

## Introduction

The 2002 Farm Bill's Conservation Security Program (CSP) was the first stewardship program rewarding managers for existing conservation, based on minimum standards for soil and water quality. The eligibility tool used for soil quality was the "Soil Conditioning Index", a simple, linear predictive model of soil carbon trend. Although SCI is technically well-documented within NRCS, many producers who farm organically or live in the warmer climates had difficulty meeting the minimum criteria for eligibility despite strong conservation efforts. Merged with the current practice-based water quality eligibility tool, the new Soil and Water Eligibility Tool (SWET), a practice-based index of management effort related to soil function, is under development for use in implementation of next Farm Bill. This tool must be validated to ensure that both management effort and environmental outcome are reasonably estimated.

## Legislative Mandate?

The 2007 US House version of the Farm Bill (passed July 27, 2007) describes a "resource-specific index...of management intensity...that estimates the expected level of resource and environmental outcomes of conservation practices...employed..."

This poster describes use and evaluation efforts for two farm bill implementation tools, SCI and the new practice-based SWET.

1) We compared SCI & SWET results from hundreds of hypothetical scenarios, with differing combinations tillage, rotation, cover crops and amendments management, repeated in the 10 USDA-ERS US climatic regions.

2) We show results comparing the two tools to measured data from an organic cropping systems experiment in Illinois. This is the fifth validation dataset, results from the first 4 were reported at the Ecological Society of America annual meeting, (Andrews et al., 2007)

SWET is a practice-based tool that documents management effort or intensity, intended for use as an eligibility tool for the Conservation Security Program (Fig 1).

## Management Practice Questions

- Organized by Disturbance Type
  - Physical (e.g. tillage)
  - Biological (e.g. diversity, residue quality)
  - Chemical (e.g. fertilizer and pesticide)
- SQ Scored for 5 Ecosystem Services
  - C sequestration
  - Nutrient cycling
  - Physical Stability
  - Habitat for soil biota
  - Water partitioning (and salinity mgt)
- WQ Scored on NRCS Quality Criteria
- SQ Uses Proportional Weighting Factors

Figure 1. The Soil & Water Eligibility Tool (SWET) scored for VEG-cmp

# Comparing Tools to Assess Soil Quality in US Farm Bill programs:



How well do they work in organic farming systems?

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## Details of SWET Use Planned for the Next CSP Sign-up.

- SWET is to replace SCI and will be used during the producer interview
- To be run on the offered cropland acres
- Scale is the farm management unit or rotation, not necessarily field by field
- Minimums can be met with a many combinations of conservation activities
- Answering Yes or No to any one question will not make the producer Ineligible
- Eventually intended to be a self-assessment tool (online)

## 1) SWET-SCI Comparison (SWET Calibration)

We ran SCI and SWET for the hypothetical management scenarios outlined in Table 2 for calibration.

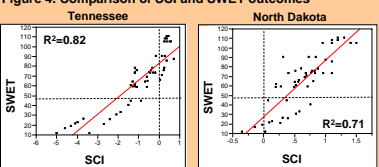
Table 1. Management practices simulated for comparison runs of SWET and SCI, in a factorial design \*design exception: HHHL & HLHPPP not run for OM additions

Tillage	Rotation	OM addition	Salinity Mgt	Pesticides
No tillage	L (low residue)	cover crop	saline	conventional
Mulch Tillage	H (high residue)	manure	non-saline	organic
Conventional tillage	LH	cc+man		
	LLH	none		
	HHL			
	HHHL*			
	HLH+3yr Perennial*			

## 1) Results & Discussion

- **SCI outcomes vary widely due to climatic effects** on decomposition and yield. Figure 3 shows SCI outcomes for TN, ME, CA & ND using identical management scenarios, varying only climate.
- **SWET does not change with climate**; there are no climatic factors, only management practice inputs in the tool.
- The pattern of significance between no-till (NT), mulch till (MT) and conventional till (CT) was:
  - NT>MT&CT for SWET & SCI ME
  - NT&MT>CT for SCI in CA & ND
  - NT>MT>CT for SCI in TN alone

Figure 4. Comparison of SCI and SWET outcomes



The Soil Conditioning Index (SCI) is a simple, linear model, embedded in RUSLE2, which predicts trend in soil carbon:

$SCI = (OM \times 0.4) + (FO \times 0.4) + (ER \times 0.2)$   
Where OM accounts for organic material additions (biomass produced & decomposition); FO represents physical disturbance from field operations; ER is the estimated loss of soil material by sheet, rill, irrigation and/or wind erosion

Figure 2. Results of validation of SCI with SOC measured at long-term experiment across the US

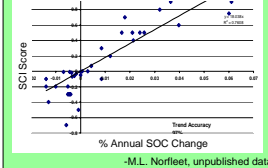
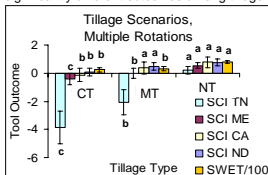


Figure 3. Mean SCI & SWET results for all management combinations grouped by tillage; SCI for 4 states only; SWET outcome scaled to fit axis; different letters indicate significantly different outcomes among tillage



- Fig. 4 shows **strong agreement (R<sup>2</sup>)** between tool results when regressed for all management scenarios combined within each state (only 2 states shown).
- Fig. 4 Dotted lines show cut-offs for eligibility. Upper right- both tools agree that system is eligible; lower left- both ineligible. **For TN, many systems are ineligible using SCI but eligible with SWET and vice versa in ND.**

## 2) Validation Dataset #5

We compared SWET & SCI with measured data from Windsor Organic Transition Experiment in Illinois. This is the fifth dataset in our validation study.



The Windsor Organic Transition Experiment compares low, medium and high intensity organic rotations, beginning in 2003. The research site is in Champaign Co., IL on Drummer SCI soils. The site was historically a conventionally managed corn-soy rotation. Soils are annually sampled for soil organic carbon (SOC) and other soil quality parameters.

We ran SWET and SCI using management records from 2003-2005.

Table 2. SWET and SCI outcomes compared with measured SOC for the Windsor Organic treatments

Treatment	SWET Score/Eligible?	SCI Score/Eligible?	Measured SOC (%)
VEG	44 no	-0.46 no	2.45 (0.72)
VEG+man	52 no	0.86 yes	2.36 (0.80)
VEG+cmp	52 no	2.80 yes	2.39 (0.63)
ROW	64 yes	-0.12 no	2.17 (0.41)
ROW+man	72 yes	1.60 yes	2.28 (0.56)
ROW+cmp	72 yes	3.60 yes	2.37 (0.40)
LEY	101 yes	0.98 yes	2.50 (0.31)
LEY+man	109 yes	2.40 yes	2.55 (0.38)
LEY+cmp	109 yes	3.70 yes	2.24 (0.63)

## 2) Results & Discussion

- **SWET outcomes showed VEG to be ineligible**, despite few differences in measured SOC.
- **SWET scores tended to be lower without OM added** but not enough to change eligibility.
- **SCI outcomes in VEG and ROW were ineligible without man or cmp amendments**
- **SOC had n.s.d. for amendments within rotation**
- **Both tools need to be examined for sensitivity to OM amendments**

Figure 5. Rotation descriptions for the Windsor Organic Transition Research Treatments (n=4); Split plots within each received manure (man) or compost (cmp) amendments

## Summary

- SWET evaluates 5 soil functions, compared to estimation of SOC trend by SCI
- SWET is a measure of effort, attempting to eliminate climatic bias in farm bill program application
- SWET is intended to be an easy-to-use tool- Eventually for self-assessment; SCI requires specialized training to run RUSLE2
- While SWET & SCI are well correlated within any given region, the threshold for eligibility varies widely.
- The 5<sup>th</sup> measured dataset, Windsor Organic, indicates that SWET scoring should be examined due to VEG ineligibility, despite n.s.d. in measured SOC. Scoring for cover crops (in soil moisture function) may be too low (Figure 1).
- SCI (and to a lesser extent, SWET) showed differences for the OM additions that were not seen in the measured Windsor Organic data. More study is needed to determine if and what model adjustments are needed.

## Next Steps

- SWET is currently being reviewed internally by approximately 50 NRCS State Technical Experts from around the US, for clarity, ease of use, and expected outcome.
- A new CESU between NRCS and ISU is underway to evaluate farmer perceptions about the tool.
- A second new CESU between NRCS and UIUC (with opportunities for sub-contracted collaborators) is underway to continue validation efforts using existing, medium- and long-term datasets containing multiple soil quality parameters, emphasizing inclusion of both dominant and unique management systems across the US.

**Interested in collaboration?** Contact Susan Andrews  
[susan.andrews@gnb.usda.gov](mailto:susan.andrews@gnb.usda.gov) to test drive SWET