Economic Valuation of the Albemarle-Pamlico Watershed's Natural Resources

PRESENTED BY:

George Van Houtven

November 1, 2017

2017 Albemarle-Pamlico Ecosystem Symposium

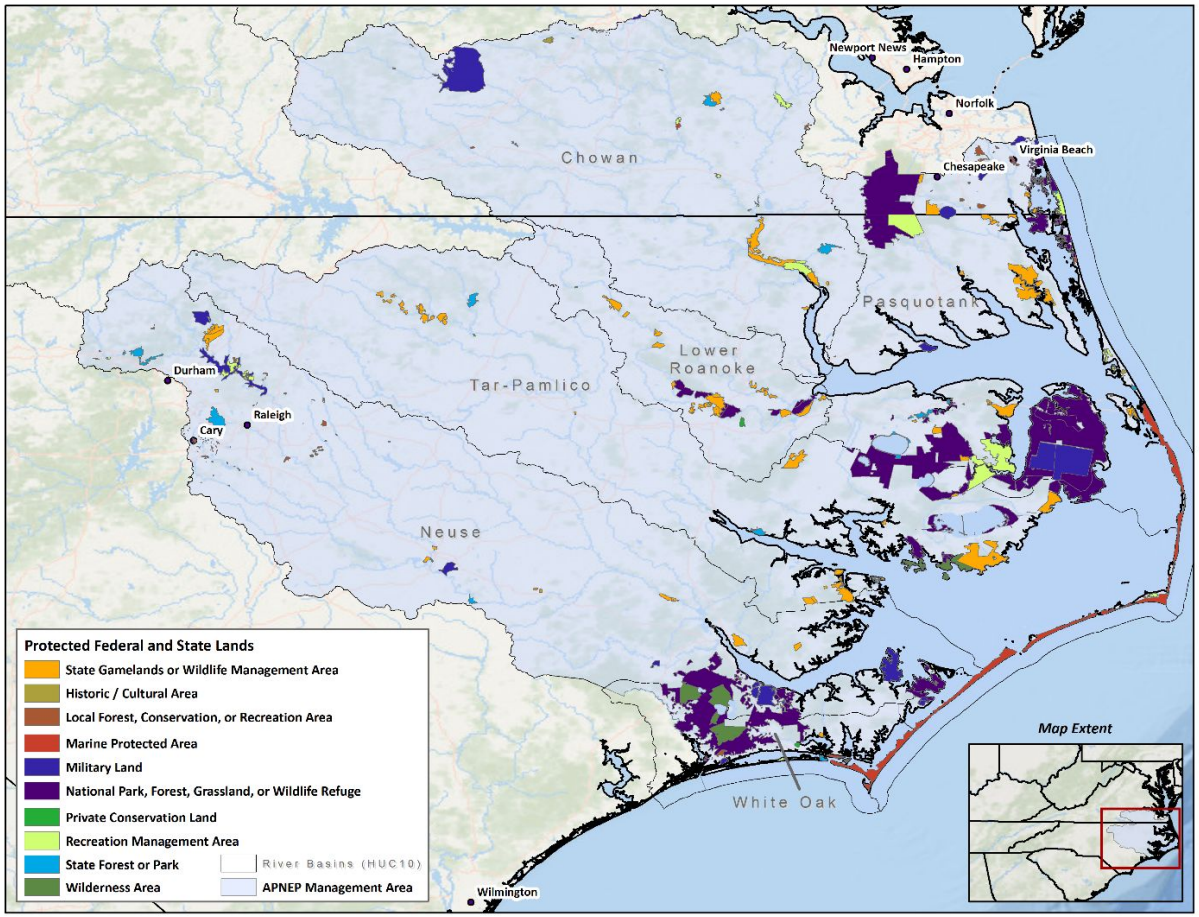
Raleigh, NC

RTI INTERNATIONAL

Overview of the Study

- **Main Objective**: Support the Albemarle-Pamlico National Estuary Partnership (APNEP) in measuring and communicating the value of the watershed's natural resources.
- **Two key questions**:
  - What are the main ways in which human populations in and around the watershed benefit from the watershed's land and water resources and related ecosystems?
  - How can the benefits they derive each year from their connections to these natural systems be measured and expressed in dollar terms?

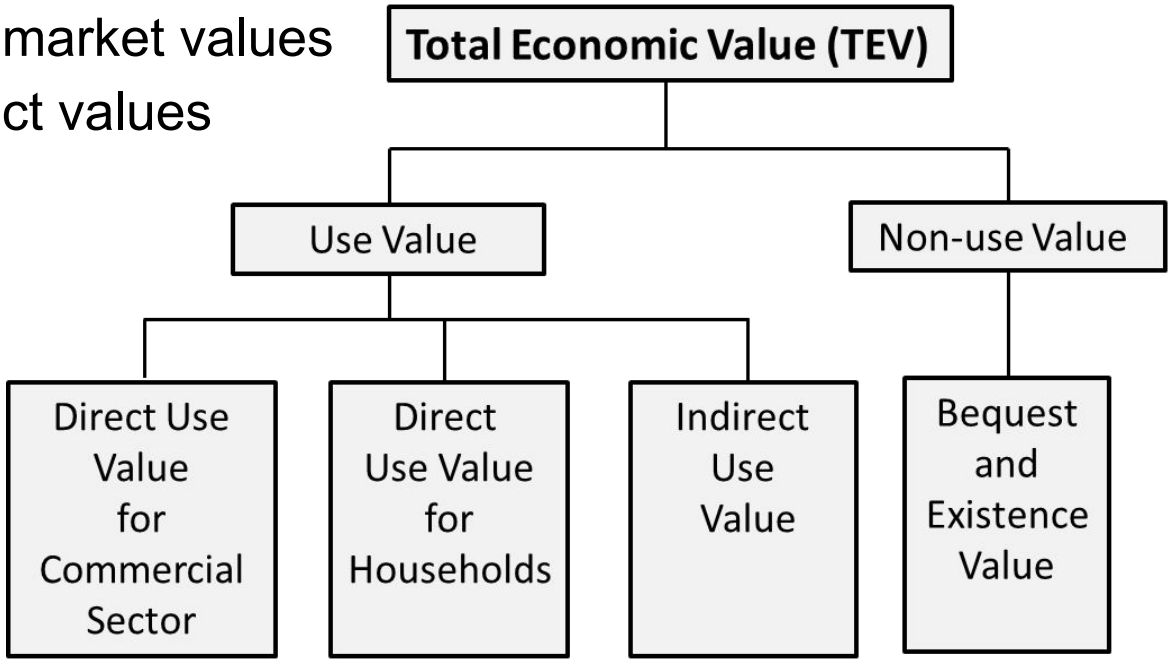
Basins and Protected Lands in A-P Watershed



- 6 main HUC 4 river basins
- Over 1 million acres of protected lands including
  - over ½ million acres of national park, forest, and wildlife refuge land
  - almost 200 thousand acres of state game lands, parks, etc.

Conceptual Framework for Economic Valuation

- TEV provides a comprehensive framework for conceptualizing the links between natural resources and human well-being
  - Use and non-use values
  - Market and non-market values
  - Direct and indirect values



Analytical Approach

- Estimate values for selected components within the TEV framework, using information from existing data and studies
  - Direct use values for "primary sector" production
    - Net revenues for agriculture, forestry, and commercial fishing
    - Combined value for all natural resource inputs to these sectors
  - Selected direct use and non-use values for households
    - Outdoor ecreation benefits (use)
    - Amenities for nearshore property owners (use)
    - Willingness to pay for wildlife protection (use and nonuse)
  - Indirect values from selected regulating ecosystem services
    - Carbon storage
    - Air filtration by trees
- Express values in average annual terms ($ per year)

Value in Agricultural Production

- Applied county-level average annual rental values ($/acre) of cropland and pastureland to approximate *net* returns to agriculture (i.e., producer surplus)

A-P Watershed Region	Farmland in A-P Region (Acres)	A-P Region ($ '000/year)	
		Commodity Total Sales in 2012	Total Rental Value of Cropland and Pastureland
North Carolina	2,773,374	4,252,053	184,660
Virginia Total	531,007	382,756	25,668
A-P Watershed Total	**3,304,381**	**4,634,809**	**210,348**

Value in Forest Production

- Estimated average annual revenues based on harvest levels and average stumpage prices for hardwoods and softwoods from 2002-2012
- Costs include establishment, replanting, and intermediate management costs

County	Average Annual			
	Harvest Levels (2002–2012) ('000 cubic feet)	Harvest Revenue*	Costs**	Net Revenue
North Carolina Total	317,857	$236,994,990	$58,413,686	$178,531,304
Virginia Total	118,280	$82,079,833	$15,440,543	$66,639,290
A-P Watershed Total	**436,137**	**$319,024,822**	**$73,854,229**	**$245,170,594**

Value in Commercial Fishing

- Revenue estimates based on NC Division of Marine Fisheries (NCDMF) data on landings 2010-2014
- Average per-trip costs based on 2014 NCDMF survey of fishing vessels

	Annual Average (2010-2014)		
	Albemarle Sound	**Pamlico Sound**	**Total A-P System**
Total trips	41,195	54,619	95,814
Total sales ($ millions)	$21.61	$25.62	$47.23
Total costs ($ millions)	$9.12	$17.44	$26.56
Estimated producer surplus ($ millions)	**$12.49**	**$8.18**	**$20.67**

Direct Value to Households – Outdoor Recreation

- Estimated recreation days in watershed based on survey data
- Applied estimates of average consumer surplus per day for selected activities

Recreational Activity	Estimated Annual Activity Days in A-P Watershed ('000 Days/Year)			Average Per-Day Value ($/day)	Total Annual Value ($ million/year)
	NC	VA	Total		
Fishing					
Freshwater	6,130	452	6,582	99.60	655.6
Saltwater	3,003	489	3,492	99.60	347.8
Hunting	2,401	1,049	3,449	44.46	153.4
Wildlife viewing	2,884	475	3,358	50.42	169.3
Saltwater be ach visits	15,165	3,024	18,189	41.64	757.4
Other freshwater recreation	14,231	1,054	15,285	103.65	1,584.3
Total	**43,814**	**6,542**	**50,356**		**3,667.8**

Direct Value to Households -- Nearshore Residents

- Estimated value of the amenities received from living near a coastal/estuarine shoreline, as reflected in property values
- Used evidence from 5 hedonic property value studies in NC, which quantify the relationship between value and distance to shoreline
- Approximated nearshore values by simulating the effect of increasing distance-to-shore by ½ to 1 mile

A-P Region	Number of Near-Shore Housing Units	Benefit Estimation Method	Annual Benefits (millions $ per year)	
			Δd = 1/2 mile	Δd = 1 mile
All 18 counties bordering estuary or coast	56,455	Linear model	48.0	96.1
		Semi-elasticity model	43.5	87.0

Direct Value to Households from Wildlife Protection

- Used evidence from two state preference survey studies that elicited households' WTP for specific programs to protect nongame wildlife in NC
  - Most likely includes both use (recreation) and non-use values

Wildlife Protection Program (Study)	Average Value ($/NC HH/year)	Total Benefits ($000/year)
Coastal nongame wildlife protection in NC (Whitehead, 1993)	51.31	201,662
Nongame wildlife protection in all of NC (Dalrymple et al., 2012)	107.26	133,034

Indirect Values from Carbon Storage/Sequestration

- Forest carbon estimated using USFS's Carbon On-Line Estimator (COLE) tool, which provides estimates of the average per-acre above and below-ground carbon pools by forest type
- Carbon values based on per-ton social cost of carbon (SCC) estimates from the US Government's Interagency Working Group on Social Cost of Carbon (2013).

	Area (acres)	Stored Carbon ('000 tons)			Annual Value (millions $/yr)	Annual Carbon Sequestration	
		Above Ground	Below Ground	Total		Total ('000 tons/yr)	Total Value (millions $/yr)
Forest	5,282,282	205,400	194,635	400,035	1,654	6,355	876
Wetland	476,359	1,143	56,529	57,673	263	152	23
Submerged Aquatic Vegetation	70,554	8	1,180	1,188	5	87	13

Indirect Values from Air Pollutant Removal by Trees

- Applied USFS's i-Tree Landscape model, which uses
  - geospatial data on forest characteristics (e.g., leaf area, tree cover, percentage of tree population that is evergreen) and air quality grids to determine the change in pollution concentrations
  - epidemiological concentration-response functions to estimate the change in adverse health effects
  - valuation functions to calculate the associated economic values

Annual Value of Avoided Health Effects from Air Pollution ($/year)				
NO_2	Ozone	$PM_{2.5}$	SO_2	Total
$397,823	$26,234,553	$54,563,342	$49,596	$81,245,314

Summary and Conclusions

- Summary of Natural Resource Value Estimates for A-P Watershed

Natural Resource Value Category	Annual Value ($ mil)
Direct Use Value to Commercial Sectors	
Agriculture	210
Forestry	245
Commercial Fishing	20
Direct Use and Non-use Values to Households	
Outdoor Recreation	3,668–4,303[a]
Natural and Aesthetic Amenities to Nearshore Residents	44–96
Preservation of Nongame Wildlife Resources	133 -202
Values for Regulating/Supporting Ecosystem Services	
Carbon Storage by Forests, Wetlands, and Seagrasses	1,922
Air Pollutant Removal by Trees	81

Summary and Conclusions

- Combined value of estimated components is roughly $6-7 billion per year, with a large portion derived from outdoor recreation and carbon regulation.
- Caveats:
  - Potential overlaps exist between these components (e.g., wildlife values and recreation values)
  - Does not account for all benefits provided by the watershed's natural resources
    - Benefits from domestic and additional commercial water uses
    - Storm surge, flood control, and water filtration benefits provided by wetlands
    - Waste assimilation benefits provided by land and water resources