Problem Area 3: Improving Conservation Effectiveness

Mark Tomer and Jean Steiner
Improve Conservation Effectiveness

- Aggregate effects of conservation practices at the watershed scale
- Ability to select and place conservation practices on the landscape for maximum effectiveness
- Improving conservation practices
- Effectiveness of conservation under changing climate and land use
- Conservation effects on ecosystem services
- Economic impacts and social drivers of conservation
Problem Area 3: Improving Conservation Effectiveness

- Aggregate effects of conservation practices at the watershed scale
  - Modeling capacity to support assessments
  - Field and simulation results
Soil and Water Assessment Tool (SWAT)

- Relied upon world-wide to guide natural resource management, planning, decision-making, and policy.

- Current US applications include:
  - Assess benefits of existing and future conservation policies (USDA CEAP project)
  - Address Congressional and Cabinet level inquiries concerning policy impacts
  - Support Farm Bill development
  - Support USDA, EPA policy formulation
  - Assist with local conservation planning
ALMANAC Model

• Biofuel Production Systems
  • At request of US Navy and Hawaiian CS&S:
    – Conducted feasibility study to determine the role that sugar-cane biofuel and the Hawaiian agricultural base could play in fueling the Navy’s Pacific Fleet.
  • For economic and environmental sustainability analyses:
    – Developing parameters for major oilseed crops, for hybrid poplar, and for perennial grasses such as switchgrass
On average, RZWQM predicts that winter rye can reduce nitrate loss to tile drains more than 40% across the U.S. Midwest.

Thus, adoption of cover crops on the drained row crop lands in five states Midwest could meet a substantial portion of the reduction in nitrate loading needed to reduce the size of the hypoxic zone in the Gulf of Mexico.
Problem Area 3: Improving Conservation Effectiveness

- Ability to select and place conservation practices on the landscape for maximum effectiveness
Problem Area 3: Improving Conservation Effectiveness

- Improving conservation practices
Alternative Surface Drainage

Tile Riser

Blind Inlet
Percent Reductions in Sediment and Nutrient Loads: Blind Inlet vs. Tile Risers

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>% Reduction</th>
</tr>
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<tbody>
<tr>
<td>Sediment</td>
<td>79</td>
</tr>
<tr>
<td>Ammonium-N</td>
<td>59</td>
</tr>
<tr>
<td>Nitrate-N</td>
<td>24</td>
</tr>
<tr>
<td>Total Kjehldahl N</td>
<td>48</td>
</tr>
<tr>
<td>Soluble P</td>
<td>72</td>
</tr>
<tr>
<td>Total P</td>
<td>78</td>
</tr>
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</table>
Managing Atrazine and Soil Loss for Claypan and Restrictive Layer Soils

Lerch et al., 2013

Phillips 4500 rotary harrow showing rotating tines and interlocking offset arrangement. (Photo from Kelley Manufacturing Co.)
Relative Change in Annual Load for Nutrients and Sediments by Conservation Practice

- NH4-N
- NO3-N
- TKN
- Soluble P
- Total P
- Sediment

Conservation Tradeoffs: St. Joseph River, Indiana
Problem Area 3: Improving Conservation Effectiveness

• Effectiveness of conservation under changing climate and land use
A five-year winter cover residue input was ~14,000 kg ha\(^{-1}\) C and 300 kg ha\(^{-1}\) N.

Included beneficial insect nectar crop borders to enhance non-chemical insect control. Non-irrigated corn yield increased 1.9-fold during drought years.
Mitigation of Erosion Impacts During Extreme Precipitation Events

Soil erosion exceeded soil tolerance in 3 of 10 years under conventional tillage, but never under strip tillage...even during tropical events in the Coastal Plains.
Problem Area 3: Improving Conservation Effectiveness

- Conservation effects on ecosystem services
Converting to sprinklers and installing settling ponds improved WQ in the Snake River by removing 6,300 Mg/yr sediment, 32 Mg/yr total P and 21 Mg/yr soluble P from the river.

Irrigation Season Suspended Sediment Balance (May through September).

<table>
<thead>
<tr>
<th>Year</th>
<th>Inflow</th>
<th>Outflow</th>
<th>Net</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971</td>
<td></td>
<td>1500</td>
<td>0</td>
</tr>
<tr>
<td>2005</td>
<td></td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>400</td>
<td>800</td>
<td>400</td>
</tr>
</tbody>
</table>
During a 3-yr study, nearly all herbicide transport to the Bay occurred during one tropical storm soon after fields were treated. Field data and modeling showed herbicide degradation in field soil and attenuation within the forested buffer limited contaminant transport to the Bay during other storm events.
Conservation practices such as cover crops, CRP, riparian and vegetated buffers were established by farmers within Beasley Lake Watershed over the last 20 years. For example, vegetative buffers were established in 2007. ARS scientists quantified significant reductions in nutrients and sediment from fields adjacent to buffers.
Beasley Lake Watershed, Mississippi

- Conservation practices have led to:
  - Improved water quality in the lake
  - Recovery of viable fishery production

Reduced Sediments

Reduced Nutrients

Increased Production
Problem Area 3: Improving Conservation Effectiveness

- Economic impacts and social drivers of conservation
Pyramid Concept for Agricultural Watershed Planning

- **Riparian Management**
  - Control Water Below Fields:
    - Impoundments (e.g., wetlands), Manage “variable source” areas
  - Control Water Within Fields:
    - Controlled Drainage, grassed waterways, filter strips
- **Build Soil Health:**
  - Zero or restricted tillage, nutrient/manure management, diversified/intensified crop rotations
Across watershed: Nutrient/manure management, Cover Crops, No-tillage or strip tillage

**In Field Practices**

**In Field Surface Depressions**
- Depressions with likely tile intakes (classified by depth)
  - Purple: < 1 meter
  - Navy: > 1 meter
  - Yellow: Drainage Management Opportunities

**Runoff Control**
- Grass Waterways (> 5 acres drainage)
- WASCOBS (Water and Sediment control basins)
- Red: Fields at risk of direct surface runoff to stream

**Edge of Field Practices**
- Bioreactors

**Riparian Practices**
- 2-stage ditch possibilities
- Depressions Along Stream (Divert & Treat)
- Estimated Water Table Depth
  - Orange: Channel
  - Light Blue: 0 - 50 cm
  - Medium Blue: 50 - 100 cm
  - Dark Blue: 100 - 150 cm

**Riparian Function**
- Orange: Critical Zone / Multi Species Buffer
Questions?