriented

✦ Commenced March 2008; funding ends March 2010

WRRRI project is *application*-oriented (North Carolina)

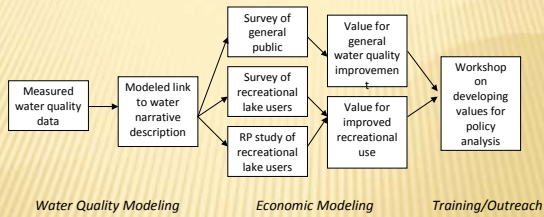
✦ Commenced June 2008; funding ends June 2009

Project Objectives

Develop an integrated modeling approach for evaluating the benefits of fresh water nutrient pollution reduction:

- Models for mapping measured water quality (e.g. TN, TP) to descriptive indexed rankings
- Economic models for mapping changes in indexed rankings in dollar-measured benefits
- Transfer knowledge on the framework and its application via a training workshop
- Application to inland Southeast generally and North Carolina particularly

Overview of Research



Water Quality Modeling

Need to map measured water quality into an index that reflects things people value...

- Physical data useful for numeric criteria but narrative description appropriate for human-use models
- Use 'expert elicitation' framework by co-PI's Reckhow and Kenney to parameterize this mapping.

Local water quality experts asked to map realizations of measured water quality (TN, TP, TSS, Chl, DO,...) to descriptive rankings

Table 3: Eutrophication Categories / Trophic Status Categories Used in the Expert Elicitation Assessment of Eutrophication

Category	Description
1	The lakes have excellent water clarity, no odor, very little algae, very low nutrient levels, very high oxygen, no odor, and very healthy, abundant aquatic life
2	The lakes have good water clarity, little odor, little algae, low nutrient levels, high oxygen, little odor, and healthy, abundant aquatic life
3	The lakes have fair water clarity, some color, moderate amounts of algae, moderate nutrient levels, moderate oxygen, little odor, and somewhat healthy, abundant aquatic life
4	The lakes have poor water clarity, noticeable color, high algae, high nutrient levels, low oxygen, noticeable odor, and unhealthy, scarce aquatic life
5	The lakes have poor water clarity, considerable color, very high algae (likely scums), very high nutrient levels, low to no oxygen, strong offensive odor, and unhealthy, scarce aquatic life or no aquatic life

→ Seven experts each rated 100 combinations of measures...

...providing data for statistical models relating physical measures to qualitative rankings...

$$\Pr(\text{rank} = j) = f(\text{TN}, \text{TP}, \text{TSS}, \text{chl}, \text{DO}, \dots)$$

Example Results for Ordered Logit Model

VARIABLE	SIGN	STAT. SIG.
Total Nitrogen	+	N
Total Inorganic Nitrogen	+	N
Total Phosphorus	+	Y
Chlorophyll	+	Y
Surface Dissolved Oxygen	-	N
Secchi Depth	-	Y
Turbidity	+	Y

...that can be used to predict narrative rankings at water bodies through our study area.

Economic Modeling

Objective:

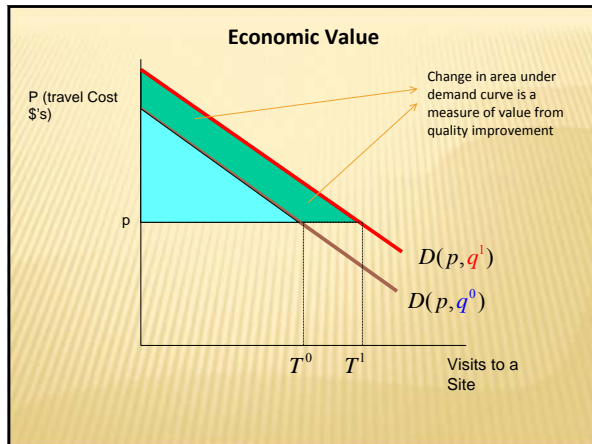
- Assess the economic value of water quality improvements filtered through the narrative index

The concept of economic value:

- Rooted in the notion of *opportunity cost*
- Our value for a particular resource is reflected in what we are willing to pay (WTP) for it
- Anthropocentric, instrumental

Approach to Quantifying Economic Values

- Focus on recreational activity:
 - Roughly half of the benefits of the Clean Water Act arise through recreation
- Travel cost model:
 - Price of visit to a lake is cost of driving there
 - Number of trips depends on travel cost
 - Will people drive further (pay more) for better quality?



Modeling Tasks

- Understand people's recreation trip-taking behavior based on travel cost (distance) and the narrative quality index

$$\text{Trips}_i = f(\text{travel cost}_i, \text{quality index}_i)$$
- Use two modeling approaches:
 - Survey-based approach using hypothetical choices that vary in distance and quality
 - Observed trip-based approach that relies on records of individual trip taking

Data Sources

- 1) Water quality data from STORET, other sources
- 2) A new survey to be implemented Summer 2009
 - Knowledge Networks internet survey
 - Target population → households in Southeastern US
- 3) Recreational data from National Survey of Recreation and the Environment (NSRE)
 - Currently conducting a pilot study using 2000 NSRE
 - 2008 NSRE (in field now) basis for main analysis


Policy Application: NC Drinking Water Reservoirs

Comprehensive nutrient management strategies:

- Strategies recently proposed at Jordan and Falls Lake, others to come
- Costly – compliance costs at Jordan Lake = \$1 billion



Policy Application: NC Drinking Water Reservoirs



- But what are the benefits?
- State law requires DWQ staff to conduct fiscal analyses with monetized benefit estimates "to the greatest extent possible"
- DWQ staff has little experience with this task
- Our goal is to deliver policy relevant benefit estimates that can be used in their fiscal analyses

Final Comments

Training workshop for state-level water quality managers

- Planned for end of project ≈ Spring 2010
- Target audience is people who need to do benefits assessment for proposed water quality criteria
- Output from our project is a framework for non-experts to conduct benefits estimate for policy purposes
- Watch for workshop announcements later next year if interested...

Contact Information

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