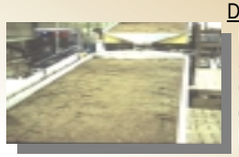
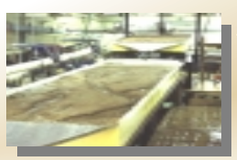
Basic and Applied Research

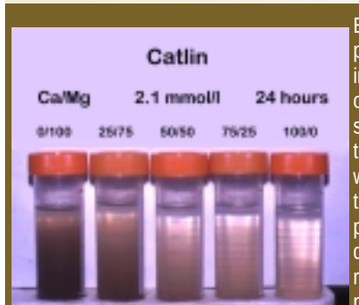
The NSERL's basic research program is to understand the basic processes that cause soils to erode and to be able to develop economical methods to control erosion in the field that will be accepted in agriculture and industry. The basic causes of soil surface sealing and runoff generation and an understanding of how low electrolyte content of rainwater causes clay dispersion has led to field scale studies to control erosion through the use of by-product gypsum and organic polymers such as polyacrylamide. The field scale studies grew from our basic laboratory studies on infiltration, aggregate stability, dispersion/flocculation and surface sealing. Studies in the laboratory have also shown the importance of drainage on controlling erosion and field studies are being planned. Research includes, biological, chemical and physical aspects.



Drainage Condition:
Erosion by an interrill-type surface scour. Sediment regime is detachment limiting due to high soil strength or low soil erodibility.



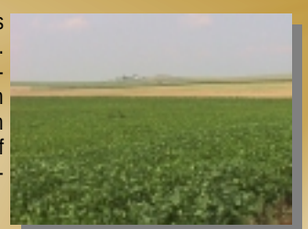
Seepage Condition:
Severe rilling occurs. Sediment regime is transport limiting due to low soil strength or high erodibility.



Basic research with practical applications include basic studies on soil clay dispersion such as the photo on the left. We found for a wide range of soil clays that Mg promotes dispersion over Ca. Since dispersion promotes runoff and erosion the practical implication is that liming fields with dolomitic lime will increase the potential for water erosion.

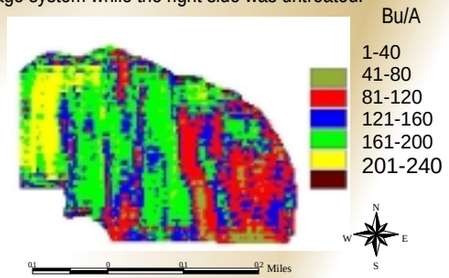
Soil Quality research is aimed at maintaining or improving the quality of the soil. The soil on the left has poor soil structure and water intake rate. This equates to poor rooting and ear development as compared to a well aggregated soil on the right.

Research is being conducted on the beneficial utilization of by-products such as synthetic gypsum produced from scrubbing stack gases for sulfur dioxide emissions. Other research includes the beneficial co-utilization of coal ashes and biosolids to produce a synthetic soil for improving soil quality.



Sustainable production is threatened by water erosion. Although crops may look uniform to the eye, redistribution of water on the landscape can greatly affect the variability of grain production and therefore, profitability.

Precision Agriculture research is being conducted to control erosion while improving yields through better water management. The left half of the field below was treated with 1 ton of by-product gypsum surface applied in a no-tillage system while the right side was untreated.



Corn Yields, 1T/A Gypsum (1997)

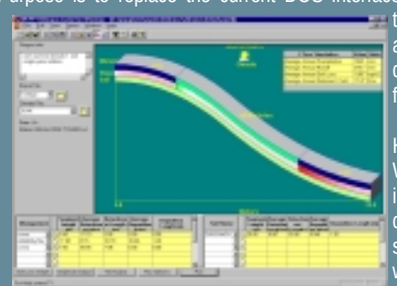
Technology Transfer

The Water Erosion Prediction Project (WEPP)

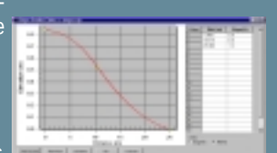
The Water Erosion Prediction Project model represents a new erosion prediction technology based on fundamentals of stochastic weather generation, infiltration theory, hydrology, soil physics, plant science, hydraulics, and erosion mechanics. The hillslope or landscape profile application of the model provides major advantages over existing erosion prediction technology. The most notable advantages include capabilities for estimating spatial and temporal distributions of soil loss (net soil loss for an entire hillslope or for each point on a slope profile can be estimated on a daily, monthly, or average annual basis), and since the model is process-based it can be extrapolated to a broad range of conditions that may not be practical or economical to field test. In watershed applications, sediment yield from entire fields can be estimated.

A CD-ROM was released July, 1995 with WEPP and a DOS interface for general public use. A WWW site(http://topsoil.nserl.purdue.edu/weppmain/wepp.html) also was established for information, technical support, and free downloads of developed software. A new Windows based interface is being developed which will be incorporated into a MOdular Soil Erosion System (MoSES) that will include WEPP, WEPS, RUSLE2 and RWEQ models.

WEPP Windows Hillslope Interface:
second beta version, March, 1999.
Purpose is to replace the current DOS interfaces which are text-based and were not designed for field users.



Hillslope Windows interface depicts a slope profile with cursor-sensitive icons that allow selection, copying, cutting, pasting, deleting, and editing of soil, management, climate, slope information.



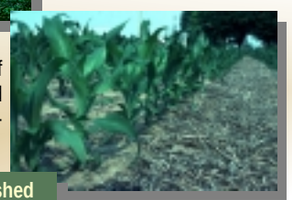
A watershed interface under development.
WEPP Windows interfaces provide basis for WEPP in common MoSES interface.

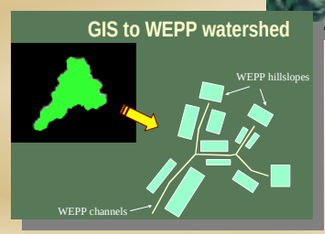
WEPP Can be used for:

Estimation of sheet and rill erosion, deposition, and sediment delivery from hillslopes.

Estimation of erosion and deposition in channels such as ephemeral gullies and grassed waterways in small watersheds.

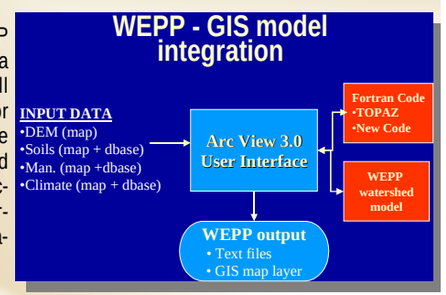
Evaluation of the effects of different crops, rotations, and tillage systems in conservation planning.





The WEPP model has been linked with the Arcview 3.0 GIS, and procedures for automatic delineation of watershed boundaries, hillslopes, and channels are being developed.

WEPP linked with a GIS will allow for easier, more rapid, and less subjective watershed simulations.



USLE Database

The NSERL serves as a repository for the Universal Soil Loss (USLE) Equation Data which is available on the internet along with other NSERL developed software and data.

Research Programs

At the NSERL we have two major research programs. The main objective of our research program is to understand the processes of soil erosion by water in order to develop more effective and cost efficient methods to control soil erosion and reduce its adverse environmental effects. We have a major project which utilizes the full potential and capabilities of the NSERL to research cause/effect relationships on a vast number of processes that are involved in water erosion. We have recently outreached with Western European Counterparts to investigate the combined effects of wind and water erosion. Our other major project includes the development of better erosion prediction technology. We are heavily involved with the MOdular Soil Erosion System (MoSES) and the Water Erosion Prediction Project (WEPP).

History

The National Soil Erosion Research Laboratory (NSERL) was opened on the Purdue University Campus in 1982. The NSERL was constructed as a result of funding provided by Congress with the support of Purdue University and sponsorship of the legislation by former Senator Birch Bayh. The laboratory was established at Purdue University because of the long history of water erosion research here. Over the years, many famous names in soil and water conservation have graced this location. The location was the birthplace of the Universal Soil Loss Equation (**USLE**), the Revised Universal Soil Loss Equation (**RUSLE**) and the Water Erosion Prediction Project Model (**WEPP**). These models have been, are, or are envisioned to be the methods of erosion prediction that are used by the USDA to administer billions of dollars in farm program dollars and also by many people far too numerous to mention in conserving our **nation's** and the **world's** natural resources. The laboratory's budget is small in comparison to many ARS locations in the USA and the world, yet we are extremely productive because of linkages with other interested industries, organizations, government agencies, NGO's, and most of all, American Agriculture. Our basic research program, which is the foundation of the NSERL, attracts financial support from a wide variety of areas. These include: private farmers, other government agencies, agricultural industries, the electric power industry, other countries, the United Nations and a multitude of other interested parties. Our laboratory, although small in size, is one of the most recognized soil and water research laboratories in the world. We have been recognized as such, by being selected to host the **10th International Soil Conservation Organization Congress** in May of 1999. This is the first time this meeting will be held in the continental USA. Our staff works very hard and is very proud of our accomplishments. We are open to any suggestions to improve our outreach and cooperative research endeavors. Please understand that we are small in number and do have limited resources and personnel.

Cutting Edge

The NSERL has been a leader in development of specialized equipment for erosion process research. These include many types of rainfall simulators for field and laboratory use and laser scanners for quantifying surface roughness and its changes due to erosive forces. Equipment developed at the NSERL is being used in many research projects all over the world.

▼ Field and laboratory rainfall simulators ▼

▲

Laser scanner for micro-topography measurements.

Infiltrometers used to collect data on detachment, runoff, and infiltration.

▼

Griffith tube for measureing aggregate stability. ►

Partial List of Cooperators

Industry

Ag Spectrum Inc., DeWitt Iowa
Indianapolis Power and Light Company, Indiana
VIM Corporation, Goshen, Indiana
Middlefork Farms Inc., Carlisle, Indiana
Curtis Farms, Prairie City, Illinois
Cinergy
Springfield Power, Illinois
Eschofen Farms, Bryan, Ohio
Aqueel Inc., UK
Deere Inc.
DuPont Inc.
Itaipu Binational Hydroelectric Authority, Brazil, Paraguay
Beijing Water Authority, China
Three Gorges Hydroelectric Authority, China

Universities

Auburn University
Ohio State University
University of Illinois
Alcorn State University
North Carolina AT&T University
University of Arizona
Agricultural University of Vienna. Austria
Utah State University
University of Wisconsin
Federal University of Minas Gerais, Brazil
Federal University of Rio Grande do Sul, Brazil
Federal University of Santa Maria, Brazil
Federal University of Lavras, Brazil
University of La Laguna, Spain
University of Sao Paulo, Brazil
Normal University of Beijing, China
University of Perugia, Italy
University of Lisbon, Portugal
University of Sydney, Australia
University of Kiev, Ukraine
Moscow State University, Russia
Southwest Agricultural University, China
Cranfield University, UK
University of Georgia
University of Tokyo, Japan
Griffith University, Australia
University of Tennessee
University of Giessen, Germany
University of Bonn, Germany
University of Gent, Belgium
Univeristy of Lueven, Belgium
Oxford University, UK
University of Hanover, Germany
University of Hawaii
Colegio de Postgraduatos, Mexico
Purdue University
- Department of Agricultural and Biological Engineering
- Department of Agronomy
- Department of Botany & Plant Pathology
- Department of Earth and Atmospheric Sciences
- Department of Agricultural Economics
- Department of Civil Engineering
- Department of Forestry and Natural Resources
- Department of Horticulture

Agricultural Development Office

Institutes and Organizations

Conservation Technology Information Center
Commonwealth Scientific and Research Organization, Australia
Institute of Agronomy Parana, Brazil
Center for Agricultural Landuse Research, Germany
Central Soil and Water Conservation Research and Training Institute, India
Institute of Soil and Water Conservation, China
United Nations FAO
United Nations Environmental Program
International Center for Agro-Forestry Research, Kenya
International Center for Tropical Agriculture, Columbia
International Center for Maize and Wheat, Mexico
Agriculture Canada
Bank of Mexico
Chinese Academy of Sciences
International Soil Conservation Organization
American Society of Agronomy
Soil Science Society of America
International Society of Soil Science
CAPES, Brazil
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Rockerfeller Foundation
Fullbright Foundation
Turkish Government
DAAD, Germany
BARD, Israel
Volcani Center, Israel
Argonne National Labs.
Los Alamos National Labs.

U.S. Government

United States Department of Agriculture (USDA)
- USDA-Agricultural Research Service (USDA-ARS)
  - USDA-ARS Bushland, TX
  - USDA-ARS Temple, TX
  - USDA-ARS Boonville, AR
  - USDA-ARS Coshocton, OH
  - USDA-ARS Columbus, OH
  - USDA-ARS Peoria, IL
  - USDA-ARS State College, PA
  - USDA-ARS Beckley, WV
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  - USDA-ARS College Station, TX
  - USDA-ARS Beltsville, MD
  - USDA-ARS Watkinsville, GA
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  - USDA-ARS Columbia, MO
  - USDA-ARS Ft. Collins, CO
  - USDA-ARS National Sedimentation Laboratory, Oxford, MS
  - USDA-ARS National Soil Dynamics Laboratory, Auburn, AL
  - USDA-ARS National Soil Tilth Laboratory, Ames, IA
  - USDA-ARS Tucson, AR
  - USDA-ARS W. Laf., IN
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  - USDA-ARS Mandan, ND
  - USDA-ARS, Lubbock, TX
  - USDA-ARS, Miami FL
  - USDA-ARS, Weslaco TX
  - USDA-Natural Resources Conservation Service
  - USDA-Forest Service
  - USDA-CSREES
  - USDA-OICD

U.S. Department of Interior (ISDI)
- Bureau of Land Management
- U.S. Geological Service

U.S. Environmental Protection Agency (USEPA)
US National Academy of Sciences
US Army Corps of Engineers

For More Information

National Soil Erosion Research Laboratory
USDA-ARS-MWA
1196 Building SOIL,
Purdue University
West Lafayette, Indiana 47907-1196

Phone: (765) 494-8673
FAX: (765) 494-5948
http://topsoil.nserl.purdue.edu

Scientific Staff

Chi-Hua Huang, Soil Physicist
Dennis Flanagan, Agricultural Engineer
Jim Frankenberger, Computer Specialist
Mike Hickman, Agronomist
Doral Kemper, Soil Scientist
John Laflen, Agricultural Engineer
Stan Livingston, Soil Scientist
Charles Meyer, Computer Specialist
Mark Nearing, Erosion Scientist/Engineer
Darrell Norton, Pedologist, Lab Director
Andy Rogowski, Hydrologist
Diane Stott, Soil Microbiologist
Roel Vining, NRCS Hydrologist
Glenn Weesies, NRCS Agronomist

National Soil Erosion Research Laboratory

USDA-ARS-MWA

on the Campus of Purdue University, West Lafayette, IN USA

To develop the knowledge and technology needed by land users to conserve soil for future generations.

USDA-ARS National Soil Erosion Research Laboratory
1196 Building SOIL, Purdue University
West Lafayette, Indiana 47907-1196
Phone: (765) 494-8673
FAX: (765) 494-5948
http://topsoil.nserl.purdue.edu

ISCO '99

10th International Soil Conservation Organization Conference

Sustaining the Global Farm
Local Action for Land Stewardship
May 23-28, 1999
Purdue University
West Lafayette, Indiana

USDA Agricultural Research Service

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