GRANT YR: 2009
GRANT AMT: $544,500

INVESTIGATOR: Shelton, D. P.; Feehan, K. A.; Franti, T. G.; Rodie, S. N.

Northeast Res & Extension Center
UNIVERSITY OF NEBRASKA –

IMPROVING AND CONSERVING WATER RESOURCES THROUGH STORMWATER MANAGEMENT EDUCATION FOR COMMUNITY DECISION MAKERS OF TODAY AND TOMORROW

NON-TECHNICAL SUMMARY: Traditional approaches treat stormwater as a problem to be conveyed away as rapidly as possible with curbs, gutters, storm drains, and similar practices. The new paradigm views stormwater as a resource to be retained and used on-site or allowed to infiltrate. Green infrastructure such as rain gardens, bioswales, rain barrels, eco roofs, and others manage stormwater more naturally, conserve water, and improve water quality by retaining runoff that may contain multiple contaminants. The project goal is to conserve water resources and improve water quality through an integrated approach to stormwater management and greenspace practice education that strongly connects extension programming, classroom education, and field research. Audiences include municipal leaders and residents, 4-H and youth, undergraduate and graduate students, landscape industry professionals, and Master Gardeners. Objectives include: deliver a multi-faceted extension education program using a variety of techniques such as hands-on workshops, green infrastructure tours, demonstration sites, publications, and on-line resources; integrate stormwater management and green infrastructure topics into undergraduate courses and service learning projects; and evaluate in situ rain garden hydrologic parameters using a unique Storm Runoff Simulator. Anticipated impacts include: audience recognition of the environmental, economic, and aesthetic benefits of green infrastructure; increased ability of graduates to design innovative stormwater management solutions; improved rain garden designs; and improved water quality and conservation. This project helps meet the education and outreach goals of the EPA National Pollutant Discharge Elimination System stormwater program for Phase II communities, and contains elements of six National Water Program Themes.

OBJECTIVES: EXTENSION: 1) Provide science-based educational materials and hands-on learning experiences for leaders and residents of Nebraska Phase II municipalities to: a. Increase the use of water-sensitive landscape design and best management practices. b. Increase information available to municipal leaders to assist in making viable, cost effective decisions for municipal stormwater management. c. Help meet the Phase II public education and outreach measures as established by EPA. 2) Design and implement a multi-media enhanced curriculum and experiential learning 4-H/Youth program that will actively engage youth to increase their understanding and knowledge of stormwater hydrology and green infrastructure, and improve the skills needed for successful career preparation and as future decision makers. 3) Develop and deliver educational programs and hands-on learning opportunities for green industry professionals to help meet the growing demand for sustainable greenspace solutions and expand recognition of entrepreneurial opportunities. 4) Integrate stormwater hydrology and greenspace topics into Master Gardener training to prepare them for incorporating new water perspectives into their outreach programs. 5) Investigate regional and national interest in developing a Green Infrastructure for Stormwater Management eXtension Community of Practice. Share information developed in this project to increase availability of green infrastructure for stormwater management information. EDUCATION: 1) Integrate stormwater management and green infrastructure topics into new and existing UNL Landscape Architecture, Landscape Design, and Turf/Landscape Management courses. 2) Develop a new professional elective course in the Landscape Architecture undergraduate curriculum that focuses on elements of stormwater management and green infrastructure. 3) Develop and coordinate interdisciplinary stormwater management and/or green infrastructure service learning projects for landscape architecture, civil engineering, and water science, and planning students. 4) Establish a landscape architecture internship to expand student learning and develop strong program linkages with professional design and planning firms that emphasizes green infrastructure projects and approaches. 5) Educate and provide teaching and research opportunities for two Masters Degree students with a specific emphasis on green infrastructure components of stormwater management. RESEARCH: 1) Evaluate plant growth and performance in established rain gardens under Nebraska climate and conditions to enable revised plant selection and care recommendations. 2) Evaluate the hydrology of established rain gardens under Nebraska climate and conditions to enable revisions of design sizing and installation recommendations. 3) Deliver a UNL research seminar series featuring regional and national experts on green infrastructure for stormwater management.

GRANT YR: 2009
GRANT AMT: $660,000

INVESTIGATOR: David, M. B.; Flint, C. G.; McIsaac, G. F.; Cooke, R. A.; Kalita, P. K.; Czapar, G. F.

PERFORMING INSTITUTION:
Natural Resources & Environmental Sciences
UNIVERSITY OF ILLINOIS

TILE DRAINAGE MODIFICATIONS TO REDUCE NITRATE LOSSES IN AN AGRICULTURAL WATERSHED: INTEGRATION OF BIOPHYSICAL AND SOCIAL SCIENCES WITH EXTENSION AND EDUCATION

NON-TECHNICAL SUMMARY: Drainage losses from tile-drained agricultural fields in the upper Midwest are now well established as the major source of nitrate to the Gulf of Mexico, delivered by the Mississippi River. This is a major factor in causing an hypoxic zone that forms each summer in the Gulf. The flat, productive soils of central Illinois produce high yields of corn and soybeans, but the tile-drainage needed to make agricultural production practices feasible and timely on these fields leak large amounts of nitrate. Therefore, the long-term goal of our project is to develop biophysical and social science techniques that could lead to large watershed-scale reductions in nitrate export. Our project will focus on the effectiveness and social barriers to implementation of two drainage-related management practices; drainage water management (controlled drainage) and saturated riparian buffers in the heavily tile-drained and high nitrate Spoon River subwatershed of the Upper Salt Fork watershed in east-central Illinois. We will work closely with an active watershed group in all phases of our work that includes a wide range of stakeholders. Modified drainage systems will be installed on the watershed and their effectiveness fully assessed, focusing on where the water goes as well as overall nitrate removal. Simulation modeling will be used to better understand how modified drainage systems would work under varied weather conditions that might occur over many years. We will implement a full range of extension activities including: fact sheets that highlight research results and document the water quality benefits of the project; field days to demonstrate results to producers, landowners, and the general public; a DVD that explains the benefits of modified drainage systems; and information on the watershed group's website about the benefits of modified drainage systems. Surveys and focus groups will assess stakeholder interests and motivations before and

after extension programming. At the end of our study we will have a thorough understanding of the biophysical aspects of modified drainage systems, as well as knowledge of stakeholder acceptance and barriers (and what incentives might overcome the barriers), effective extension programs, and evaluations of our work. The next generation of professionals will receive education from both biophysical and social science viewpoints, including a field methods course using the watershed as a laboratory, a seminar discussion course that integrates biophysical and social sciences, and a service learning course for 6-8 grade students about watersheds and water quality problems.

OBJECTIVES: In conjunction with an active watershed group, our overall goal is to further develop and determine the effectiveness of methods of modifying tile drainage systems to reduce nitrate export at the watershed scale, including understanding stakeholder motivations and response to extension programs, allowing better development of programs that will lead to increased participation in new conservation programs (behavior change) and watershed level reductions in nitrate loads. Specific objectives for a tile-drained agricultural watershed in east-central Illinois are to: 1. Determine the fate of water and nitrate with both saturated riparian buffers and managed drainage and at the field scale, including the effectiveness in removing nitrate (research objective); 2. Model modified drainage systems using a long-term climate record to assess performance beyond the weather conditions that occur during the monitoring phase of this project (research objective); 3. Demonstrate how modified drainage systems can improve local water quality with a variety of outreach tools (extension objective); 4. Understand stakeholder motivations with respect to water quality and acceptance of modified drainage systems, leading to better targeted extension programming (research objective); 5. Evaluate the acceptance by stakeholders of modified tile drainage systems that improve water quality, including possible incentives needed to implement these practices to obtain watershed scale improvements (research and extension objective); 6. Develop both seminar/discussion and field-based courses for undergraduate and graduate students, leading to students equipped with both biophysical and social science skills who can deal with watershed scale water quality issues (education objective); and 7. Involve grade 6-8 students in local water quality issues through a service-learning experience (education objective). Major specific outputs from the project will include: a web site documenting all results, activities, and meetings with stakeholders; field and seminar/discussion courses taught, focused on integration of biophysical and social science on water quality in the watershed; a service learning course taught to grade school children on watersheds; results on effectiveness of modified drainage systems; long-term modeling results on how climate affects performance of the modified drainage systems, leading to a more complete understanding of what we could expect at the watershed scale; final measurement of effectiveness of extension programming and how stakeholder motivation, acceptance, and views of modified drainage system have changed; an increased understanding of how new incentive programs might be designed to have widespread stakeholder acceptance to improve water quality; understanding of how our education program has affected student learning and views about water quality; and a workshop report and web site to provide results to a wide audience.

GRANT YR: 2009
GRANT AMT: $615,000

INVESTIGATOR: Arabi, M. A.; Bauder, T. B.; Fontane, D. F.; Hoag, D. H.; Garcia, L. G.; Osmond, D. O.

PERFORMING INSTITUTION:
Civil and Environmental Engineering
COLORADO STATE UNIVERSITY

A MULTI CRITERIA DECISION TOOL FOR THE ASSESSMENT AND PLANNING OF WATERSHED MANAGEMENT PRACTICES

NON-TECHNICAL SUMMARY: This integrated study aims to develop and disseminate an innovative open-source web technology, called eRAMS, that enhances decision makers' capacity to target conservation practices for sediment, nutrient and pesticide control. The development of eRAMS will focus on the nexus of technical and institutional barriers in adoption of targeting strategies. Technical barriers will be addressed by automating the multi criteria targeting process on the internet. The eRAMS technology will automate spatial overlay of soil, land use, and other data layers in order to create input files for the field-scale APEX and the watershed-scale SWAT models. The technology will also include a system optimization module that fully explores the tradeoffs between conflicting socioeconomic and environmental criteria at the watershed scale, but more importantly, can unambiguously identify the range of solutions that are most consistent with stakeholders' priorities. This project takes technology transfer to a whole new level, because extension of the targeting tool does not require installation of any specialized hardware and software by end-users. Thus, watershed planners will benefit from vast data resources and models that are currently accessible to the research community, and will be empowered to assess the costs and conservation benefits of alternative management scenarios. To foster broad participation, the web technology will be developed under the supervision of an advisory group from agencies that are most likely to use the tool for the assessment and planning of conservation systems and making management decisions. In addition, farmers and landowners will be included in this group since decisions are implemented at a landowner and farm level. Although our efforts will be initially focused in the South Platte River Basin in Colorado, the applicability of the technology will be spatially corroborated in two other watersheds within the U.S. with significantly different eco-hydrologic regimes. We will address institutional barriers to adoption of new technologies by coordinating our efforts with federal agencies that are responsible for building capacities for conservation planning. The eRAMS tool and its components will be designed in line with the data and modeling infrastructure of these institutions, who have pledged their support and commitment to the successful completion of this project. Moreover, the versatility of the proposed targeting approach will be weighed against current policy instruments (e.g., cost-sharing) for prioritization of conservation practices. We will use multiple vehicles to conduct extension and outreach of our findings to targeted groups including the National Integrated Water Quality Project Committee for Shared Leadership - Water Quality, USDA, USEPA, and watershed groups. Educational and outreach materials will be developed and used in two courses at CSU and national workshops.

OBJECTIVES: This project aims to develop and disseminate an innovative web technology- called eRAMS- that enhances decision makers' capacity to target conservation practices for sediment, nutrient and pesticide control. The eRAMS technology will be designed such that it can explicitly incorporate socioeconomic and environmental factors in the targeting process. Focusing on the nexus of technical and institutional barriers in adoption of targeting strategies, we will establish the versatility of the proposed approach in comparison with current policy instruments for implementation of BMPs, particularly with the field-scale scoring system used in the Environmental Quality Incentive Program (EQIP). This project takes technology transfer to a whole new level, because extension of the tool does not require installation of any specialized software by end-users. The development of eRAMS is well in line with the long term vision of federal agencies that develop tools and capacities for conservation planning. Thus, as new data become available and the scientific basis of models (e.g., SWAT and APEX) improves, so does our technology. We envision that eRAMS will benefit watershed

stakeholders that are involved with the planning and implementation of conservation systems at multiple levels. First, eRAMS will allow collection and cataloging the location and attributes of conservation practices at no cost. Availability of high resolution satellite images in the background will facilitate identification of field boundaries and mapping of practice locations. The tool will be compatible with current databases, and thus, can be used seamlessly upon its transfer to watershed stakeholders. Second, planners will benefit from vast data resources and models that are currently accessible to the research community. The merely technical aspects of modeling such as watershed delineation and input creation will be automated. Thus, planners can easily create a field model (e.g., APEX) and a watershed model (e.g., SWAT) for their area of interest on the internet, and perform scenario analysis for conservation planning. Further, the visualization component of the tool will enable planners to engage producers in the assessment of costs and conservation benefits of their management decisions. Finally, the planning component of our technology can be used to answer questions such as: what combination of types and locations of practices will provide the most conservation benefits at the field level or in the watershed of interest for a specified budget What would be the cost of attaining water quality standards for a given watershed Is it feasible to attain certain water quality targets (e.g., TMDLs) for a specified budget

PROJECT CONTACT:

Name: Arabi, M.
Phone: 970-491-4639
Fax: 970-491-7727
Email: mazdak.arabi@colostate.edu
URL: http://www.engr.colostate.edu/~marabi

GRANT YR: 2009
GRANT AMT: $566,610

INVESTIGATOR: Ullman, J. L.; Pan, W. L.; McCracken, V. A.

PERFORMING INSTITUTION:
Biological Systems Engineering
WASHINGTON STATE UNIVERSITY

PROTECTING WATER RESOURCES BY ENGAGING STAKEHOLDERS IN TARGETED IMPLEMENTATION OF FILTER STRIPS

NON-TECHNICAL SUMMARY: The essential problem addressed by this project is the degradation of surface water and groundwater by agricultural nonpoint source pollution. The establishment of best management practices (BMPs) has been effective in some places and with some sources of pollution, but more work is needed to develop decision-making tools that target BMP implementation to maximize water quality protection. This project examines vegetative filter strips as a BMP to mitigate sediment and nutrients in the highly irrigated Yakima River Basin of central Washington State. Filter strips have been adopted in other parts of the United States, but information is limited on appropriate design for arid areas in the Pacific Northwest. The long-term goal of this project is to provide decision-making tools and adaptive management strategies to help watershed managers and producers protect water resources in the context of sustainable agriculture. The project will obtain field and socio-economic data to support development of interactive outreach tools that engage watershed stakeholders and encourage filter strip adoption.

OBJECTIVES: 1. Develop vegetative filter strip design parameters for sediment and nutrient removal in irrigation return flows to protect surface water and groundwater systems. 2. Develop a novel, interactive decision-making tool that incorporates economic impacts and social determinants for use in a multi-media setting to disseminate information. 3. Inspire Native American and Hispanic youth to join the next generation of leaders in agricultural and natural resource fields.

PROJECT CONTACT:

Name: Ullman, J. L.
Phone: 509-335-5948
Fax: 509-335-2722
Email: jullman@wsu.edu

GRANT YR: 2009
GRANT AMT: $652,000

INVESTIGATOR: Walker, F. R.; Hawkins, S. A.; Clark, C. D.; Layton, A. C.; Lambert, D. M.

PERFORMING INSTITUTION:
Biosystems Engineering and Soil Science
UNIVERSITY OF TENNESSEE EXTENSION

ENHANCING WATER QUALITY IN OOOSTANUALA WATERSHED: AN INTEGRATED APPROACH TOWARD UNDERSTANDING ADOPTION AND EFFICACY OF BEST MANAGEMENT PRACTI

NON-TECHNICAL SUMMARY: The Oostanaula Creek Watershed lies halfway between Knoxville and Chattanooga in eastern Tennessee. It covers almost 45,000 acres and includes the City of Athens. Land-use in this watershed is typical of many watersheds in Appalachia - all the way from Georgia to New York State. The valleys are long and narrow and separated by tall ridges. Forests dominate the sandstone ridges and animal agriculture (typically beef pasture and dairy operations) the limestone valley bottoms. When it rains, runoff from the ridges quickly finds its way to the valley floor carrying with it soil and manure particles that can impact water quality. For the people living in the watershed and those downstream it is important to understand how water quality can be improved in ways that are cost-effective and practical. Often, these non-point sources of pollution can be more difficult to control than pollutants from industrial discharge pipes. It can also be difficult to find the origin of these pollutants. We can collect a water sample and find that it has bacteria in it, but we need to know where the bacteria is coming from - is it the cattle in the pasture, wildlife, or the leaking septic system next to the creek Answering these questions would help us better target the way we spend money to improve water quality. We do know that there are some things farmers and others can do to reduce water pollution but often we are just guessing that these practices will always improve water quality. Education and public awareness campaigns can help people understand why water quality is important for everyone and inform them as to what simple things we can do to improve water quality- and this will be a large part of our project. But we do need to develop tools and techniques to help us better understand which practices work. We will be working with farmers and other landowners to try and understand why some people are keen to follow best management guidelines to improve water quality. We also want to understand why some people may be more reluctant to adopt best management practices that may enhance water quality. Is it because they have less money, are uninterested, or are less informed Our work will also refine techniques that can be used to identify where the bacteria are coming from. For example, we have the tools to find out if bacteria in water is from humans or cattle. This information lets us know whether we need to look for failing septic systems, or poorly managed farms. However, we still do not know whether the bacteria are coming from dairy cattle or beef cattle. Because these different types of animals are fed different diets and their manure treated in different ways, we think we can come up with

a new test that would tell us to which type of livestock operation we need to be targeting. A final thing we will be working on in this project is the improvement of a computer program that can predict how changes in watershed management practices might change water quality. If we have a reliable model then we could test our ideas before we implement any changes and save ourselves a lot of expense and effort by avoiding changes which have little impact on water quality.

OBJECTIVES: The Oostanaula Creek (HUC TN06020002083) is an agricultural watershed in eastern Tennessee, typical of the Ridge-and-Valley region occupying much of the eastern United States. The issues facing this watershed are common throughout the Ridge-and-Valley region (urbanization, water quality degradation, etc.). Segments of Oostanaula Creek are listed as impaired due to pathogens (E. coli), nutrient runoff, and loss of biological integrity due to siltation from pasture grazing systems. Total Minimum Daily Load targets have been established for sediment, pathogens, and phosphorus. In 2007, a watershed restoration plan was approved by Tennessee. Implementation of the plan will reduce E. coli loading, sedimentation and siltation, and eutrophication. Our goal is to use the best available science to identify sources of water quality degradation in the watershed and to encourage agricultural producers and other stakeholders to adopt cost-effective best management practices (BMPs) to reduce pathogen loading into the watershed, then to study why producers adopt or do not adopt BMPs. Our research objectives are to (1) analyze the willingness of livestock producers to adopt BMPs and model BMP adoption for the Watershed; (2) develop microbial source tracking assays discriminating between dairy and pastured beef fecal waste and; (3) improve ArcSWAT model sub-routine for pathogen fate and transport. Our education and extension objectives are to (4) develop a comprehensive watershed-wide education program to inform farmers, youth and adult residents about the importance of maintaining and improving water quality in the Watershed and; (5) conduct educational events throughout the Watershed to demonstrate that BMPs can simultaneously improve water quality and increase agricultural productivity. Expected results will (1) suggest the most cost-effective ways to improve water quality, (2) inform which incentives are likely to maximize acres allocated to BMPs by producers in the watershed, (3) isolate pathogen sources, and (4) provide understanding for the reasons producers adopt different BMPs. Tandem to optimal policy modeling, a two-phase survey will gauge the effectiveness of education and extension efforts geared towards disseminating information to producers about BMPs, pathogen vectors, and water quality.

APPROACH: Under Objective 1, we will analyze willingness of livestock producers to adopt BMPs and model BMP adoption for the Watershed. We will conduct two different surveys; in year one and year three. Responses will be georeferenced and integrated with the ArcSWAT architecture and will supplement secondary data collected from other sources to allow a more accurate geographic projection of agricultural practices in the Watershed. The information will provide a more accurate assessment of BMP efficacy, including estimates of the acres covered by various BMP packages under different policy scenarios. Under Objective 2a we will develop microbial source tracking assays to discriminate between dairy and pastured beef fecal waste. The microbial community profiles of cattle waste derived from dairy waste holding ponds and pastured cattle manure will be compared based on 16S rRNA gene sequences. After broad groups unique to either dairy waste or pastured cattle have been identified, specific primers will be designed to amplify targets that are more specific. For Objective 2b we will improve ArcSWAT model sub-routine for pathogen fate and transport. Fresh fecal samples will be collected from beef cattle and during dairy waste application events and analyzed for E. coli, as well as total, human and bovine Bacteroides genetic markers and any new source tracking genes identified in Objective 2a. Additionally, we will determine the stochastic relationships between E. coli and the source tracking targets, which may prove useful in selecting and specifying BMP installation using ArcSWAT. Under Objective 3, we will develop a comprehensive watershed-wide education program to inform youth and adult residents about the importance of maintaining and improving water quality. We will use a variety of proven methods using different educational models from mass media to one-on-one contacts. The youth of the Watershed will be targeted through programs delivered through an active 4H program in McMinn County. A standardized water curriculum called 4H2O for "4H'ers" will be tested. Adult education programs will be given through local farmer groups. We will continue to partner with the City of Athens for the annual Oostanaula Creek clean up and develop an educational display board for two local events held in Athens. Under Objective 4 we will conduct educational events throughout the Watershed to demonstrate that BMPs can simultaneously improve water quality and increase agricultural productivity. Funding was received funding from a 319 grant to implement practices that require minimal cost or planning, such as improvements to pastures, riparian buffers and fences. Project personnel will work with farmers to sign up for cost-share programs for larger cost BMPs (such as manure storage structures) and with the Tennessee Stream Mitigation Program to identify suitable streambank stabilization projects. In addition to the implementation of BMPs, various farmer field days and classroom training events are planned, for example the McMinn County "beef college" that gives farmers current information on optimizing their pasture beef operations.

PROJECT CONTACT:

Name: O'Neill, D.
Phone: 865-974-7128
Fax: 865-974-4514
Email: doneill1@utk.edu

GRANT YR: 2009
GRANT AMT: $599,027

INVESTIGATOR: Delate, K.; Cambardella, C.; Jaynes, D.; Sauer, T.; Malone, R.; Chase, C.

PERFORMING INSTITUTION:
Horticulture
IOWA STATE UNIVERSITY

ENHANCING FARMLAND WATER QUALITY AND AVAILABILITY THROUGH SOIL-BUILDING CROP ROTATIONS AND ORGANIC PRACTICES

NON-TECHNICAL SUMMARY: U.S. agriculture is facing worldwide competition for petroleum and increased costs for fertility inputs, leaving producers to compete within the larger system or re-align their farming practices to allow participation in alternative markets, such as organic agriculture, to garner greater economic returns. Non-point source contamination from leaching of nitrates in synthetic fertilizers is a major water quality concern in the upper Midwest, where extensive subsurface tiling drains the highly productive soils. Surface-water nitrate concentrations routinely have been reported in excess of the 10 mg L-1 drinking water standard. This multi-disciplinary, multi-agency project, with over 50 years combined experience in water quality and organic agriculture research, aims to assist producers in developing systems that would facilitate access to the growing organic market while improving water quality on their farms. This is a long-term, integrated project encompassing research, extension and education, targeted at meeting Program Goals to improve water quality on organic and conventional farms through the development of science-based management practices identified as a result of state-of-the art water quantity and

quality monitoring in replicated organic and conventional research station and on-farm sites. The hypothesis is that the use of integrated organic crop rotations with legume and grass crops will result in improved water retention and water quality by enhancing nutrient and water cycling in the soil-plant system. Our objectives include the development of nitrogen budget and water balance estimates from research sites and the identification of relationships between individual/integrative indicators of soil quality and water balance/environmental/productivity endpoints. Additionally, research results will be used to calibrate and validate the Root Zone Water Quality Model (RZWQM) for organic grain cropping systems. Results will be presented in classroom and Extension programs and publications to facilitate producer involvement in self-development of water quality enhancement techniques. National environmental benefits include the reduction of crop nutrient losses, soil erosion, and pesticide transport; and improved security and quality of the food system.

OBJECTIVES: 1. Design integrated, multi-functional organic crop rotations that include legume and grass crops for improved water retention and water quality enhancement, based on stakeholder input in focus groups prior to the establishment of research sites; 2. Establish experimental systems at University and on-farm sites, including extensive instrumentation to monitor water quantity and water quality; 3. Develop recommendations for methods to improve water quality based on results derived from agronomic and soil data, tile drain water flux and water quality, and simulation models: a. Develop nitrogen budget and water balance estimates; b. Develop relationships between individual/integrative indicators of soil quality and water balance/environmental/productivity endpoints; c. Calibrate and validate the Root Zone Water Quality Model (RZWQM) for organic grain cropping systems; 4. Enhance economic performance of farms that develop Best Management Practices (BMPs) for managing water resources; and 5. Develop and offer educational projects through specific class modules taught at Iowa State University, and technology transfer techniques with farmer networks, that enhance understanding of water quality and organic farming connections for undergraduate/graduate students, farmers, Extension, and policymakers. Expected outputs from Objectives 1, 2, and 3 of this project include the development of a new site for tile drainage water quality research in certified organic systems at the ISU Agronomy Research Farm. Once the infrastructure for tile drain water monitoring has been installed, the site will provide the opportunity for long-term studies to accurately assess water quality for the extended cropping rotations typically used in organic agriculture. The project will provide unique data, including model calibration and validation of the RZWQM for organic systems, that quantifies the impact of extended organic cropping rotations and pasture systems on subsurface tile drain water quantity and quality. Possible limitations include similar potential limitations for any water quality study: difficulty in calibrating drainage flow from each plot or failure of some plots to drain adequately due to differences in soil type at the site. Expected outcomes from Objectives 4 and 5 include a better understanding of water quality parameters and BMPs by local communities resulting from the demonstrations and educational modules; more efficient organic crop and animal production systems; and more vibrant local communities resulting from additional economic activities associated with diversified farming and marketing systems.

PROJECT CONTACT:

Name: Good, C.
Phone: 515-294-4544
Email: cgood@iastate.edu

FY: 2008 **GRANT YR:** 2007
GRANT AMT: $147,601

INVESTIGATOR: Boll, J.; Mahler, R. L.; Wulfhorst, J. D.; Vellidis, G.; Steenhuis, T.; Kurkalova, L.

PERFORMING INSTITUTION:
BIOLOGICAL & AGRICULTURAL ENGINEERING
UNIV OF IDAHO
MOSCOW, IDAHO 83843

SYNTHESIS AND ANALYSIS OF 13 CSREES CEAP PROJECTS

NON-TECHNICAL SUMMARY: **The Conservation Effectiveness Assessment Program has funded 13 project across the nation**. A synthesis and analysis is needed to achieve recommendations for future assessment and implementation of BMPs at the national level given the variable settings in the 13 CEAP projects. This project will establish the foundation for continued analysis and synthesis of BMP systems.

OBJECTIVES: The overall goal of our project is to provide science-based information for designing and implementing effective systems of BMPs across the country. Effectiveness is defined as the ability of BMPs to meet short-term and long-term water quality goals while maintaining or enhancing farm viability. Our goal will be met by addressing each of the following objectives: 1. Develop a web-based data information system for easy access to data from 13 CSREES CEAP watersheds and create a knowledge base system by providing guides and tools for analysis. The 24 ARS Benchmark and Special Emphasis watersheds will be included when possible. 2. Analyze BMP effectiveness of both individual and systems of BMPs in the 13 CEAP watersheds according to the desired water quality goal(s) related to sediment, nutrients, pesticides, and habitat properties. 3. Analyze social and economic factors that either facilitate or impede implementation or proper maintenance of BMPs in the 13 CEAP watersheds. 4. Synthesize the findings obtained under objectives 1 - 3 and develop systems of BMPs for agricultural landscapes to meet the optimal balance and combination of physical, biological, chemical, social, and water quality and economic goals (accounting for the views of landowners/operators and agency managers). 5. Develop a synoptic approach for geographic prioritization of BMP implementation at multiple scales. 6. Translate findings under objectives 5 and 6 into science-based knowledge that informs policy decisions to enhance the effectiveness of conservation programs and practices through improved design and implementation. 7. Conduct targeted outreach activities with key stakeholder groups to begin dialogue about prescribed synthesis results for improving management of agricultural landscapes. Evaluate and report on the impact of targeted outreach activities. Train stakeholders to use prioritization tool.

APPROACH: We will achieve the project objectives in three distinct yet cohesive and sometimes concurrent phases: - Phase 1 - Analysis and synthesis of findings from the 13 CEAP projects; - Phase 2 - Synthesis of science-based knowledge for conservation policy decisions; and - Phase 3 - Outreach of findings from Phases 1 and 2 to key stakeholder groups. During each phase, we will interact with CEAP investigators and stakeholders annually by organizing workshops at the National Water Quality Conferences. Site visits by a selection of PIs will be concentrated during the first 24 months of the project. An outreach strategy will be designed, executed, and evaluated in Years 3 & 4 of the synthesis project.

PROGRESS: 2008/09 TO 2009/09
OUTPUTS: The overall goal of this project is to provide science-based information for designing and implementing effective systems of conservation practices in watersheds across the country. The project is divided into three phases. To date, our activities in phase 1 (Analysis and synthesis of findings from the 13 CEAP projects) consisted of visits to seven CEAP projects (ID, UT, IA, AR, GA, NY, OH) and developing an analysis framework for watershed management with the aim to reduce field-scale and watershed-scale pollutant loading at the least cost. Our framework focuses on knowing what practices work, where practices should be placed, and which practices will be most acceptable considering physical, social and economic constraints. We developed a prototype GIS-based hydrologic characterization tool that evaluates conservation practices based on analysis of dominant hydrologic delivery mechanisms, which depend on pollutant type, climate, soils, land use (e.g. crop type and rotation), and topography. The prototype tool was applied to CEAP locations in ID, UT, and IA, after the visits, and AR, GA, NY, and OH before the visits. This tool relies only on publicly available soil, climatic, and topographic databases. We presented the results to CEAP investigators in AR and GA who confirmed the trends across the appropriate climatic region to various BMPs. A web-based version of this tool is being developed. The output of the hydrologic characterization tool provides sensitive areas in a watershed with reference to the dominant flow paths. These are being linked to a BMP effectiveness tool for specific pollutants, by region. Work also includes development and estimation of a statistical model to predict the costs of adoption of conservation tillage based on soil and landscape characteristics of geographic areas (e.g. soil water holding capacity, clay content, average slope), climate (mean and variability metrics of the average temperature and precipitation during crop growing season), and farmers' characteristics (e.g. age, tenure, full-time status). The model uses meta-analysis of existing studies on the determinants and costs of the adoption of conservation tillage including those conducted in the CEAP projects. The model being developed is based on Bayesian statistics and allowing for continuous update of the estimates as new conservation tillage adoption studies become available. As part of Phase II (synthesis of science-based knowledge for conservation policy decisions), we met with the CEAP steering committee and with the Committee for Shared Leadership for an update of the project and coordination with the CEAP synthesis project led by Deanna Osmond (North Carolina State University). A presentation about our prototype GIS-based framework was presented at the National Water Conference in St. Louis, where we conducted CEAP investigator meetings on data quality for effectiveness evaluation, modeling, and the hydrologic characterization tool. We presented "Regional Classification for the Identification of Dominant Hydrologic Flow Path and Critical Management Zones" at the American Geophysical Union meetings. PARTICIPANTS: Nothing significant to report during this reporting period. TARGET AUDIENCES: Nothing significant to report during this reporting period. PROJECT MODIFICATIONS: We are coordinating our project with CSREES project "synthesizing and extending lessons learned from the 13 CSREES-CEAP watersheds" (lead-PI Deanna Osmond, North Carolina State University).

IMPACT: 2008/09 TO 2009/09
Direct impacts of this research will be achieved when more CEAP project visits have been completed. Interactions with other CEAP investigators as part of the CEAP synthesis projects provide an unique opportunity to create a collaboration across all CEAP watersheds in the nation. Two-way communication with scientists, agency personnel, and farmers during CEAP synthesis visits further created awareness of a broader effort by CSREES in making a difference in watershed management across the country.

PUBLICATIONS (not previously reported): 2008/09 TO 2009/09
No publications reported this period

PROJECT CONTACT:

Name: Boll, J.
Phone: 208-885-7324

Fax: 208-885-8923
Email: jboll@uidaho.edu

GRANT YR: 2009
GRANT AMT: $645,788

INVESTIGATOR: Smart, A. J.; Clay, D. E.; Troelstrup, Jr., N. H.; Mousel, E. M.; Stover, R. G.; Janssen, L.; Burckhard, S. R.

PERFORMING INSTITUTION:
Animal & Range Sciences
SOUTH DAKOTA STATE UNIVERSITY

CONSERVATION PRACTICES ASSESSMENT OF THE LOWER BAD RIVER BASIN

NON-TECHNICAL SUMMARY: This project investigates the impact of rangeland Best Management Practices (BMPs) on watershed improvement and effectiveness of a 16 year watershed project on producer behavior. The semi-arid watershed is located in the mixed-grass prairie ecoregion of western South Dakota. The multiagency/disciplinary group of scientists will collaborate with other CEAP projects in the investigation of linkages between conservation and land management practices. This project will utilize soil assessments, rangeland vegetation assessments, historical and current producer surveys, watershed stream gauges, and water quality data collected at state monitoring sites to assess the effectiveness of locally defined conservation practices on range health. This watershed has been identified as impaired because of total dissolved solids and total suspended solids found in the Bad River because of excessive erosion. Demonstration, research, and educational projects were conducted in this watershed from 1990 to 2006. Conservation practices tested included the implementation of: 1) prescribed grazing treatments and proper stocking rates to reduce rangeland sheet and rill erosion; and 2) streambank protection, grade stabilization, deferred grazing, and diversion structures to reduce rangeland channel and gulley erosion. Within targeted watersheds, rangeland BMPs were implemented on greater than 95% of the lands. During the project, forty percent improvements in water quality were reported in targeted watersheds. This project will: 1) assess the potential long-term impacts of conservation practices on one of the most successful rangeland implementation projects in the Great Plains; 2) determine producer perceptions 5 years after the termination of the implementation project; 3) evaluate the social and economical factors influencing continued maintenance of BMPs following the project termination; and 4) conduct extension/outreach education to transfer knowledge from this research to producers, community leaders, decision-makers, and other stakeholders.

OBJECTIVES: This project investigates the impact of rangeland Best Management Practices (BMPs) on watershed improvement and effectiveness of a 16 year watershed project on producer behavior. The semi-arid watershed is located in the mixed-grass prairie ecoregion of western South Dakota. The goal of this project is to assess the effectiveness of long-term rangeland BMPs on ecosystem goods and services. Findings from this study will complement other CEAP projects and lead to a synthesis of common principles and lessons learned across grazing lands. Demonstration, research, and educational projects were conducted in this watershed from 1990 to 2006. Conservation practices tested included the implementation of: 1) prescribed grazing treatments and proper stocking rates to reduce rangeland sheet and rill erosion; and 2) streambank protection, grade stabilization, deferred grazing, and diversion structures to reduce rangeland channel and gulley erosion. Within targeted watersheds, rangeland BMPs were implemented on greater than 95% of the lands. During the project, forty percent improvements in water quality were reported in targeted watersheds. This project will: 1) assess the potential long-term impacts of one of the most successful rangeland implementation projects in the Great Plains; 2) determine the impacts of range quality and producer perceptions 5 years after the termination of the implementation project; 3) evaluate the social and economical factors influencing continued maintenance of BMPs following the project termination; and 4) conduct extension/outreach education to transfer knowledge from this research to producers, community leaders, decision-makers, and other stakeholders.

APPROACH: This proposal will focus on seven sub-watersheds within the Lower Bad River Basin. This will allow the research team to conduct a paired watershed approach with pre- and post-conservation practice analyses. We plan to digitize the existing data and identify latitude and longitude coordinates of sampling sites. Data that will be digitized includes geo-referenced vegetation structure and species composition data (1997-2006), stream channel classification data from 1995-1996, and BMP implementation projects. Once the data is entered it can be matched up with the GIS layers of the land use practices, soils, and ecological sites to analyze its effects on watershed health. These will be valuable in further refinement of the state-and-transition model of the Clayey and other ecological site in MLRA 63A. Re-classification of the previous stream channels within the Lower Bad River Basin. New sediment yield estimates will be generated using procedures and models from the earlier estimates (1995-1996) to validate the implemented conservation practices. Re-classification will follow the Rosgen scheme that was used back in 1995-1996 and we will measure the same physical parameters as previous workers. AnnAGNPS modeling incorporating the results of the vegetation data and the revised universal soil loss equation (RUSLE2) will be applied to the SSURGO databases of the sub-watersheds in the Lower Bad River Basin to assess the optimal set and placement of conservation practices. This project will determine the characteristics of previous implementation projects and the attitudes of the ranchers toward those projects. The first part of the research component is to accomplish a complete inventory of all of the implementation projects. By examining the files of the sponsoring agencies, a data set will be compiled documenting the manner in which the producer was recruited, the timing (beginning and end) of the project, the type of project, the nature and degree of funding, and the funding agency. That data set will be completed in the first year of the project. The second part of the research will involve interviews and surveys (principally interviews supplemented by surveys) of the producers who had any of those conservation projects. Standard approaches used in benefit/cost analysis of agricultural projects adapted to conservation resource projects will be used as the analytical framework for the economic analysis in this project. The main emphasis will be on assessment of private (producer) benefits and costs along with estimated public costs associated with adopting the conservation practices in the Lower Bad River Basin. It should also be possible to estimate a range of values for the public benefits of reduced erosion and improved water quality stemming from adoption of the conservation practices. This would complete all major components of an economic benefit / cost analysis and also provide an assessment of the effectiveness of specific conservation practices from the producer/landowner perspective.

PROJECT CONTACT:

Name: Smart, A. J.
Phone: 605-688-4017
Fax: 605-688-6170
Email: alexander.smart@sdstate.edu