Metrics Committee – Soil Carbon Update

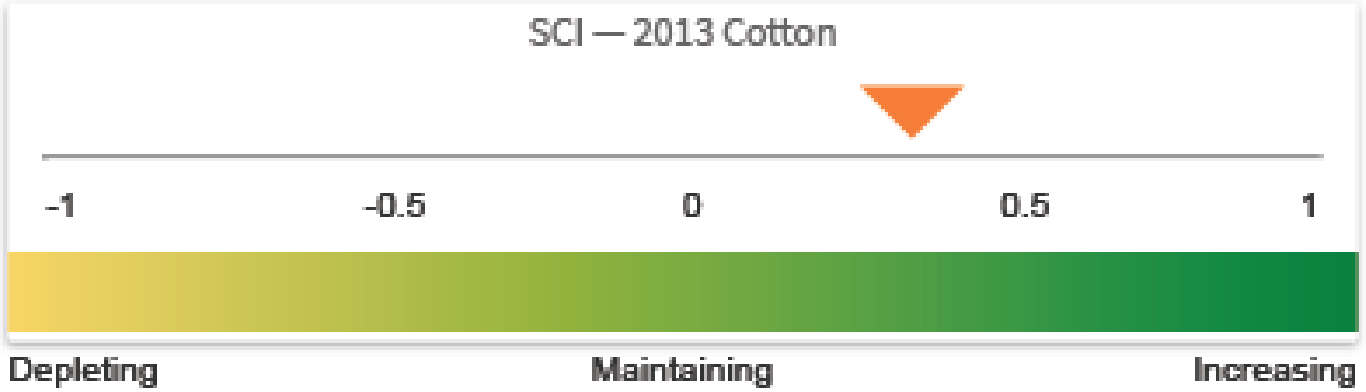
Soil Carbon Metric

- Indicates whether a field is gaining or losing carbon
- Based on NRCS Soil Conditioning Index (SCI)
- Accounts for three major factors influencing soil carbon:
  - Organic matter and crop residue
  - Wind and water erosion
  - Tillage

Soil Carbon Example

Soil Carbon Score Description

The SCI returns a value between -1 and 1 for each field. A positive value indicates increasing soil carbon, a neutral value (between -0.05 and 0.05) indicates maintaining soil carbon, and a negative value indicates losses of soil carbon. The magnitude of the index reflects confidence in the directionality and does not indicate a higher or lower quantity of carbon in the soil.



- Use Walton Family Foundation funds to further options on soil carbon for users of the Fieldprint Platform
  - Timeline for decision was too short to allow for a formal metric revision discussion/ documentation/ review/ approval.
- The Committee discussed adding an existing 3rd party tool – **COMET-Planner** - as an optional, educational feature
  - This will enhance our capabilities on soil C within 12 months
  - While also providing a new option for revising the Soil Carbon Metric

What approaches are carbon markets using?

- **Climate Action Reserve Soil Enrichment Protocol** requires soil carbon changes to be directly measured or modeled
  - Modeled on ESMC draft protocol and being used by IndigoAg
- **Nori** – Using COMET-Farm and records verification
- What is the best approach to enable "laddering in" from a sustainability assessment to a market opportunity?
  - By using a simplified version of a complex model we can offer users some assurance that their estimated soil carbon from the Fieldprint Platform will be consistent if they choose to enroll in a market opportunity
  - Opportunity to directly connect to market opportunities through data transfer (input data and initial soil C estimate).

How does COMET-Planner relate to other models?

- Model Hierarchy: Simple models appropriate for decision support are often built from more complex models used in research

Simple

Complex

Meta-model to capture complexity of detailed models without requiring modeling experts to interpret (suitable for general public)	**COMET-Planner**	**N/A**	**N/A**
Interface for a detailed model to make it user friendly (suitable for experienced users; require detailed data)	COMET-Farm	N/A	NTT (Nutrient Tracking Tool)
Detailed complex research model (suitable for experts)	DayCENT (Carbon and GHG)	DNDC (GHG and carbon)	APEX (water quality)

Alternatives to using models – Emissions Factors

- Other tools for carbon accounting use "emissions factors"
  - Derived from field research and documented in scientific literature
  - *"Based on available field studies, results show corn grown in region 'X' with no tillage and cover crops can sequester on average 'Y' C per acre per year"*
- The emissions factor is then extrapolated to all corn in that region with those practices
  - Simple, easy to use and can be applied across many regions even when observations are difficult or scarce
  - Can only account for limited specific features of a field

Examples of Emissions Factor Approaches

- IPCC "Tiers"
  - 1: National scale emissions factors
  - 2: Region and practice specific emissions factor
- FAST GHG tool developed by Cornell for Project Gigaton value chain reporting
- Cool Farm Tool
  - "Soil carbon sequestration based the results of published studies built from over 100 global datasets"
  - Data entries capture tillage and cover crop practice changes
  - Assume emissions factors are applied based on crop, region, and change in tillage and cover crop

	Options to select from	Comment/ definitions	Change *Select 1 option from list on the left*	Years	% of area with practice change
	Frequency of tillage / replanting (how often is the field replanted using tillage?), in years				
Tillage practice applied	No change Conventional to Reduced Conventional to No-till Reduced to Conventional Reduced to No-till No-till to Conventional No-till to Reduced	**Conventional:** Substantial soil disturbance, such as ploughing, and/or frequent tillage operations; little surface coverage with residues at planting time (< 30%); **Reduced-till:** Primary and/or secondary tillage with reduced soil disturbance (shallow and without full inversion); normally leaving >30% surface coverage at planting; **No-till:** Direct planting without primary tillage, a litter layer is maintained on the surface, minimal soil disturbance in the planting zone; weed control via herbicides.			
Cover cropping	No change Started adding Stopped adding				

From CFT data entry guide: [Data-Input-Guide.pdf (wpengine.com)]

Recommendation: Integrate COMET-Planner into the Fieldprint Platform

COMET-Planner Background

- Developed by NRCS and Colorado State University as a meta-model that approximates results of the COMET-Farm tool for individual fields
- Provides estimates of sequestration over a 10-year period following the practice change.
- Established and ready-to-use for farmer decision support
- USDA commitment to ongoing development and support of COMET Farm and Planner to keep up-to-date with scientific advances
- Provides consistency with other FTM metrics (GHG Emissions N2O calculation)
- Clear path to more complex tools proposed for use in carbon markets
- Could be applied either/both to evaluate current practice impacts or as a “what-if” scenario tool.

Example: Benton County, IN – No till, non-legume cover crop , 25% N reduction

Emission Reduction Coefficients (ERC)
(tonnes CO_2 equivalent per unit per year)

NRCS Conservation Practices	Soil Carbon	Biomass Carbon	Fossil CO_2	Biomass Burning CO_2	Biomass Burning N_2O	Biomass Burning CH_4	Liming	Direct Soil N_2O	Indirect Soil N_2O	Soil CH_4	Total Emission Reductions	Minimum Total Emission Reductions*	Maximum Total Emission Reductions*
Residue and Tillage Management - No-Till (CPS 329) - Reduced Till to No Till or Strip Till on Non-Irrigated Cropland	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.61	0.31	0.83
Cover Crop (CPS 340) - Add Non-Legume Seasonal Cover Crop (with 25% Fertilizer N Reduction) to Non-Irrigated Cropland	0.46	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.02	0.00	0.47	-0.07	0.70

*Minimum and maximum emission reductions represent the minimum and maximum total emissions over a range of soil, climate and management conditions within multi-county regions. Min/Max emissions are not estimated for all practices, due to limitations in quantification methods

**Values were not estimated due to limited data on reductions of greenhouse gas emissions from this practice

These practice changes combined result in a total of 2.75 tons C per acre over 10 years (= 0.28 tons C per acre per year)

How would the results be presented to the farmer and project?

Options under discussion

1. Recent or current year practice change:

A user indicates if any relevant tillage, cover crop or nutrient management change in the past 10 years. They are provided with a measure of the annual per acre change in Soil Carbon related to those practice changes and the time period that applies

If they changed from reduced to continuous no-till in 2015, then they are currently sequestering X tons/acre/year for the period 2015-2025

2. Considering a future practice change:

A user could duplicate their field and label it a scenario, then indicate any changes in practices they are considering. The Platform would re-run and show all metric scores associated with that change, as well as the estimated Soil Carbon increase.

If a change from reduced to continuous no-till is planned for 2021, they could expect to achieve sequestration of X tons/acre/year from 2021-2031

Example COMET Planner Benton Co. IN

Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	*2021*	*2022*	*2023*	*2024*	*2025*	*2026*	*2027*	*2028*	*2029*	*2030*
Practice adoption		**adopt reduced tillage**			**adopt no-till**			*planning a cover crop*								
CT to RT Soil C		0.22	0.22	0.22												
RT to NT soil C					0.56	0.56	*0.56*	*0.56*	*0.56*	*0.56*	*0.56*	*0.56*	*0.56*	*0.56*		
cover crop soil C								*0.46*	*0.46*	*0.46*	*0.46*	*0.46*	*0.46*	*0.46*	*0.46*	*0.46*
Carbon seq (tCO2eq/ac/yr)	**0**	**0.22**	**0.22**	**0.22**	**0.56**	**0.56**	***0.56***	***1.02***	***1.02***	***1.02***	***1.02***	***1.02***	***1.02***	***1.02***	***0.46***	***0.46***
							Projected									

Metric Considerations

Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	*2021*	*2022*	*2023*	*2024*	*2025*	*2026*	*2027*	*2028*	*2029*	*2030*
Practice adoption		**adopt reduced tillage**			**adopt no-till**			*planning a cover crop*								
CT to RT Soil C		0.22	0.22	0.22												
RT to NT soil C					0.56	0.56	*0.56*	*0.56*	*0.56*	*0.56*	*0.56*	*0.56*	*0.56*	*0.56*		
cover crop soil C								*0.46*	*0.46*	*0.46*	*0.46*	*0.46*	*0.46*	*0.46*	*0.46*	*0.46*
Carbon seq (tCO2eq/ac/yr)	**0**	**0.22**	**0.22**	**0.22**	**0.56**	**0.56**	***0.56***	***1.02***	***1.02***	***1.02***	***1.02***	***1.02***	***1.02***	***1.02***	***0.46***	***0.46***
							Projected									

1. Requires a **change in practice** to produce a result
   - Requires more than one year of information
   - In this example, what would the metric score be in 2015?
2. Options **only include adoption of conservation** practices – for example, stopping a cover crop, or going from no till to reduced till are not available practice change options
   - Would not capture the full suite of operational changes farmers may make
   - Could be overly optimistic if only score options are 0 or positive for sequestration as would not indicate where loss of soil C may be occurring.

Metric Considerations – Alternatives

- Consider a 2 part metric?
  - All users receive the SCI score automatically
  - Ask users whether they have recently adopted a conservation practice; provide COMET Planner sequestration estimate for that practice as a supplemental metric.
- Moving to a more complex model (e.g. COMET Farm, DNDC): Will involve some of the same limitations (COMET) and/or extensive development (DNDC) and/or will require multiple years of data entry to establish a record of a practice change (both)
- Work with COMET team to enable reverse and additional practices in COMET-Planner (R&D required).
- Move to an emissions factor approach based on literature (similar to Cool Farm Tool) (R&D required)