Improving Cover Crop Benefits in Sustainable Farming Systems Using Integrated Approaches and Tools

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Abstract

Global reduction in agricultural productivity due to soil erosion and degradation, depletion of irrigation water supplies, and competing land uses is limiting our capacity to meet increasing world-wide demand for food and fiber. Sustainable farming systems can be well-suited to control soil loss due to water erosion. Improving soil quality is key to improving soil, water, air, plant, and animal resources. Cover crops can help reduce water erosion and improve soil quality, among other resource improvements, when applied within an integrated cropping system. Integrated approaches and tools are necessary for achieving and assessing sustainable farming systems. The Revised Universal Soil Loss Equation version 2 (RUSLE2) is a process-based model that predicts long-term average annual soil loss for a given set of climatic conditions, on a defined land slope, and under a specified cropping and tillage management system. RUSLE2 can be used to predict the erosion and soil quality benefits of cover crops. Practical applications, integrated approaches and tools, and interpretations of the effect of cover crops on soil erosion and soil quality will be provided.

Introduction – Improving Cover Crop Benefits

Conservation planners, soil scientists, and inter-disciplinary teams work with producers to inventory soil, water, air, plant, and animal resources on the land and develop conservation plans and sustainable farming systems.

Objectives include:

- Reduce overall on-farm energy use, inputs, production costs, pest incidences, water loss, soil loss
- Improve production, air, water, and soil quality
- More economical, sustainable farming enterprise
- Healthier watershed and community

Integrated Approaches

Conservation planning considers resource opportunities on the farm and also resources available in the community or watershed which could be utilized. A problem-posing/solving approach should be used. The goal is to reduce the use of external inputs if these are available internally. The philosophy is to provide technology exchange with a producer not technology transfer and to develop an economically feasible and environmentally responsible conservation management system.

Sustainable Farming – Maximize Biodiversity

- Integrate crop and livestock production
- Use hedgerows, insectary plants, cover crops, etc. to attract beneficial insects, bats, and birds
- Plant trees and perennial crops
- Abandon monocropping in favor of crop rotations, intercropping, and polycultures
- Manage pastures to support diverse selection of forage plants
- Plant cover crops

Other considerations:

- Besides using crop residues and cover crops, what other practices can I apply to build soil quality? To recycle nutrients? To use water efficiently?
- Which practices would contribute to an environmentally and economically sound farm?
- Am I making the best use of compost, animal manure, legumes as nutrients for plants?
- How can I conserve/produce energy or reduce energy use?

Cover Crop Benefits – More Than Just Soil Erosion

Improve Soil Health

- Build organic matter – Soil Conditioning Index
- Increase water infiltration – hydrology model
- Reduce soil compaction – soil tillage intensity rating
- Boost microbial activity

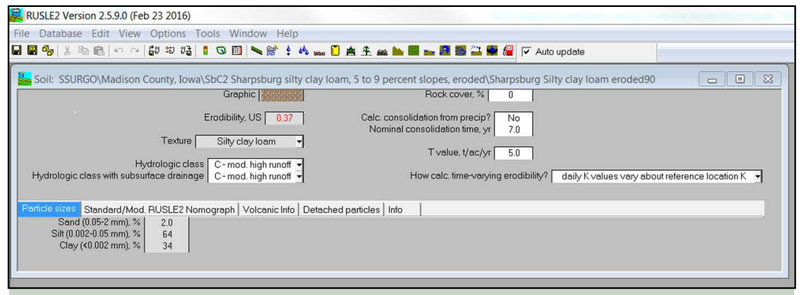
Other Benefits

- Attract beneficial insects and pollinators
- Pest suppression
- Wildlife habitat
- Forage for grazing/hay

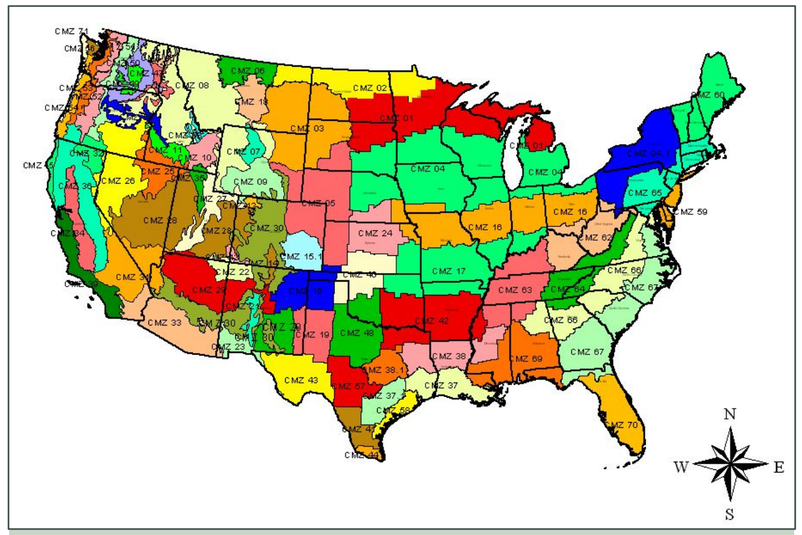
Integrated Tools

RUSLE2, WEPS, WEPP, and LMOD

- RUSLE2 is the official NRCS water erosion model that is used by field staff to plan, design, and assess conservation practices that reduce sheet and rill erosion and improve soil quality.
- New version provides integrated resource management planning capability for addressing major resource concerns; including soil erosion, soil quality, water quality, energy use; for both national and international planners, consultants, interagency partners, farmers, and ranchers designing and implementing sustainable resource management systems.
- WEPS is the official NRCS wind erosion model used by field staff to reduce wind erosion.
- WEPP, when completed, will be the new official NRCS web-based water erosion model; transition being worked on.
- Land Management Operations Database provides field operations, vegetations, residues, and cropping systems for planning tools.



RUSLE2 release with SSURGO soils import functionality – soil erosion and soil quality

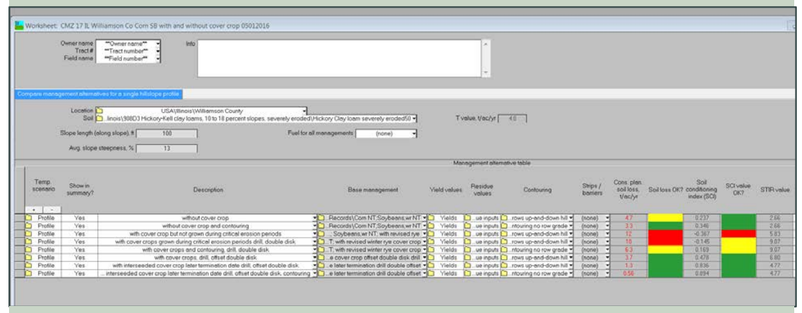


Developing representative cover crop management templates for each Crop Management Zone

RUSLE2 and Cover Crops

- Developed Cover Crop Guide showing how to properly build cover crop managements.
- Selecting appropriate vegetations, operations, planting and termination dates; graphing live biomass, canopy cover, and total erosion; and having the right surface residue at the right time is key.
- Cover Crop Guide provides further detail on taking residue measurements in the field and making adjustments in RUSLE2.
- Working with RUSLE2 developers on a revised vegetation builder.
- Developed new and revised cover crop vegetations with more current data (national Plant Materials Center data and ARS/university studies).
- Developed additional options for no-till drills and interseeding.

Compare alternative management systems using the worksheet view in RUSLE2 to show to client and determine a suitable alternative:



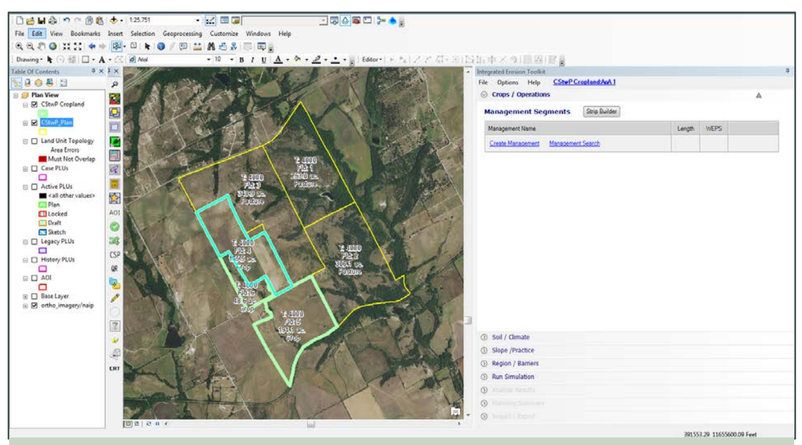
For adding a cover crop to a no till system, by virtue of just adding additional drilling and harvest operations, remember there will be greater soil disturbance with a cover crop than without; include cover crops which will have the right residue during the critical erosion period, select the proper vegetation and drill and consider interseeding cover crops and later cover crop termination dates. On steeper slopes, you may need to supplement with other practices such as contouring or stripcropping. We must plan for the entire farming system.

Integrated Erosion Tool (IET)

IET is intended to:

- provide a simplified and accurate planning tool in order to identify wind and water erosion resource concerns and develop alternative conservation treatments to address identified concerns
- combine approved wind and water erosion technology

IET is not intended to replace stand alone versions of RUSLE2, WEPS, WEPP or other NRCS approved models for uniquely complex conservation planning scenarios.



Integrated Erosion Tool (IET)

Summary: Keys to Achieving Sustainable Farming

- Use integrated systems approach (ecosystem, whole farm, watershed)
- Use problem-posing, problem-solving approach
- Actively seek resource, watershed, marketing opportunities
- Provide resource efficient and resource conserving alternatives
- Utilize technology "exchange" vs. "transfer"
- Develop whole farm conservation plan; plan creatively and flexibly
- Consider on-site and off-site effects
- Focus on keeping energy flow through the integrated system
- Reemphasize biological factors, improve biodiversity
- Improving soil quality is key to improving soil, water, air, plant, animal resources
- Develop case studies, field trials, on-farm research/demonstrations, farmer-to- farmer networks
- Form interdisciplinary teams, including producers and partners; hold integrated planning workshops
- Develop user friendly fact sheets, tech notes on integrated systems and tools
- NRCS has model approach and advises on developing soil survey and planning infrastructure internationally
- Increase NRCS staffing to provide inventory, technical assistance, and user friendly technology
- Reemphasize the importance of training at all levels; include field training in workshops
- Reemphasize importance of whole farm and watershed planning with NRCS in lead
- Reemphasize importance of keen observation skills; develop observational planning tool; promote folks getting to field
- Increase funding for development of new technology and user friendly tools
- Reemphasize the importance of people; do not promote automated tools which decrease the creative ability and critical thinking of people
- Decrease data mining of knowhow; only hands-on experience provides knowhow
- Provide living soil demos; integrate soil systems approach with conservation planning process; jointly share passion for conservation
- Communicate - Let us know your other ideas as we work together to achieve sustainable farming and communities

Selected Cover Crop Resources

Managing Cover Crops Profitably, 3rd Edition

- http://www.sare.org/

Midwest Cover Crop Council

- http://www.mccc.msu.edu/

Accumulation of Articles

- http://plantcovercrops.com/

Detailed species information

- http://www.sarep.ucdavis.edu/database/covercrops

References

Dabney, Seth and Daniel Yoder. USDA, ARS. 2013. Revised Universal Soil Loss Equation 2 (RUSLE2) Science Document, Washington, DC.

RUSLE2 NRCS Website: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/tools/rusle2/ (including Cover Crop Guide).

USDA, ARS. 2006. The wind erosion prediction system (WEPS), User Manual, 2011 Wind Erosion Research Unit, Manhattan, KS.

Flanagan, D.C. and M.A. Nearing. USDA-Water Erosion Prediction Project, Hillslope Profile and Watershed Model Documentation, NSERL Report #10, July 1995.