USDA's NIFA-CEAP Watershed Synthesis: Lessons Learned

Watershed Academy Webcast
Tuesday, May 15, 2012
1:00–3:00 PM Eastern

Instructors:
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Guide to Our Webcasts

- **To Ask a Question** – Type your question in the text box located at the bottom of your screen and click on the "Ask" button
- **To Answer Poll Questions** – Click on the radio button to the left of your choice and click submit.
- **To See Closed Captioning** – Turn your pop-up blocker off and click on the "closed captioning" button
- **To Complete the Evaluation** – Answer questions in the slide window

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Topics for Today's Webcast

- USDA's CEAP Project and US EPA
- USDA's CEAP Project: Project Overview and Watershed Assessments
- USDA's NIFA CEAP Watershed Synthesis: Lessons Learned

The Watershed Academy

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USDA's Conservation Effects Assessment Project (CEAP) and US EPA

Roberta Parry
US EPA
Office of Water

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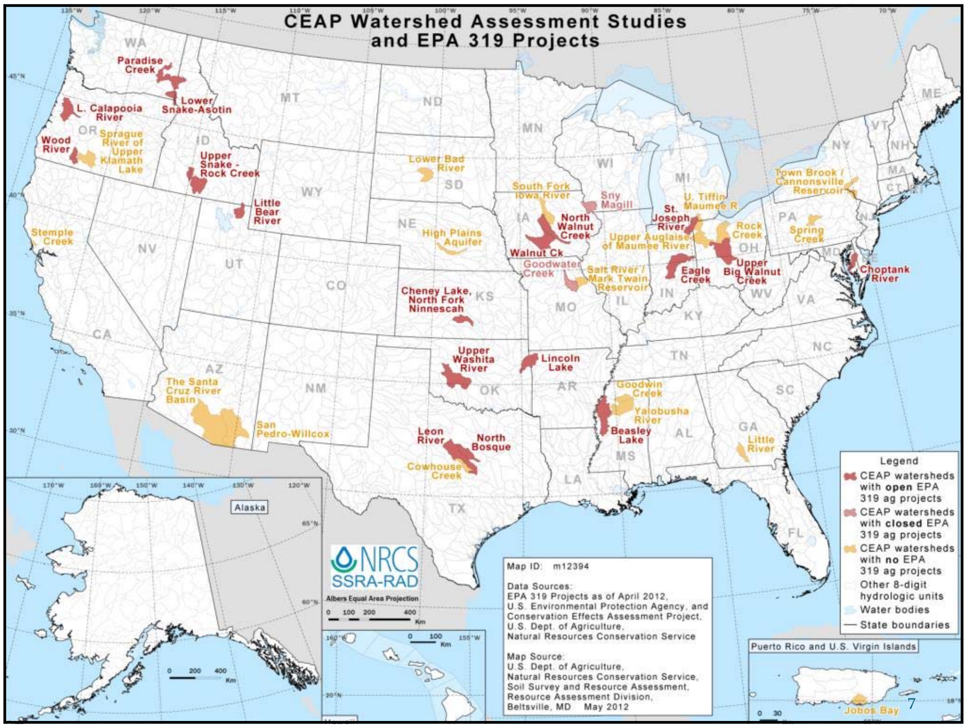
Conservation Effects Assessment Project (CEAP)

- Multi-agency effort to
  - quantify the environmental effects of conservation practices and programs, and
  - develop the science base for managing the agricultural landscape for environmental quality.
- Activities within CEAP
  - National / Regional Assessments
  - Watershed Assessment Studies
  - Bibliographies and Literature Reviews

US EPA History with CEAP

- 1st and 2nd CEAP coordinators were on detail to NRCS from EPA.
- EPA has served on the CEAP Steering Committee since the beginning.
- Participated in the watershed selection and other peer reviews.
- National / Regional Cropland Assessments
  - Mississippi River Basin
    - Utilization of the CEAP survey/modeling in design of the Mississippi River Basin Initiative.
  - Chesapeake Bay
    - A 2nd, more intensive CEAP cropland survey is underway.
    - EPA will continue to coordinate with USDA as part of the joint 2011 workplan that outlines commitments for continued collaboration on accounting for agricultural conservation and coordinating modeling efforts.
    - This study will provide useful insights into how things have changed since the 2003-2006 study, what's working, what more needs to be done, and where there are opportunities to more comprehensively manage nutrients.
- Overlap with §319 projects – in many of the CEAP watershed project areas.



CEAP Resources

- Wealth of information and products from CEAP.
- Cropland: Statistically valid survey on implementation of conservation practices
  - complete nutrient management
  - sediment control
- Many journal articles
  - Synthesis paper from CEAP Agriculture Research Service watersheds.

    Tomer & Locke (2011) Water Science & Technology 64:300-310

    "The challenge of documenting water quality benefits of conservation practices: a review of CEAP watershed studies,"

    available in the National Agriculture Library digital collection at:
    http://ddr.nal.usda.gov/dspace/handle/10113/49869
- Conservation Insights – watersheds, wildlife
- Literature Reviews: cropland, wildlife, wetlands, grazing lands

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Applicability to EPA/State Programs

- CEAP provides many important lessons for
  - designing and targeting conservation practices, systems, and programs
  - understanding factors that effect the ability to measure changes in water quality
  - moving away from individual practice implementation to conservation systems at the watershed scale
- At a minimum these lessons can be applied to these EPA/state/local programs
  - nonpoint source
  - source water protection
  - TMDL development and implementation
  - wetland restoration
  - water quality trading

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United States Department of Agriculture
Natural Resources Conservation Service

USDA NRCS

The Conservation Effects Assessment Project (CEAP)

Project Overview and Watershed Assessments

Lisa Duriancik, CEAP Coordinator
NRCS Resource Assessment Division

EPA Watershed Academy
May 15, 2012

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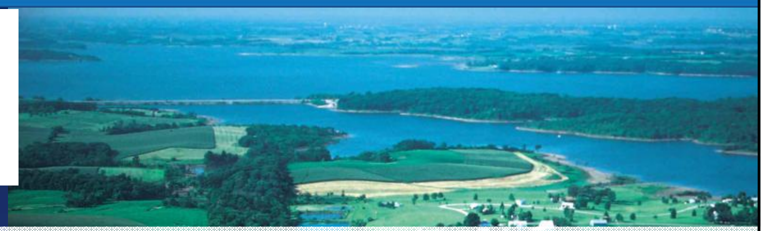
United States Department of Agriculture
Natural Resources Conservation Service

USDA NRCS



"…This study will …enable USDA to design and implement conservation programs that will not only better meet the needs of farmers and ranchers, but also help ensure that taxpayers' conservation dollars are used as effectively as possible."

- Tom Vilsack, Agriculture Secretary

United States Department of Agriculture
Natural Resources Conservation Service

USDA NRCS

Why do CEAP?

- OMB requests for outcome-based reporting
- 2002 Farm Bill
  - significant increase in conservation funding
  - call for better accountability
- Assessment to guide design and implementation of conservation programs

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Natural Resources Conservation Service

USDA NRCS

Goals of CEAP

- Estimate conservation effects and benefits at regional and national scales (2003)
- Quantify and establish the scientific understanding of conservation practice effects at watershed scales (2003)
- Improve efficacy of conservation practices and programs (2008)
  - Conservation Planning and Implementation
  - Management Decisions and
  - Policy

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Duriancik, et al., 2008, JSWC Vol. 63, No. 6, pp.185A-197A.
Maresch, et al., 2008, JSWC Vol. 63, No. 6, pp. 198A-203A.

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CEAP Vision for the Future (2008)

- **Vision:** enhanced natural resources and ecosystems through
  – more effective conservation
  – better management of agricultural landscapes

- Research
  – Build science base for environmental quality
    - Evaluating alternative conservation strategies
    - Identifying socio-economic factors
- Assessment
  – Estimate conservation effects and treatment needs
- Translating of Science into Practice
  – Implementing CEAP knowledge and insights

Maresch, et al., 2008, JSWC Vol. 63, No. 6, pp. 198A-203A.

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Collaboration is critical to CEAP

- CEAP Interagency Steering Committee
  - USDA
    - **Natural Resources Conservation Service**
    - Agricultural Research Service & National Agricultural Library
    - National Institute of Food and Agriculture
    - Farm Service Agency
    - National Agricultural Statistics Service
    - Economic Research Service
    - U.S. Forest Service
  - U.S. Environmental Protection Agency
  - DOI U.S. Geological Survey
  - DOI Bureau of Land Management
  - DOI U.S. Fish and Wildlife Service
  - DOC National Oceanic and Atmospheric Administration
  - National Aeronautics and Space Administration
- Other partners: LGUs, State agencies, SWCS, TNC, Joint Ventures, AFWA, ESA, SSSA/ASA/CSSA…many others
- AAFC Watershed Evaluation of Beneficial Management Practices

AAAS Award: Exemplary Collaborative Case Study

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CEAP Organization: Activities

- National / Regional Assessments
  - Cropland (Cultivated)
  - Grazing Lands (Range and Pasture)
  - Wetlands (Depressional and Riverine)
  - Wildlife (Terrestrial and Aquatic)

❖ Focus on estimating conservation effects and assessing future conservation treatment needs

CEAP Wetlands

CEAP Croplands

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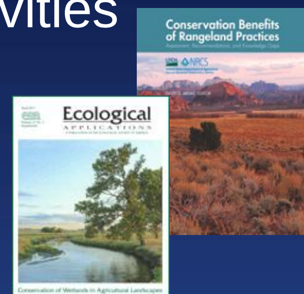
CEAP Organization: Activities



- National / Regional Assessments
  - Cropland (Cultivated)
  - Grazing Lands (Range and Pasture)
  - Wetlands (Depressional and Riverine)
  - Wildlife (Terrestrial and Aquatic)
- Watershed Assessment Studies
  - ARS Benchmark
  - NIFA Competitive (including a synthesis study)
  - NRCS Special Emphasis

- Bibliographies and Literature Reviews
  - 3 NEW literature syntheses last year
  - Bibliographies- http://www.nal.usda.gov/wqic/ceap/index.shtml

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Key Findings from CEAP —

- Conservation practices work.
- Comprehensive planning is needed because suites of practices work better than single practices.
- Targeting critical acres improves effectiveness significantly.
- Although gains have been made, critical conservation concerns still exist.

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ARS CEAP Watersheds Key Findings –

"While practices improved water quality, problems persisted in larger watersheds.

This dissociation between practice-focused and watershed-scale assessments occurred because:

(1) Conservation practices were not [always] targeted at critical sources/pathways of contaminants;
(2) Sediment in streams originated more from channel and bank erosion than from soil erosion;
(3) Timing lags, historical legacies, and shifting climate combined to mask effects of practice implementation; and
(4) Water quality management strategies addressed single contaminants with little regard for trade-offs among contaminants."

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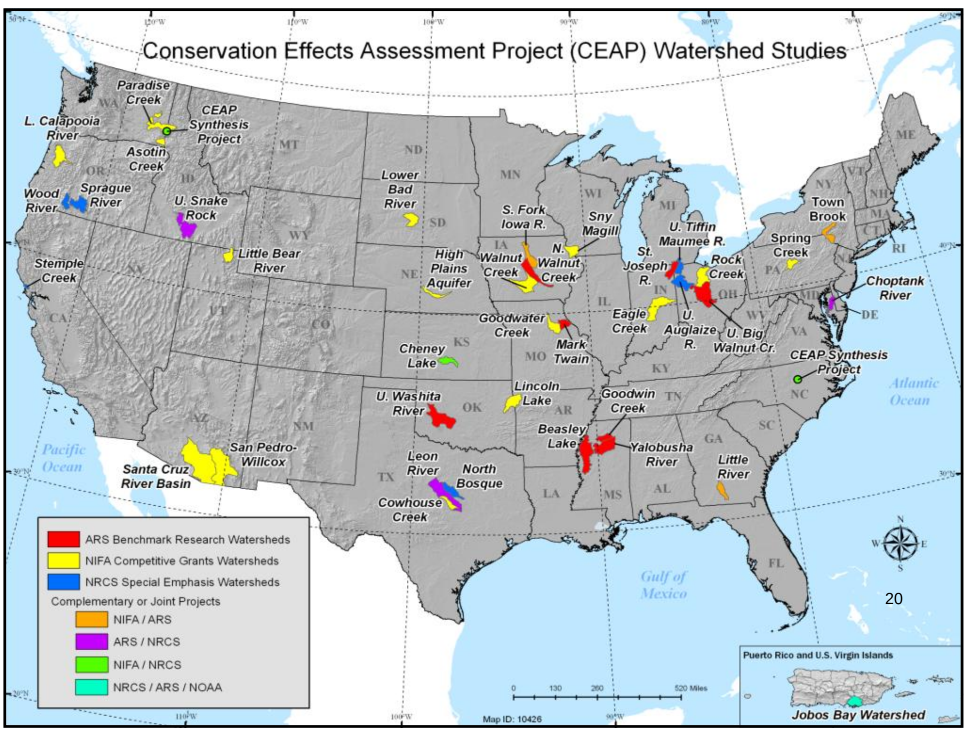
Tomer & Locke. 2011. Water Science & Technology 64:300-310
http://ddr.nal.usda.gov/dspace/handle/10113/49869



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Key questions: Watershed Assessments

- **Effects of location, suites and timing of practices**
- Interactions among practices
- Socio-economic factors that facilitate or impede implementation and maintenance
- Optimal suite and placement of conservation practices

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Approaches: Watershed Assessments

- Small Watershed Scale – 8 to 12 HUCs
  - cropland and pastureland
- Long-term databases (10 to 30+ years)
  - retrospective analyses initially
- Geospatially referenced data
  - land use history/land cover, soils, conservation practices, water monitoring data
- Model Use & Development
  - SWAT, AnnAGNPS, APEX, WEPP, CONCEPTS
- Human dimensions analysis

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Questions?

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USDA's NIFA CEAP Watershed Synthesis: Lessons Learned

D. Osmond[1], D. Meals[2], M. Arabi[3], D. Hoag[3], A. Luloff[4], M. McFarland[5], G. Jennings[1], A. Sharpley[6], J. Spooner[1], and D. Line[1]

[1]NC State University, [2]Ice.Nine Environmental Consulting, [3]Colorado State University, [4]Penn State University, [5]Texas A&M University, [6]University of Arkansas

USDA United States Department of Agriculture National Institute of Food and Agriculture

NRCS

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Relating Water Quality Change to Conservation Practice Adoption: A History

Black Creek Project,1978-1984.

NIFA CEAP, 2004-2011

The Rural Clean Water Program,1980-1995.

Hydrologic Unit Area Projects
and Demonstration Projects,1991-1994.

Model Implementation Program,1978-1982

USEPA Section 319 National Nonpoint Source Monitoring Program, 1991 to present.

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NIFA CEAP Watershed Locations

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NIFA-CEAP Watershed Characteristics

State	Water Resource	Pollutant of Concern	Pollutant Source
Arkansas	Lincoln Lake & streams	P	Pastures, Animals, Development
Georgia	Little River	N, P	Crop Land
Idaho	Paradise Creek	Sediment	Crop Land
Indiana	Eagle Creek & Reservoir	Sediment, P, N, Atrazine, *E-Coli*	Crop Land, Development
Iowa	Walnut Creek	N	Crop Land
Kansas	Cheney Lake	P, Sediment	Crop Land, Animals
Missouri	Goodwater Creek	Atrazine, P, N, Sediment	Crop Land
Nebraska	High Plains Aquifer	N	Irrigated Crop Land
New York	Cannonsville Reservoir	P	Crop Land, Animals
Ohio	Rock Creek to Lake Erie	Sediment, P	Crop Land
Oregon	Calapooia River	Temperature, *E-Coli*	Crop Land, Animals
Pennsylvania	Spring Creek	Sediment, N, P, Macro invertebrates	Pastures, Animals, Development
Utah	Little Bear River	P	Crop Land, Animals

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Questions to Be Answered by All NIFA CEAP Projects

Four principal questions:

1. How do the **timing, location, and implemented practices** affect water quality at the watershed scale?
2. What are the **relationships among conservation practices** implemented with respect to their impact on water quality?
3. What **social and economic factors** facilitate or impede implementation of conservation practices?
4. What is the **optimum set of conservation practices and optimal placement** within the watershed in order to achieve water quality goals?

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NIFA CEAP Watershed Projects: Outputs

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Synthesizing and Extending Lessons Learned from the 13 NIFA-CEAP Watershed Projects: Objectives

- Summarize and describe the science-based information and lessons learned from CEAP NIFA projects
- Deliver knowledge to policy makers within key organizations

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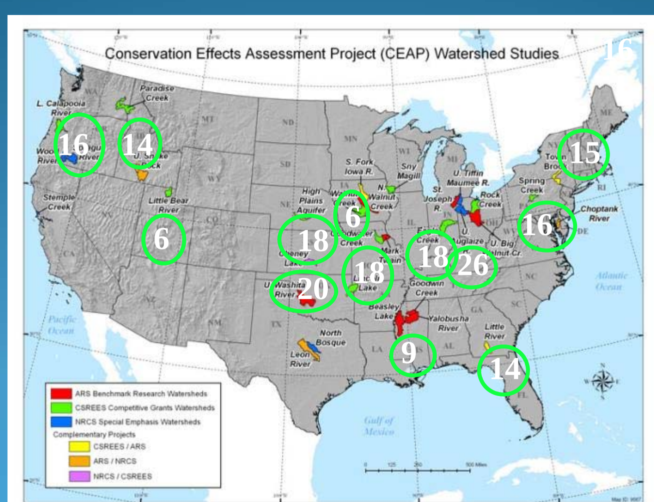
Methodology for Synthesizing Lessons Learned

- Framework or template
  - Compile information prior to site visit
  - Site visit: four person team
    - Project overview
    - Watershed tour
    - Discussions by topics
  - Template information reviewed by NIFA CEAP project personnel
  - Finalize project information
- Key informant survey
  - Identify participants
    - Project personnel
    - Agency personnel
    - Producers
    - Community leaders
    - NGOs
    - Agribusiness
  - Interview participants
  - Finalize key informant information

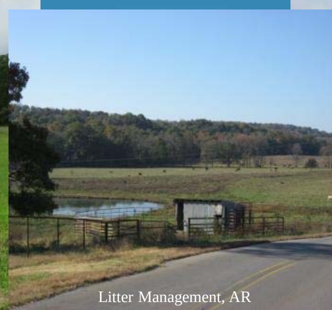
Number of Key Informant Interviews at Each NIFA-CEAP Watershed



NIFA CEAP Synthesis: Land Treatment

Lessons Learned


Conservation Tillage, GA


Litter Management, AR


Terrace and Grassed Waterways, OH

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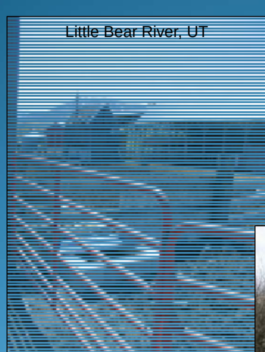
What would make conservation practice implementation better?


Little Bear River, UT


Paradise Creek, ID


Little River, GA

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Land Treatment

Identify appropriate conservation practices

Before identifying and implementing appropriate conservation practices, it is critical to understand

- pollutants of concern
- pollutant sources
- hydrology

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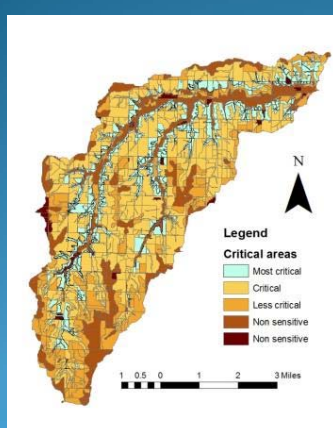
Land Treatment

Target practices to the most critical areas in the watershed and assure sufficient coverage



- Spatial distribution of treatment matters
- Past conservation practices have not been effectively targeted to critical source areas
- Sufficient numbers of practices

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Land Treatment

Understand how conservation practices function


Missouri CEAP, 2010

- Conservation practices may function differently than expected
- Conservation practices may affect pollutants differentially
- Conservation practices may lead to other changes that affect water quality

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Land Treatment

Understand the farmer's perspective

Kansas CEAP, 2011

- Ability to see the pollutant or effects increases adoption
- Threat of regulation, implementation of regulation, or lawsuits focuses adoption

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Land Treatment

Understand the farmer's perspective

Idaho CEAP, 2008

- Producers tend to select practices that encourage ease of management, increased yields, and or profits.
  - ..."conservation competes with the time the farmer could be using to make money"

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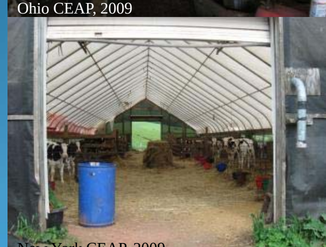
Land Treatment

Understand the farmer's perspective

Ohio CEAP, 2009



New York CEAP, 2009

- Technology changes or trust in a product can have large impacts in adoption
- Producers and professionals may see conservation practices differently
- Management practices are more frequently abandoned than structural practices

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Land Treatment

Understand human relations


New York CEAP, 2009

- Conservation practice acceptance may take a generation
- Family dynamics affect conservation practice adoption

Conservation practice adoption is a multivariate choice

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What would improve conservation education?

Focus on where farmers already obtain information

- Farmer – to – farmer works best
- Trusted local agency personnel
- Self-research, magazines, grower meetings, and demonstrations were also mentioned.
- Reduction in government services


Photo by Don Meals,,Kansas CEAP 2010

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Land Treatment: Key Points

Iowa CEAP, 2008

Agencies and producers must do a better job of selecting the correct conservation practices and implementing sufficient amounts in the appropriate critical areas.

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Land Treatment: Key Points

Kansas CEAP, 2010

Conservation planners must do a better job of understanding the needs, work environment, family demands, and mindset of the end-users of conservation practices – farmers.

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Land Treatment: Key Points


Missouri CEAP, 2009

Erosion control has increased substantially due to technological advances, price and labor pressures, and conservation programs. Much of the sediment is coming from streambanks and streambeds, not uplands.

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Land Treatment: Key Points


Kansas CEAP, 2010

Controlling nutrient pollution will continue to be a significant challenge:

- **management practices**
- **farmer buy-in**
- **antagonistic outcomes of conservation practices**
- **significant coverage necessary**
- **increased drainage**
- **climate change**

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Questions?

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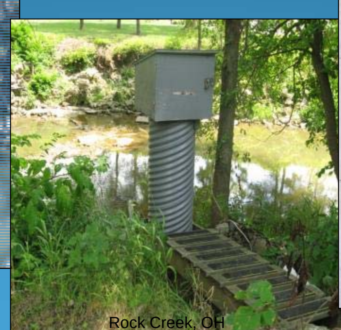
NIFA CEAP Synthesis: Water Quality Monitoring

Lessons Learned

Little Bear River, UT



Rock Creek, OH

Cheney Lake, KS

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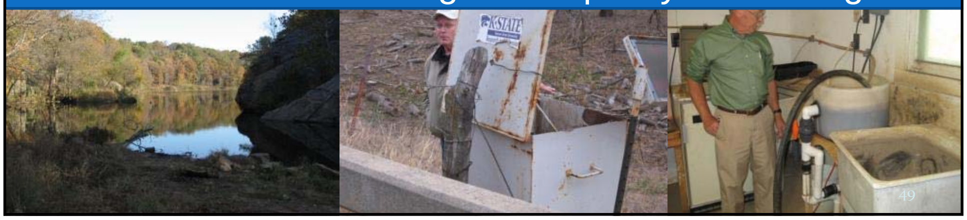
Water Quality Monitoring to Validate Effectiveness of Conservation Practices

The majority of watershed projects should not spend resources conducting water quality monitoring



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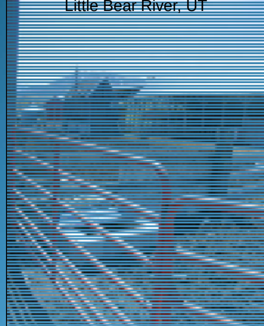
What would make conservation practice monitoring better?

Little Bear River, UT



Little River Watershed, GA

Cheney Lake Watershed, KS

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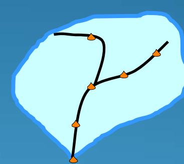
Water Quality Monitoring

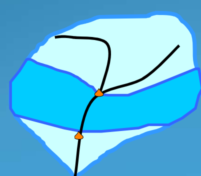
Design watershed monitoring to meet objectives

Designs for monitoring effectiveness of conservation programs are critical

Trend/Load



Sub-basin



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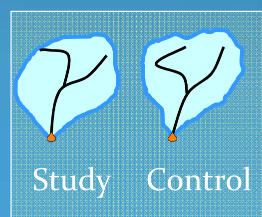


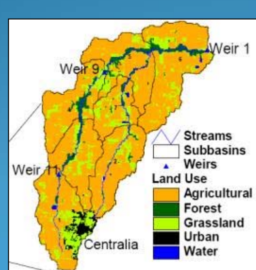
Paired Watershed

Water Quality Monitoring

Scale matters

Water quality improvements are easier to detect in a reasonable timeframe in small watershed compared to large basins

- Low level of implementation relative to pollutant sources
- More complex transport/storage
- Longer lag time
- Watershed activities more difficult to track



Water Quality Monitoring

Follow good monitoring practices

- Monitor the pollutant(s) being treated and important covariates
- Account for variability – watershed, climate, pollutant generation
- Capture temporal patterns, e.g., storm events, seasons
- Capture spatial variation; focus on small watersheds
- Monitor at adequate duration to overcome lag time
- Monitor at adequate frequency
  - Infrequent fixed-interval grab samples for water quality variables coupled with sparse flow measurement cannot generate adequate load data

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Water Quality Monitoring

Use care in relying on historical water quality data

- It is extremely challenging to rely on past water quality data for present-day analyses
- Historical water quality data should be evaluated critically as they may not be usable for contemporary purposes

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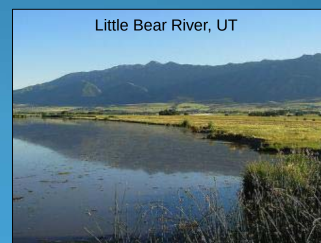
Water Quality Monitoring

Use effective indicators of response to treatment

PA: effects of riparian buffers seen in simple number of aquatic organisms, but not community indices

UT: Aerial video used to evaluate effects of historical land treatment on riparian condition

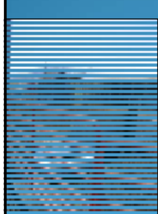


Water Quality Monitoring

To couple water quality monitoring and land use it is critical to know status and location of practices

Must account for changes in land use and management when evaluating conservation practice impacts over time.

- Data on farming systems (e.g., split application of herbicides) needed to explain monitoring results
- Information on conservation practice operation and maintenance is critical in long-term projects, yet rarely obtained
- Need to extend oversight activity beyond initial installation period



Utah CEAP:

- Official records very limited on nature, location, timing, long-term operation and maintenance of conservation practice implementation
- More robust and accurate systems for tracking, operation, and maintenance are needed

Jackson-Smith et al. 2010. *J Soil Water Cons. 65(6):413-423*

Water Quality Monitoring

No matter how rigorous the water quality monitoring, it will be impossible to link observed changes in water quality to land treatment without equally rigorous land treatment and management monitoring.

- Lack of reliable data on conservation practice status – especially operation and maintenance – is a major problem
- Access to USDA practice data and records is very important and was difficult to obtain. However recent changes have made data access less difficult.

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Without effective water quality AND land treatment monitoring, we are unlikely to be effective in linking conservation practices to water quality response.

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Water Quality Monitoring: Key Points

Monitoring must be designed to meet specific objectives in a specific context; generic programs or past data are unlikely to be effective

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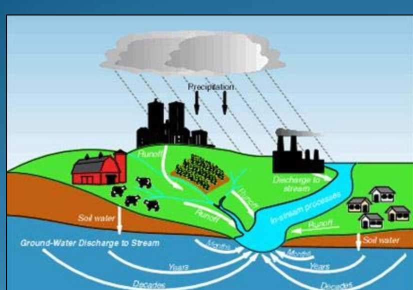
Water Quality Monitoring: Key Points



Understand the system being monitored – especially pollutants, sources, transport, and lag time

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Water Quality Monitoring: Key Points

Good monitoring is necessary, but also complex, technically challenging, and expensive. Resources spent on poor design and execution are often wasted.

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Water Quality Monitoring: Key Points

Knowledge of land use, management, and conservation practices is absolutely essential to understand effectiveness of conservation programs. Such data are often unavailable due to confidentiality or incomplete accounting.

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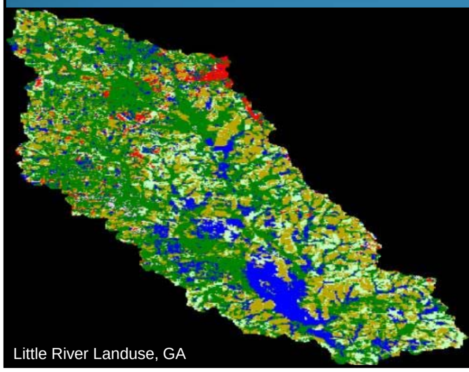
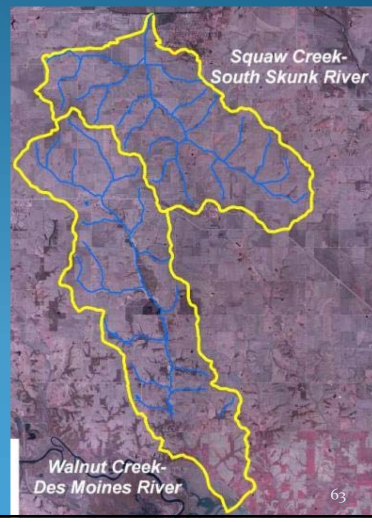
NIFA CEAP Synthesis: Water Quality Modeling

Lessons Learned



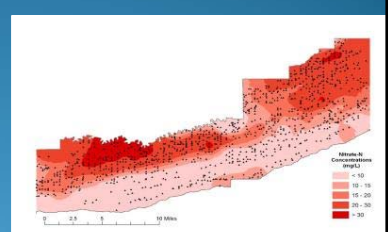
Little River Landuse, GA



Water Quality Modeling

Ensure skilled personnel

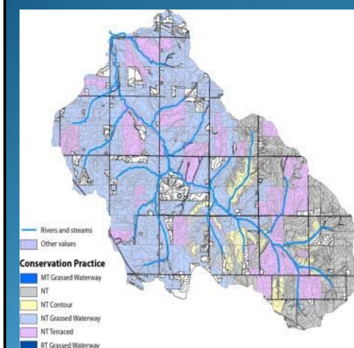
- Expertise for development and application of watershed models involve:
  - comprehensive knowledge of hydrologic and biogeochemical processes and essential characteristics of the watershed system under study
  - computer programming and GIS skills
  - adequate knowledge of statistical concepts for exploratory data analysis



From NE CEAP with permission of M. E. Exner

Water Quality Modeling

Select the appropriate model and analyze results



From Rabotyagov et al. 2010

- Add additional algorithms if necessary to better represent hydrologic processes
- Use linked models, such as WEPP and CONCEPTS where appropriate but
  - be careful in linking models due to parameter interactions that lead to, for example, inaccurate identification of critical pollutant source areas and pathways
- Analyze model results relative to the biophysical system

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Water Quality Modeling

Use modeling information and monitoring data

Benefits of land treatment options from modeling studies often overestimated reductions in sediment and nutrients relative to monitored trends due to:

- modeling uncertainties
- lack of sensitivity and/or statistical power in the monitoring program
- lag time between implementation of conservation practices and reduction of pollutants at the watershed outlet
- degradation of practices due to operation and maintenance issues
- unaccounted disturbances in the systems

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Water Quality Modeling

Models are still "young"

The Scientific basis of existing models for conservation planning is still evolving……

There are still many deficiencies in our knowledge and in existing modeling tools for representation of critical natural processes and key management actions at the watershed scale. In general, the complexity and non-linear nature of watershed processes overwhelm the capacity of existing modeling tools to reveal the water quality impacts of conservation practices.

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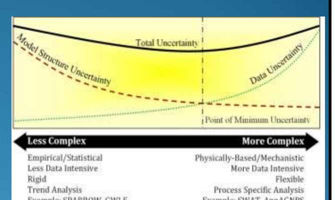
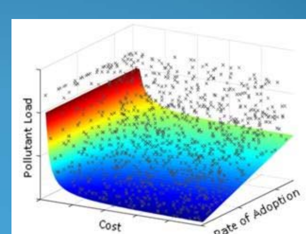
Water Quality Modeling: Key Points

Models are very complex. Select the correct model(s) and modify if necessary. Ensure sufficiently trained personnel, well calibrated and validate models, and adequate water quality and land treatment data, including spatial and temporal changes of these data.





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Lessons From History

Programs to link land treatment with water quality have been funded since 1978 with the goal of understanding conservation practice effects at the watershed scale. Some of the lessons learned in the NIFA-CEAP were observed in these earlier programs and projects; some are new. The lessons were rarely integrated into most state and federal programming that funds conservation practices. With dwindling resources and mounting environmental degradation, it is essential that many of the lessons from NIFA-CEAP be integrated into policy and agency protocol if water resources are to be protected or improved.

2004-2011.

91-1994.

onpoint
91 to present.

Conclusion

Taken in their aggregate, and with the new knowledge provided through the NIFA-CEAP projects, agencies (public and private), industry, and farmers and ranchers can increase the effectiveness of conservation practices and leverage public funds by reorienting conservation planning and implementation.


Indiana CEAP, 2011

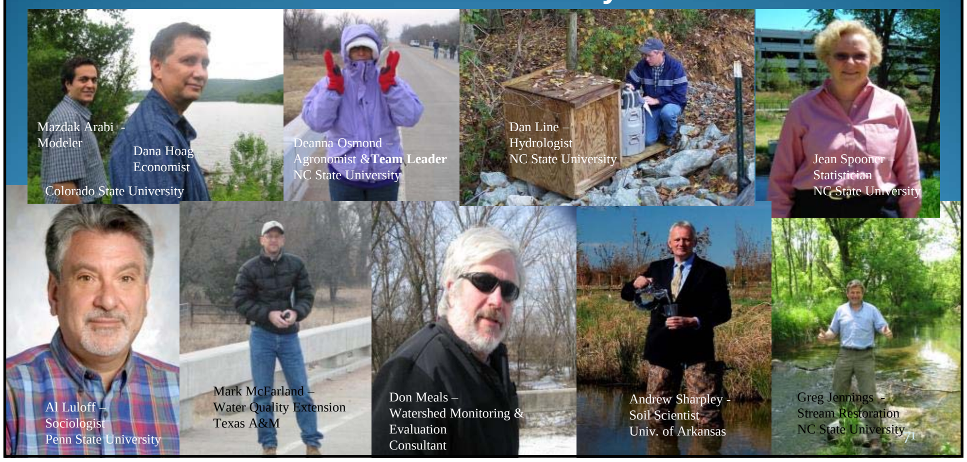

Oregon CEAP, 2011

The CEAP Synthesis Project

Thanks all the NIFA-CEAP watershed project personnel, key informants, NIFA-CEAP staff, and USDA-NRCS-CEAP personnel

Our Sponsors USDA United States Department of Agriculture National Institute of Food and Agriculture NRCS

The NC State University Team



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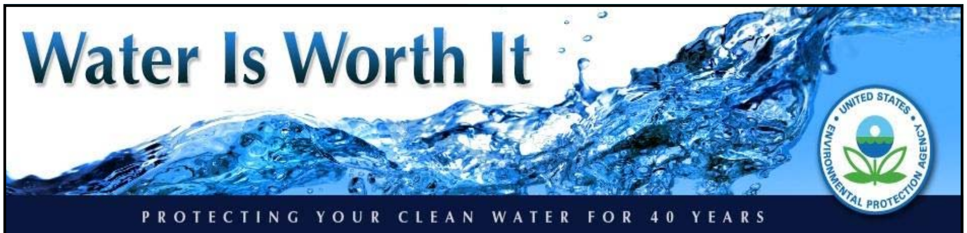

Next Watershed Academy Webcast

June 14, 2012 Webcast:

Section 319 Nonpoint Source Projects Reducing Agricultural Pollution

Registration will be posted at
www.epa.gov/watershedwebcasts

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