The Importance of Watershed Modeling for Conservation Policy
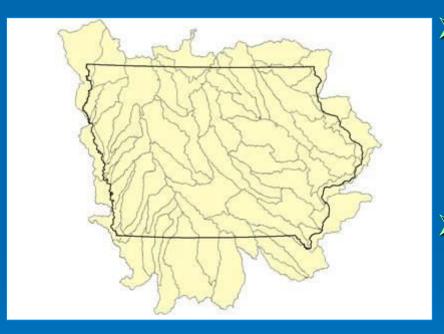
Or

What is an Economist Doing at a SWAT Workshop?

Watershed Models Critical for Conservation Policy Analysis

➢ Conservation policies need to be cost-effective
- Targeting,
- watershed trading,
- put practices on sites that achieve greatest gain for the cost

➢ Policy Assessment
- Section 305(b) of the Clean Water Act requires states to prepare estimates

  "of the environmental, economic and social costs and benefits needed to achieve the objectives of the CWA and an estimate of the date of such achievement."

Iowa: Non-point Source Needs Assessment

- ➤ CARD is working with DNR to provide such an estimate; how?

- ➤ Combining simple economic models of costs with SWAT

Steps: Non-point Source Needs Assessment

➢ Establish baseline, calibrate SWAT

➢ Scenarios:

1. Identify set of conservation practices in each watershed, compute cost of those practices

2. Predict flow and water quality (sediment and nutrients) under this set of practices

3. Does it meet goal ("need")? If no, repeat with more extensive conservation practices; if yes, write final report.

Other Applications

- Nutrient Standard in Iowa
  - Improved SWAT capabilities (buffers!)
  - Finer spatial scale (NRI level)
  - Better cost information

- Detailed watershed studies
  - Walnut Creek
  - Sny Magill
  - South Fork

- Upper Mississippi River Basin – Hypoxia

The USDA Conservation Effects Assessment Project (CEAP)

Components and Reporting Scales

National assessment of conservation benefits led by NRCS supported by ARS hydrologic modeling

Watershed assessment studies (WAS) – jointly led by ARS and NRCS to provide more detailed information on conservation effects in benchmark watersheds.

ARS 12 Benchmark Watershed Assessment Studies (WAS) 2003-2007

Objectives of WAS

- **Implement a system to compile and manage water, soil, management and economics data.**

- **Measure water quality, water quantity, soil and ecosystem effects of conservation practices.**

- **Calibrate watershed models and quantify uncertainties of model predictions.**

- **Develop and apply planning tools for selection and placement of conservation practices.**

- **Develop and verify regional watershed models to quantify environmental effects.**

Water Quality Measures

- **Nitrogen (nitrate, total, organic)**

- **Phosphorus (total, dissolved, available)**

- **Sediment (concentration, particle size -- suspended, bed)**

- **Pathogens (*E. Coli*)**

- **Pesticides**

- **Annual, event, and seasonal loads**

- **Temperature**

Conservation Practice Categories Emphasized

- **nutrient management**
- **pest management**
- **conservation buffers**
- **tillage management**
- **manure management**
- **drainage management**
- **channel management**
- **Land Conversion**

Conservation Practices

	Buffers	Channel	Drainage	Manure	Nutrient	Pest	Tillage	Land Conversion
S. Fork Iowa River, IA	●		●	●	●			
Walnut Creek, IA					●			
Mark Twain Reservoir, MO	●				●	●	●	
Upper Washita River, OK		●						●
Goodwin Creek, MS	●	●			●		●	
Yalobusha River, MS	●	●						
Beasley Lake, MS	●	●	●		●		●	
Leon River, TX	●			●	●		●	
Little River, GA	●	●		●	●	●	●	
Town Brook, NY	●	●	●	●	●		●	
St Joseph River, IN	●			●	●	●	●	
Upper Big Walnut Creek, OH	●		●		●	●	●	

Watershed Assessment Questions

- What are the measurable effects of CPs on environmental indicators at the watershed scale?

- How does the location of CPs affect environmental indicators?

- What is the appropriate time scale to expect changes in environmental effects?

- What are the environmental effects of multiple CPs. (+, -, *, ?)

- What are the optimal combinations and location of CPs to achieve environmental goals?

- What are the risks and uncertainties associated with achieving these environmental effects?

- What social and economic factors facilitate or impede implementation of CPs within watersheds?

SWAT Applications for Climate Change

➢ Variability of streamflow, sediment, and nutrient transport under current climate variability

➢ Changes of streamflow, sediment, and nutrient transport in future scenarios of climate change

➢ Attribution of current streamflow variability to anthropogenic greenhouse gas emissions

Climate Data Resources

➤ Observed climate

➤ Reanalyzed climate (1979 - present)

➤ Future scenario climates at regional scale [(4 GCMs/current+4GCMs/future)x5 RCMs = 40 future scenario climates]

➤ Pre-industrial climate at regional scales

Questions to be Answered

➤ Will conservation practices implemented today be appropriately designed for future climates?

➤ Can we design a fully integrated modeling framework that couples policy options and resulting management choices together with climate scenarios and hydrological consequences to develop science-based options for promoting profitable but sustainable use of land and water resources.