The benefits and costs of reducing excess nutrients from agriculture

Marc Ribaudo
Economic Research Service

The views expressed are those of the author and not necessarily those of the Economic Research Service or the U.S. Department of Agriculture

United States Department of Agriculture
Economic Research Service

Nutrient pollution imposes costs on users of environmental resources

- Increased drinking water treatment costs
- Degraded water-based recreation opportunities dues to eutrophication
- Reduced commercial fishing
- Changed biodiversity due to terrestrial enrichment

How can we value environmental costs and benefits?

- Costs on those abating pollution
  - Changes in production costs
  - Addition of pollution-abatement technology
- Economic benefits to those using environmental service
  - Reduced treatment costs
  - Reduced avoidance behavior
  - Increased amount and quality of recreation

Some examples from ERS research

- Cost to crop producers of meeting water quality goals for the Chesapeake Bay
- Cost of animal producers of managing manure in the Chesapeake Bay
- Benefits of reduced nitrogen loads to the drinking water treatment industry

Chesapeake Bay TMDL

- Agriculture is a major source of nutrients in the Chesapeake Bay
  - Fertilizer
  - Manure
- Total Maximum Daily Load set nutrient loading goals
  - 25 percent reduction in nitrogen
  - 24 percent reduction in phosphorus
- Confined animal feeding operations required to implement nutrient management plans (prevent agronomic over-application of nutrients)

Cost of meeting reduction goals

- Estimated “shadow prices” of a basin-wide constraint on nitrogen and phosphorus loadings
  - Developed a programming model using data from NRCS CEAP project and other sources
  - Producers could select from 8 combinations of management options (depending on their baselines) to meet discharge goals at least cost

Cost of meeting reduction goals

- Cost to producers of providing the last unit of abatement to meet the N and P goals are:
  - $2.36 per pound of N delivered to the tidal waters
  - $39.98 per pound of P delivered to the tidal waters
- These "shadow" values could be used to assess whether the abatement goals make economic sense if we also had information on the marginal benefits of improved water quality (which we do not)
- These values could be used to design the "optimal" tax or subsidy programs for meeting water quality goals at least cost

Policy challenge for animal operations

Large concentrations of animal production

-- Large animal farms with relatively limited cropland

-- Manure production often exceeds the nutrient uptake capacity of the local cropland base

Evolving policy environment to address water-quality concerns

-- Federal CAFO regulations

-- State requirements on applied nutrients

-- USDA technical & financial assistance for manure management

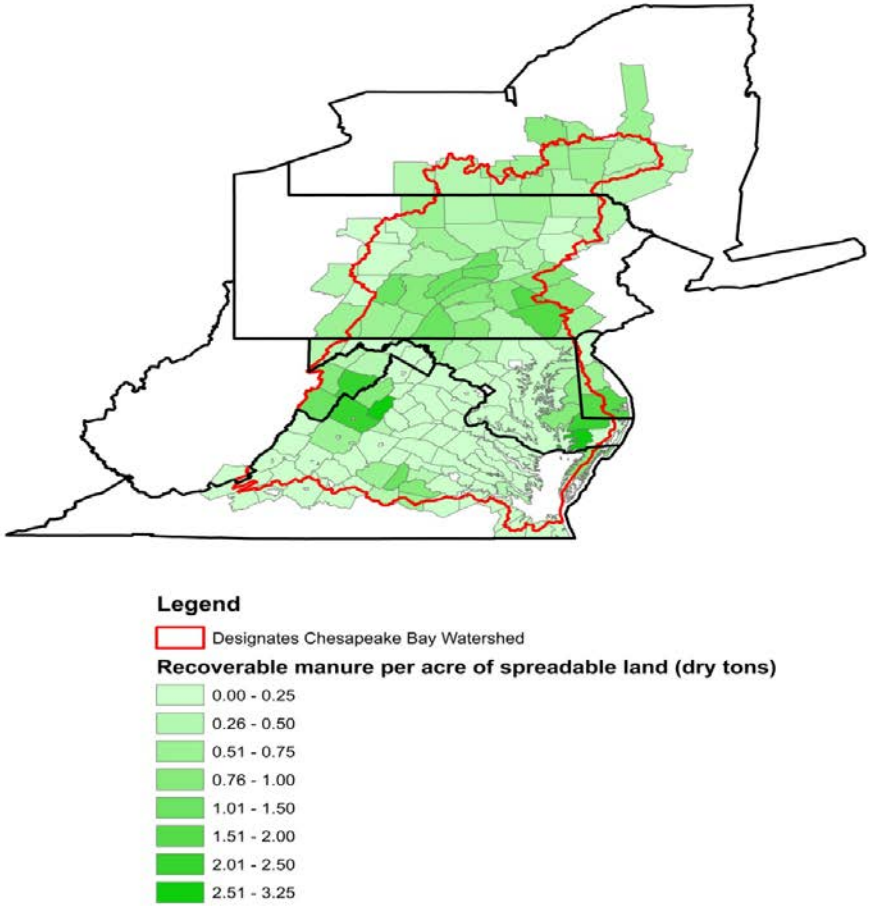
-- TMDL mandates for nutrient load reductions

Nutrient Management Plans (NMPs) for confined animal operations

-- Reduced rates of applied manure to meet agronomic needs

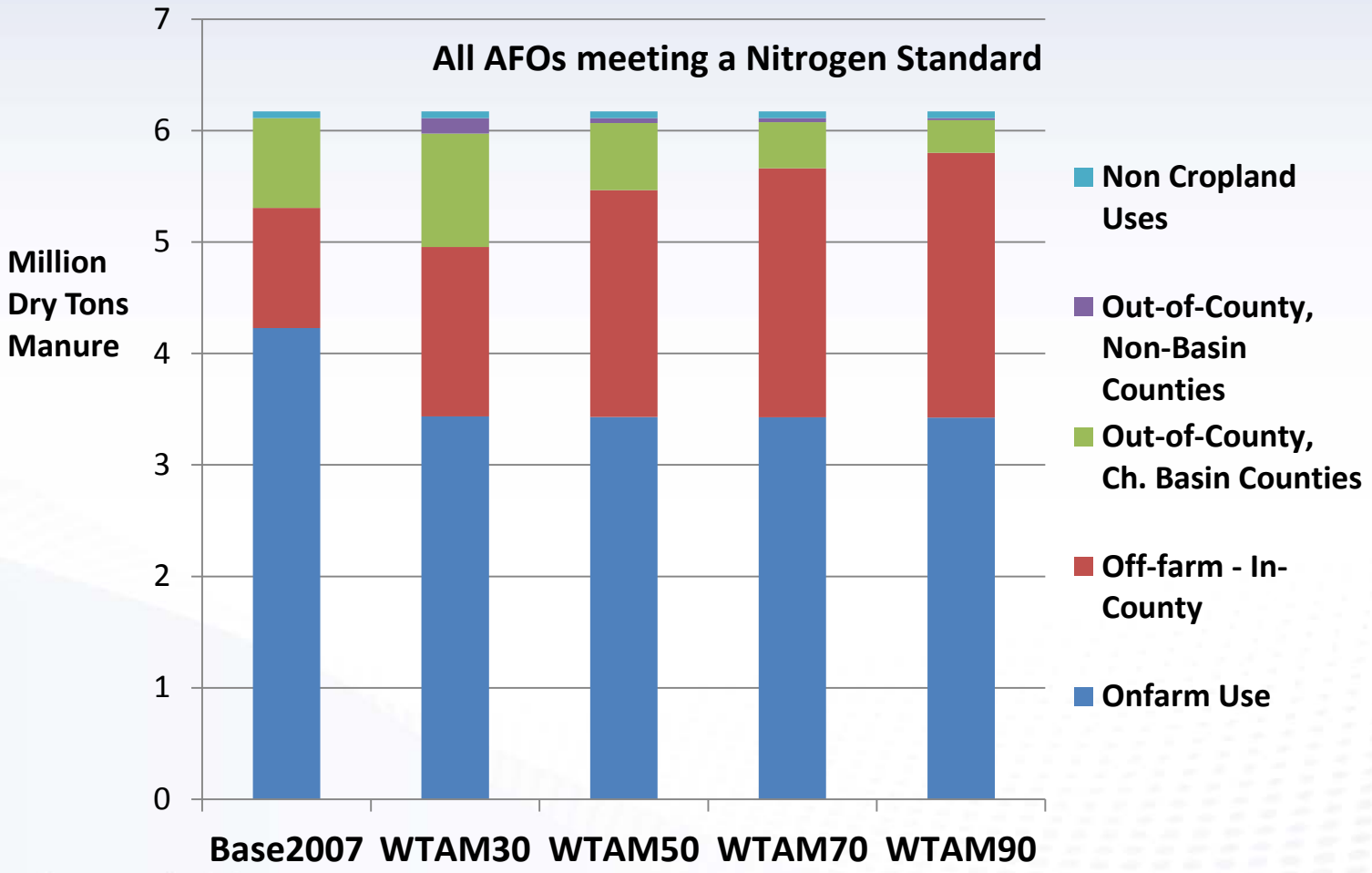
-- Cost implications of off-farm manure transport

Recoverable manure (dry tons) per spreadable acre in the Chesapeake Bay watershed, 2007



Source: Economic Research Service

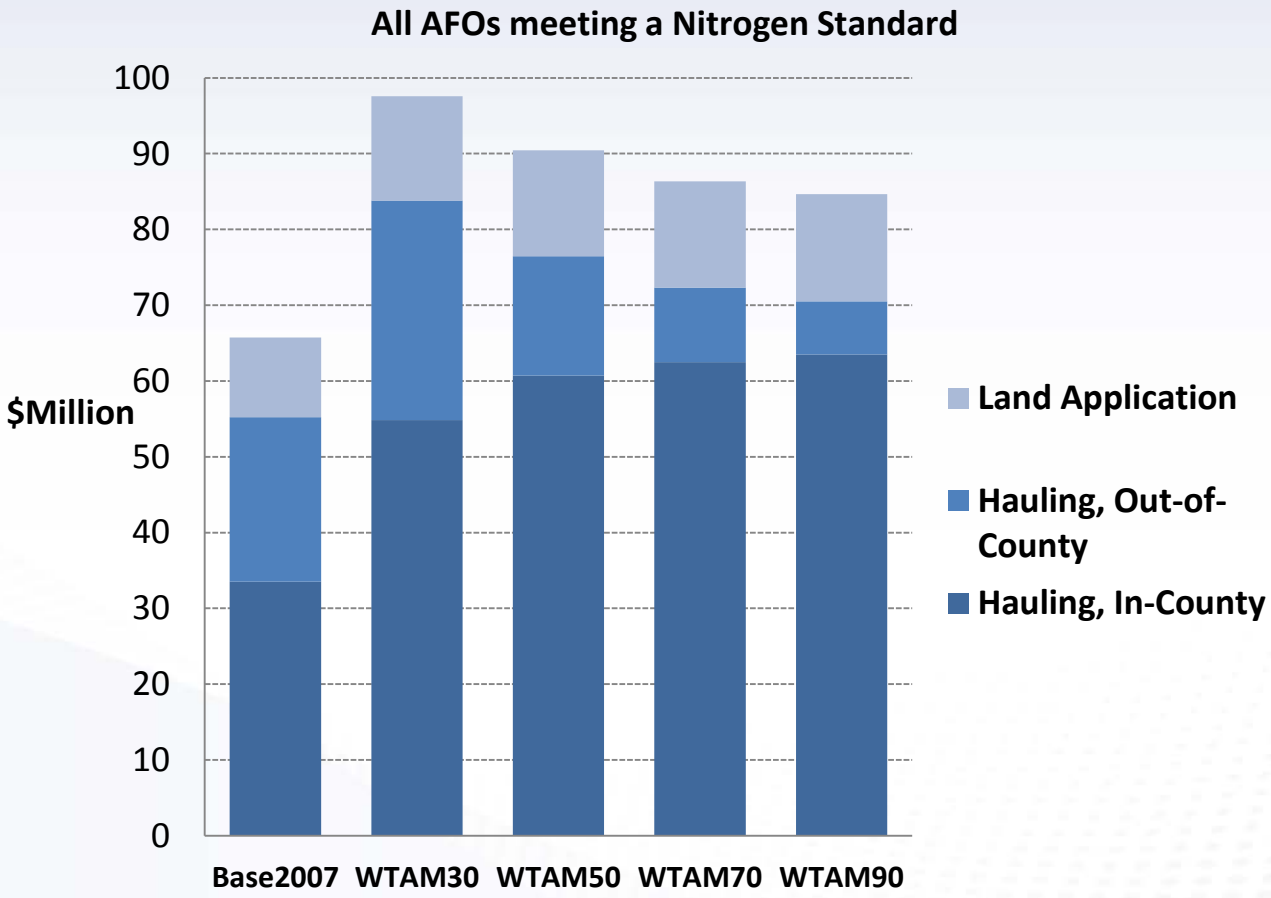
Disposition of manure in the Chesapeake Bay watershed -- current conditions and full NMP compliance, by share of non-AFO crop producers willing to accept manure (WTAM)



United States Department of Agriculture
Economic Research Service

Source: Economic Research Service

Off-farm manure hauling and application costs in the Ch.Bay watershed -- current conditions and full NMP compliance, by WTAM



United States Department of Agriculture
Economic Research Service

Source: Economic Research Service

Drinking water benefits

- Safe Drinking Water Act regulations require treated water contains no more than 10 mg/l N as nitrate
- High concentrations in source water necessitates blending with other sources or expensive treatment
- Reducing nitrogen losses from agriculture could reduce treatment costs

Water treatment model

- Model estimated with data from 1996 American Water Works Association
- Cost a function of inputs (labor, energy, chemicals), plant size, and difference in N concentration between raw and finished water
- Annual cost of $4.8 billion for community water systems to remove nitrogen
- Agriculture's share about $1.7 billion

Water treatment benefits

- Based on model, a 1 percent reduction in nitrogen concentrations in source water would results in benefits of over $120 million per year

Final thoughts

- Managing nutrients to improve water quality is likely to impose costs on producers
- Nature of costs depends on the nutrient sources being managed (commercial fertilizer vs manure) and the requirements that are being imposed
- Improving water quality is a source of economic benefits to water users
- Estimating environmental benefits is generally more difficult than estimating costs of abatement