Title. Simulating the soil erosion from land removed from CRP

Statement of regional, interstate, or multi-state water problem. A South Dakota survey conducted in May 2007 indicated that approximately 50% of the CRP acres due for renewal in the next four years will not be renewed. Conversion of these areas from CRP back to crop production without regard to environmental quality could have huge impacts on water quality in the state. In this project, we will calibrate an erosion model and use it to estimate the erosion potential from lands removed from CRP and returned to crop production under a variety of management scenarios.

The economics of grain production, especially production of row crops like corn, are much more favorable now than when the CRP contracts were established. Because of the better grain production economics, higher CRP lease rates will be required if it is desirable to keep much of the current land enrolled in CRP. Appropriate quantification of the increased erosion potential and associated water quality impairments will assist in targeting new CRP lease rates. Extensive field research to quantify soil erosion rates in South Dakota would require many years of measurements and analysis. But producers and water managers don’t have the luxury of that much time because many CRP contracts will be expiring during the next three years. This research proposes to use limited field research to calibrate a runoff and erosion model then use the model to estimate soil erosion to estimate the water quality impacts of removing land from CRP and returning it to row crop (especially corn) production.

Statement of results or benefits. The product of this project will be a calibrated version of a standard model that simulates, among other things, runoff and soil erosion due to water. That model will be useful in identifying areas of particularly high susceptibility to soil erosion and in identifying the expected magnitude of change of erosion due to changed land use. The magnitude of the change of erosion can be used by producers to help them maintain the long-term productivity of their farms and policy makers to assess the environmental impacts of removing land from CRP and assist in setting appropriate prices for new CRP contracts.

Nature, scope, and objectives This will be a two-year project. Both growing seasons will be used for data collection. The objectives of this project are to measure and characterize the runoff and transported sediment from a small watershed under continuous corn production to be used to calibrate a runoff process model. Field measurement of model parameters will take place during the first growing season (2008). Runoff and sediment transported in the runoff will be measured during the frost-free part of both seasons- 2008 and 2009. Simulation model testing and calibration will take place during the winters of 2008-2009 and 2009-2010. The erosion simulations will be focused on land removed from CRP and returned to corn production. Of particular interest will be land in continuous corn production but alternative scenarios such as a corn-soybean rotation will also be included.

Methods, procedures, and facilities. The field research will take place at the SDSU Opportunities Farm near Lennox, SD. The field is in continuous corn production.

Water balance components that will be measured will be evapotranspiration (ET), precipitation, and runoff (this project). Drainage will not be measured and will be
calculated as the remainder of the water balance. An Ameriflux eddy covariance flux tower will be established in the field in the autumn of 2007. The data from this tower will be available via the internet at public.ornl.gov/ameriflux. Tower data include latent heat flux (ET), precipitation, and other weather variables. Carbon fluxes will also be measured and used in a separate project. Precipitation and other weather parameters are also measured at the farmstead, ~3 km from the field site.

ISCO automatic samplers will be placed in the waterway leading away from the flux tower location. Runoff from the small watershed that contains the flux tower all leaves the watershed via this waterway. Using the automated samplers and bubbler attachment, runoff during the frost-free season will be measured. Flow-weighted samples will be collected with the samplers and will be analyzed in the SDSU Olson Biochemistry Laboratory for total suspended solids (TSS), the sediment leaving the watershed.

The runoff and TSS data, along with other required parameters such as soil type, slope, etc. will be used to calibrate a standard runoff erosion model.

This calibrated model will then be applied to locations in South Dakota where CRP land might be converted back into corn production. This model can then estimate the additional soil loss (if any) when the land is converted to corn production to estimate the water quality impacts of that erosion.

The facilities and equipment required for this project are all available to this project at no cost. The flux tower installation is expected to be completed by the end of November 2007. The ISCO sampler was previously used by the lead PI at the Opportunities Farm for feedlot runoff research and is now available to this project. Other equipment such as soil water sensors, weather station, etc. will be installed or available as part of a related but separate project.

**Related research.** Potential runoff/erosion models that could be used in this research include EPIC (http://www.brc.tamus.edu/epic/), WEPP (http://octagon.nserl.purdue.edu/wepp/projects.php), SWAT (http://www.brc.tamus.edu/swat/), RUSLE2 (http://bioengr.ag.utk.edu/rusle2/), or AGNPS (e.g. http://grass.itc.it/intro/modelintegration.html). These are all rather standardized models that have been used in a variety of situations. It is proposed that a mechanistic model such as WEPP will be selected preferential to a model employing an empirical approach, such as RUSLE2. However, models such as RUSLE2 that are widely used in agencies such as NRCS will be considered because of their widespread use and familiarity.

**Training potential.** One MS student in ABE will be trained in this project and partially funded with this request. That student began his MS program in August 2008. Other undergraduate students will also be trained but are not funded with this request. We anticipate that other graduate students in the ABE program will assist with occasional tasks in this project.

**Investigator's qualifications.** Attached.
Todd P. Trooien
Natural Resources Engineer (Professor)
Agricultural and Biosystems Engineering Department
South Dakota State University
Brookings, SD 57007

Research Areas

Courses Taught
- AST 333, Soil and Water Mechanics
- AST 434, Landscape Irrigation

The following courses are team-taught, with Trooien’s percentage in parentheses:
- AST/ABE/CEE/ENVM 225, Princ of Environmental Science and Engineering (20%)
- ABE 533, Advanced Irrigation Engineering (67%)
- ABE 752, Theoretical Microclimatology (33%)
- ABE 733, Groundwater Engineering in Agriculture (75%)

Education
Ph.D. Agricultural Engineering, 1988; Colorado State University.
M.S. Agricultural Engineering, 1985; South Dakota State University.
B.S. Agricultural Engineering, 1983; South Dakota State University.

Professional Experience
2006 to Present South Dakota State University. Professor (Natural Resources Engineer), Agricultural and Biosystems Engineering, Brookings, SD.
2000 to 2006 SDSU. Associate Professor. Agricultural and Biosystems Engineering.
1996 to 2000 Kansas State University. Assistant Professor (Research Irrigation Engineer), Southwest Research-Extension Center, Garden City, KS.
1988 to 1996 USDA-ARS. Agricultural Engineer, Natural Resources Management Research, Northern Great Plains Research Lab, Mandan, ND.
1985 to 1988 USDA-ARS. Agricultural Engineer, Irrigation and Drainage Research, Ft. Collins, CO.

Professional Service
- Associate Editor, Irrigation Science. 2005-present.
Selected Publications


Dennis P. Todey  
State Climatologist  
Agricultural and Biosystems Engineering  
South Dakota State University

**Professional Preparation**

- Iowa State University  
  Meteorology  
  BS - 1988
- South Dakota School of Mines and Technology  
  Meteorology  
  MS - 1990
- Iowa State University  
  Agricultural Meteorology  
  Ph.D - 1995

**Appointments**

- Assistant Professor of Agricultural and Biosystems Engineering  
  South Dakota State University  
  2003- Present
- Adjunct Assistant Professor of Agricultural Meteorology  
  Iowa State University  
  1998-2003
- Adjunct Assistant Professor of Geography  
  Central College (Iowa)  
  1996-1999
- Postdoctoral Research Associate in Agricultural Meteorology  
  Iowa State University  
  1996-1998
- Graduate Teaching Assistant in Meteorology  
  Iowa State University  
  1990-1995
- Graduate Research Associate in Meteorology  
  South Dakota School of Mines and Technology  
  1988-1990

**Refereed Papers**


**Relevant publications**

Other publications


Synergistic Activities

State/extension climatologist for South Dakota developing an integrated environmental monitoring system using various existing and for South Dakota including
Comparing yield trends of various crops to long term climate data to develop yield expectations and potential climate change impacts of various climate variables

Member of USDA Regional Climate Committee examining the impact of climate on regional crop management and production

Awards

Certificate of Merit South Dakota Extension Specialist’s Association 2004
Larry R. Johnson Special Award National Weather Association 2002
Teaching Excellence Award Iowa State University 1993

Collaborators

Adnan Akyuz (North Dakota State), Jeff Andresen (Michigan State), Rhoda Burrows (SDSU), Bill Capehart (SDSMT), Rick Cruse (Iowa State), Stuart Gage (Michigan State), Daryl Herzmann (Iowa State), Carter Johnson (SDSU), Boris Shmagin (SDSU), Todd Trooien (SDSU)

Graduate Advisors

Carlson, Richard E. Iowa State University (Ph.D.)
Orville, Harold South Dakota School of Mines and Technology (M.S.)
David Edward Clay  
Professor Plant Science  
South Dakota State University  
Brookings, SD, 57007

Education
B.S. Soil Science, Natural Resources, University of Wisconsin, Madison, WI, 1976.

Awards and Accomplishments
- Co-founded the South Dakota Precision Farming Consortium;
- Chair for Division A-8 (Agricultural Systems) in the American Society of Agronomy (2005);
- Editor of the Site-Specific Farming Guidelines manual. The manual is published by the Phosphate and Potash Institute and is available at, http://plantsci.sdstate.edu/precisionfarm/Guideline%20TOC.htm;
- Awarded the Deans Award for Excellence, 1994;
- Awarded the Gamma Delta Research Award, 1996;
- Awarded the Deans Award for Teamwork, 2004;
- Awarded SDSU F.O. Butler Award for Excellence in Research, December 2004
- Awarded SD Sigma Xi presidents award for service, 2006;
- Editor SD Corm BMP manual
- Awarded USDA-ARS collaboration award, April 20, 2006;
- Nominated Ag/Bio Teacher of the Year, 2006;

Books

Publications (>120 since 1990)


Dr. Thomas E. Schumacher  
Professor of Plant Science  
South Dakota State University  
Brookings, SD, 57007

EDUCATION

B.A., Biology, Bluffton University, 1972.  
M.S., Crop and Soil Science, Michigan State University, 1979.  
Thesis Title: The Influence of Mechanical Impedance and Short Term Anoxia on Respiration, Growth and Structure of Phaseolus vulgaris L. Roots  
Ph.D., Soil Biophysics, Michigan State University, 1982.  
Dissertation Title: Growth, Respiration, Ion Uptake and Carbon Partitioning of Phaseolus vulgaris L. Root Systems Exposed to Localized Anoxia

POSITIONS

Professor, Plant Science Dept., South Dakota State University, 1993 – present  
Exchange Professor, Chungnam National University, Daejeon, Korea, Spring 2003  
Soils Program Manager, South Dakota State University, 1994 - 1997  
Associate Professor, Plant Science Dept., South Dakota State University, 1988-1993  
Assistant Professor, Plant Science Dept., South Dakota State University, 1983-1988  
Graduate Assistantship, Crop & Soil Department, Michigan State University, 1975-1982  
Instructor, Sierra Leone, West Africa, Mennonite Central Committee, 1972-1975

PROFESSIONAL ORGANIZATIONS


AWARDS and ACTIVITIES

Invited Lecturer 2006 Sewery Colloquium, South Dakota State University, 2006  
Invited Keynote Speaker, Soil Quality Attributes Conference, Esfahan, Iran, 2005  
Best Research Article Award in 2004 – Journal of Soil and Water Conservation, 2005  
Associate Editor, Soil Science Society of America Journal, Division S6, 2005  
Environmental Excellence Award, SD-DOT, 2004  
ISTRO, Tillage Erosion Working Group Chair, 2004 – present  
International Arid Lands Research and Demonstration Advisory Committee, 2003 - present  
Honorable Mention Journal Soil Water Conservation Reviewer of the Year, 1999  
Plant Science Graduate Student Association Faculty and Staff Award, 1995  
Gamma Sigma Delta Outstanding Teacher Award, 1992  
Plant Science Graduate Student Association Faculty and Staff Award, 1990  
Sigma Xi Graduate Research Award, Michigan State University, 1981


