Speakers

Michelle Perez

Sr. Liaison Between Research & On the Ground Practice

Ben Wiercinski

Senior Agricultural Economist

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Agricultural Economist

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Senior Soil Health Scientist

Team members: Aysha Tapp Ross, Robert Ellis, Bonnie McGill, & Bianca Moebius-Clune

Predictive Soil Health Economic Calculator (P-SHEC) Tool

What it means for planners, producers, & the bottom line

Presenters: Michelle Perez, Ben Wiercinski, Meng Li, Chellie Maples

Collaborators: Aysha Tapp Ross, Robert Ellis, and Bonnie McGill
American Farmland Trust

NRCS Conservation Webinar Series
March 2, 2026

American Farmland Trust's mission is to save the land that sustains us

- Protecting farm and ranch land
- Promoting sound farming practices
- Keeping farmers on the land

No Farms No Food®

American Farmland Trust

Background & Overview of the P-SHEC Tool

- **How:** AFT & NRCS developed the P-SHEC Tool thru a Cooperative Agreement:
  - NRCS Economists: Julie Suhr Pierce, Bryon Kirwan, & Lynn Knight
  - Soil Health Division: Karl Anderson, Amanda Branham, Candiss Williams, & Lori Metz
- **What:** The tool helps farmers & ag advisors predict the potential 10-year costs & benefits from adopting cover crops, nutrient management, & no-till
- **Goal:** Provide unique & value-added information to help farmers & their ag advisors make more informed decisions on soil health practices

Initial AFT-NRCS Collaboration on Soil Health Economic Resources

Soil Health Economic Case Studies

- Features 23 row crop & 3 almond "soil health successful" farmers in 12 states

Farmers' Guides to Soil Health Economics

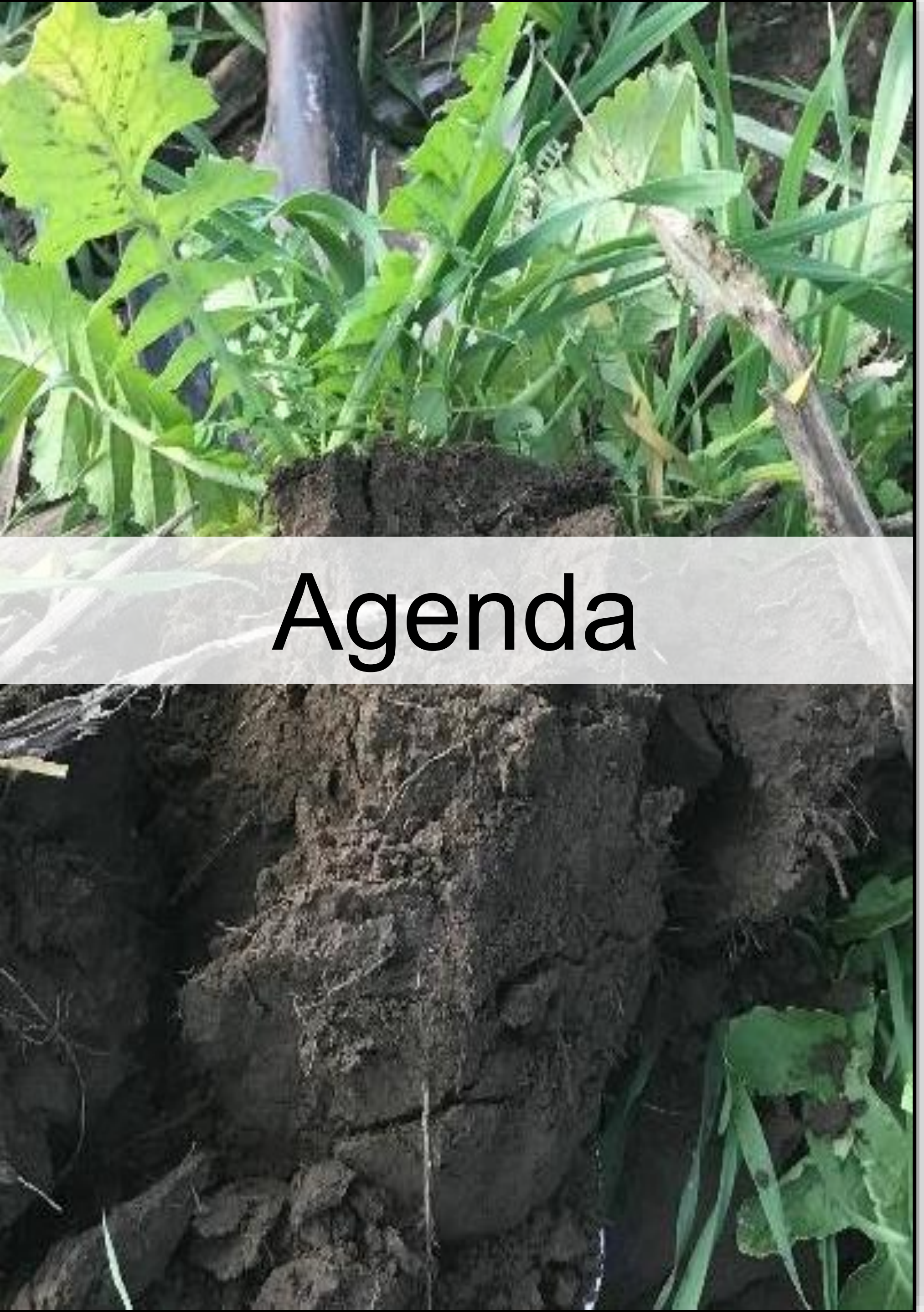
Summarizes literature from 79 studies for:

3 Row crop guides:

- Research trials
- National surveys
- Budget analyses

4 Grazing guides:

- Transition from conventional to intensive grazing
- Seasonal grazing practices
- Cover crop grazing



Agenda

- Soil health overview
- Soil health economics overview
- P-SHEC Tool methods
- P-SHEC Tool tour

General Signs of Poor Soil Health

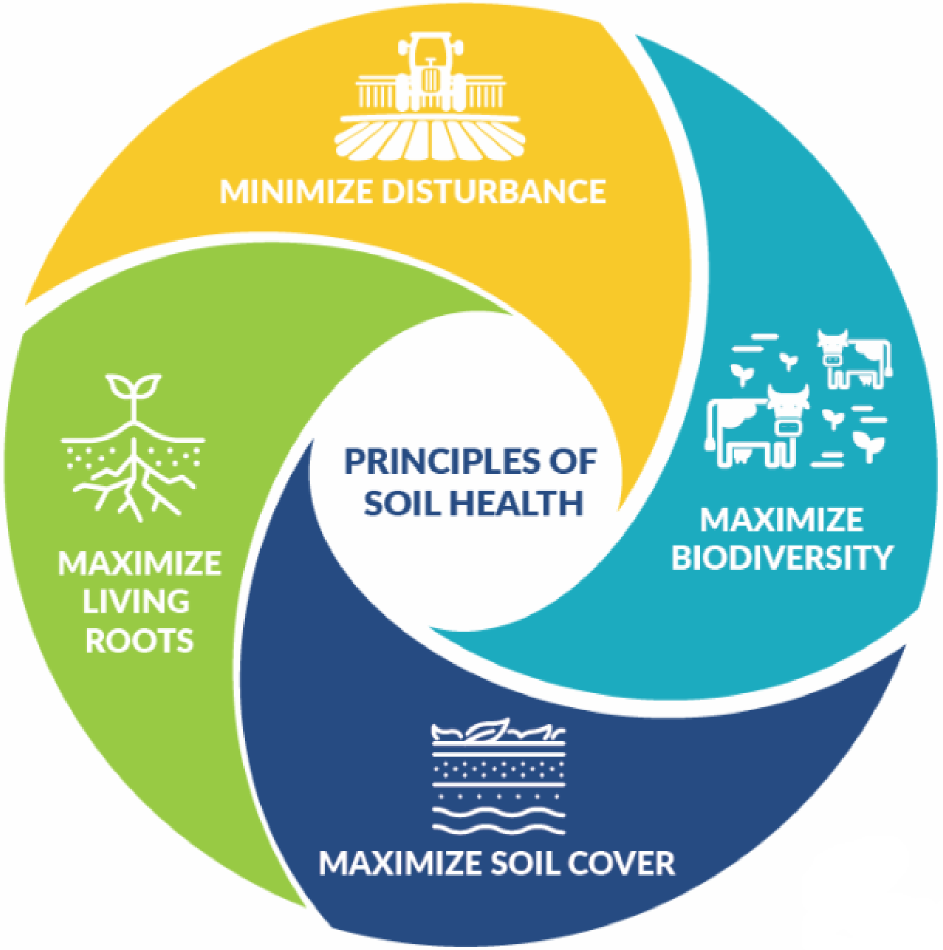

Ponding, rutting


Plowing up cloddy


Crusting


Hard soil, horizontal cracking

4 Soil Health Principles that Conserve the Soil Ecosystem



P-SHEC Tool includes "the Big 3" Soil Health Practices

Conservation Practice

Soil Health Principle	Conservation Cover (327)	Conservation Crop Rotation (328)	Cover Crop (340)	Forage & Biomass Planting (512)	Pest Mgmt. Conservation System (595)	Mulching (484)	Nutrient Mgmt. (590)	Prescribed Grazing (528)	Residue & Tillage Mgmt. (329/345)
Minimize Soil Disturbance	✓			✓	✓		✓	✓	✓
Maximize Soil Cover	✓		✓	✓		✓		✓	✓
Maximize Biodiversity	✓	✓	✓	✓				✓	
Maximize Living Roots	✓	✓	✓	✓				✓	

Table 1. Conservation practices that can be used in a soil health management system to help achieve the soil health principles.

https://directives.sc.egov.usda.gov/44340.wba

Outcomes of Soil Health Practices

Prevents soil, water, & nutrient runoff

Provides crop yield resistance to drought (Example from Carroll, Ohio 2012)

40 yrs No-till & Winter Cover Crops:
144 bu/ac - Dave Brandt

>20 yrs Conventional Tillage:
40-80 bu/ac - Neighbor

Soil Health Economics

- Economics is "**the study of scarcity, the study of how people use resources and respond to incentives, or the study of decision-making**" *–American Economic Association*

Private Costs and Benefits

- Changes in input and machinery costs
- Changes in yield
- Risk associated with practice adoption

Public Costs and Benefits

- Cleaner waterways
- Increased biodiversity
- Changes in federal expenditures
- Changes in pest pressure

“Moving the Needle”

- Decision **<u>Support</u>** Tool
- Predictive ≠ Prescriptive
- Various factors influence the decision-making process
- No single factor or resource drives adoption

Corn, Soybean and Small Grains

From national surveys, experiments, and budget analyses

Production Costs	• Conservation tillage reduces costs by \$40–\$90/ac (fuel, labor, equipment) (Bowman et al., 2021) • No-till systems show higher net returns (+\$53/ac corn; +\$35/ac soybean) (Bowman et al., 2021)

Yield Impacts	• Long-term no-till and cover crops maintain or increase yields
	  • +0.5–1.5 bu/ac corn (Cai et al., 2019)
	  • +3–18 bu/ac soybean (Cai et al., 2019)
	  • +4% wheat (SARE, 2023)

Profitability	Short-term returns can be neutral or slightly negative, but tend to increase over time (Myers et al., 2019) -\$31 (Y1)→ \$1 (Y3)→ +\$18/ac (Y5) corn -\$23 (Y1)→\$0 (Y3)→ +\$10/ac (Y5) soybean Mixed net income results associated with cover crops

PSHEC: Predictive Soil Health Economic Calculator

To answer farmer questions about costs, benefits, & 10-year net return on soil health practices

Crop list:

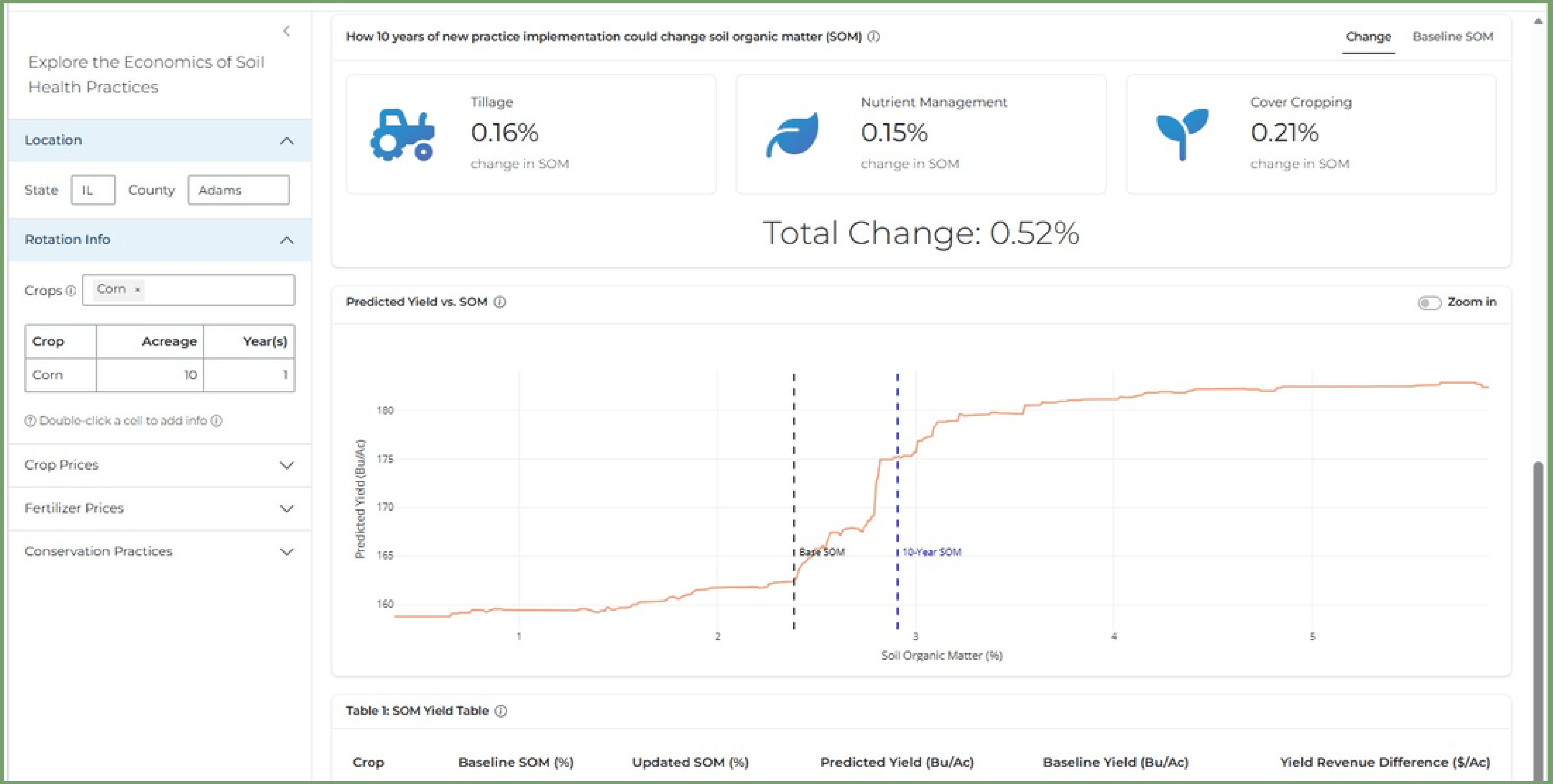
- Barley
- Corn
- Cotton
- Tobacco
- Sorghum
- Oats
- Peanut
- Sugar Beet
- Soybean
- Wheat

Soil health practices:

- No-till/Reduced Till
- Cover Crops
- Nutrient Management

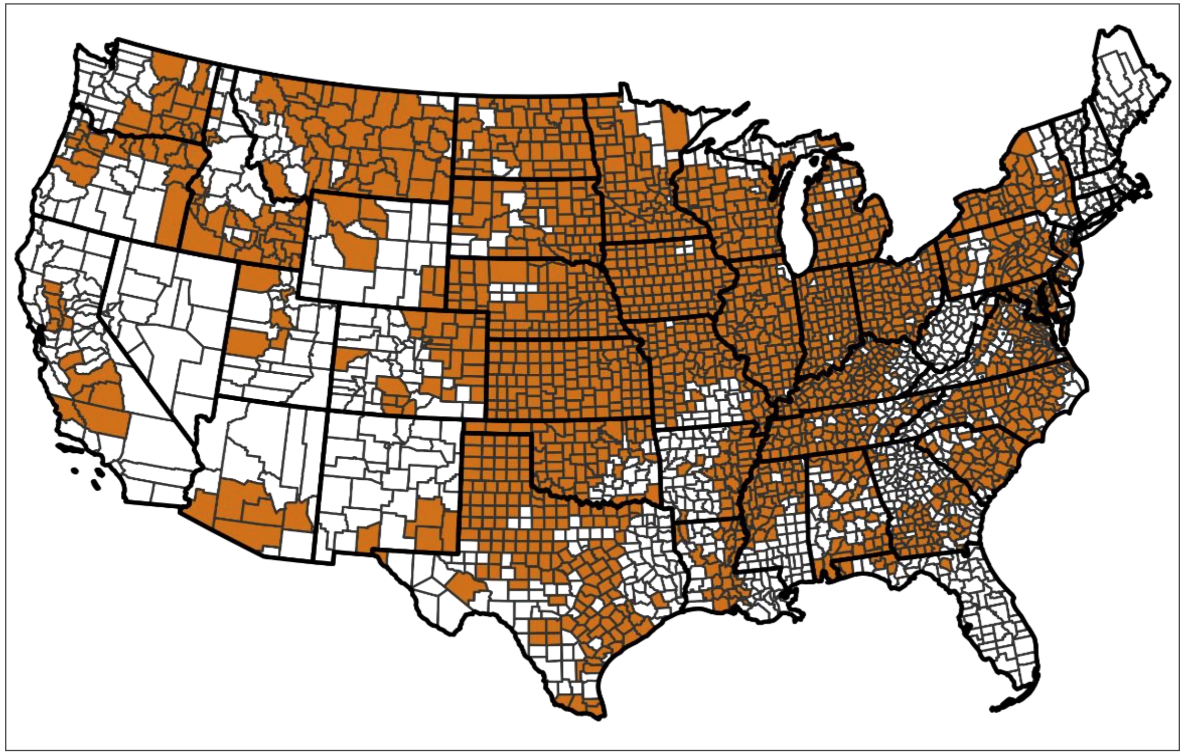
Yield resitence to extreme weather:

- Drought (available now)
- Excessive rainfall (coming soon)
- Excessive temperature (coming soon)



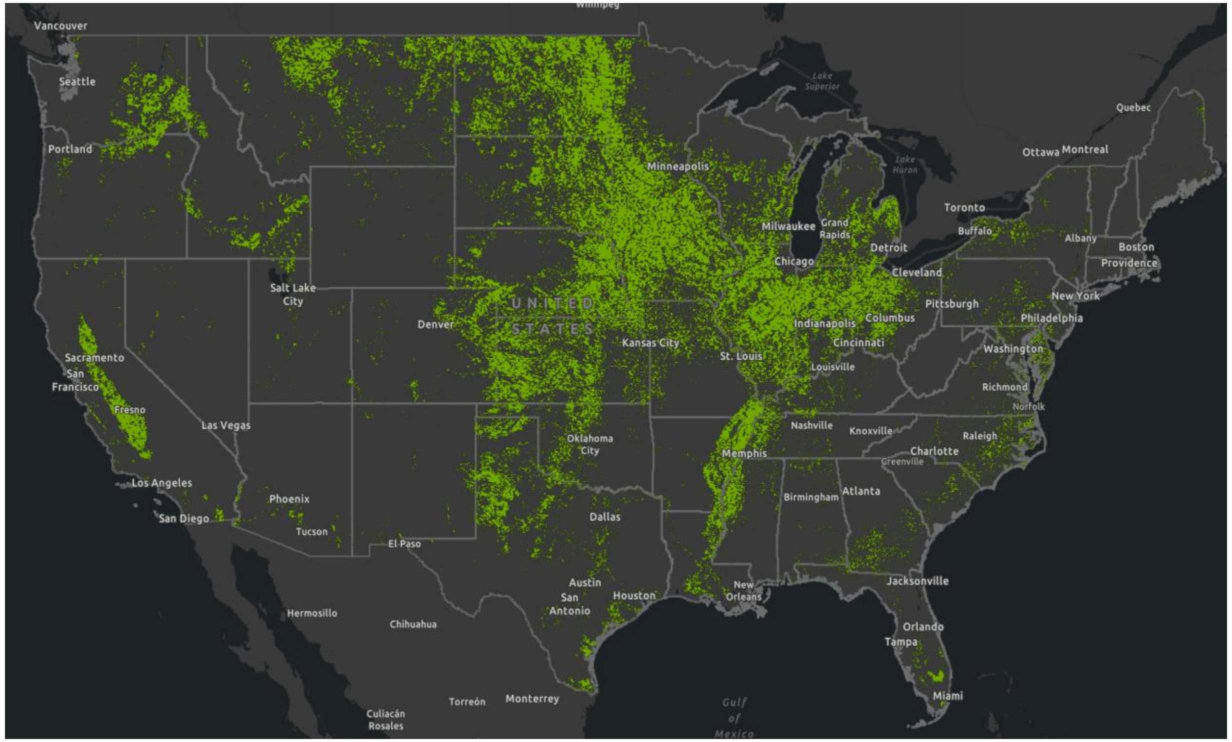
P-SHEC Coverage:
41 states and 1,962 counties

P-SHEC (county-level)



(Maples et al. 2026)

US cultivated land (30 m)



(Source: NASS National Cultivated Layer 2020-2024)

Questions P-SHEC Answers

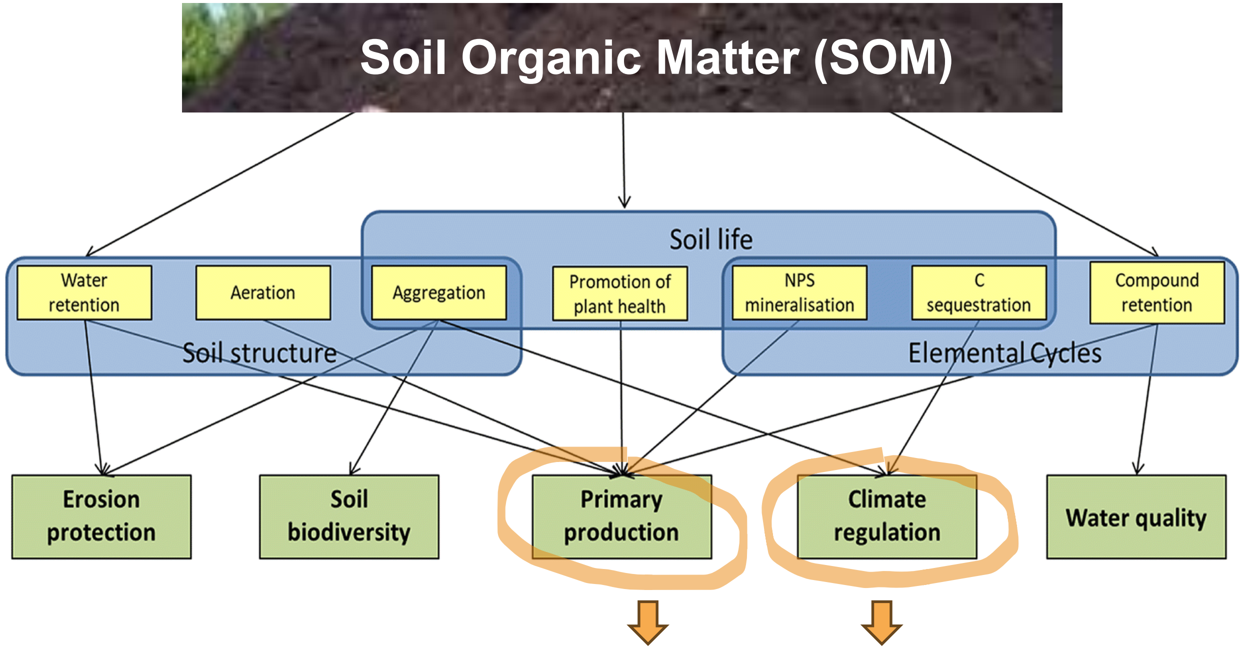
- “How will soil health practices impact **crop yield** and farm **net income**?”

- “What are the **recurring** and **long-term economic benefits and costs** of adopting soil health practices?”

- “How can soil health practices help **mitigate the effects of drought**?”

Why Soil Organic Matter matters for production and resilience

- SOM is a widely used indicator for soil health
- SOM supports both crop production and climate resilience



Key outcomes relevant to P-SHEC

(Hoffland et al., 2020)

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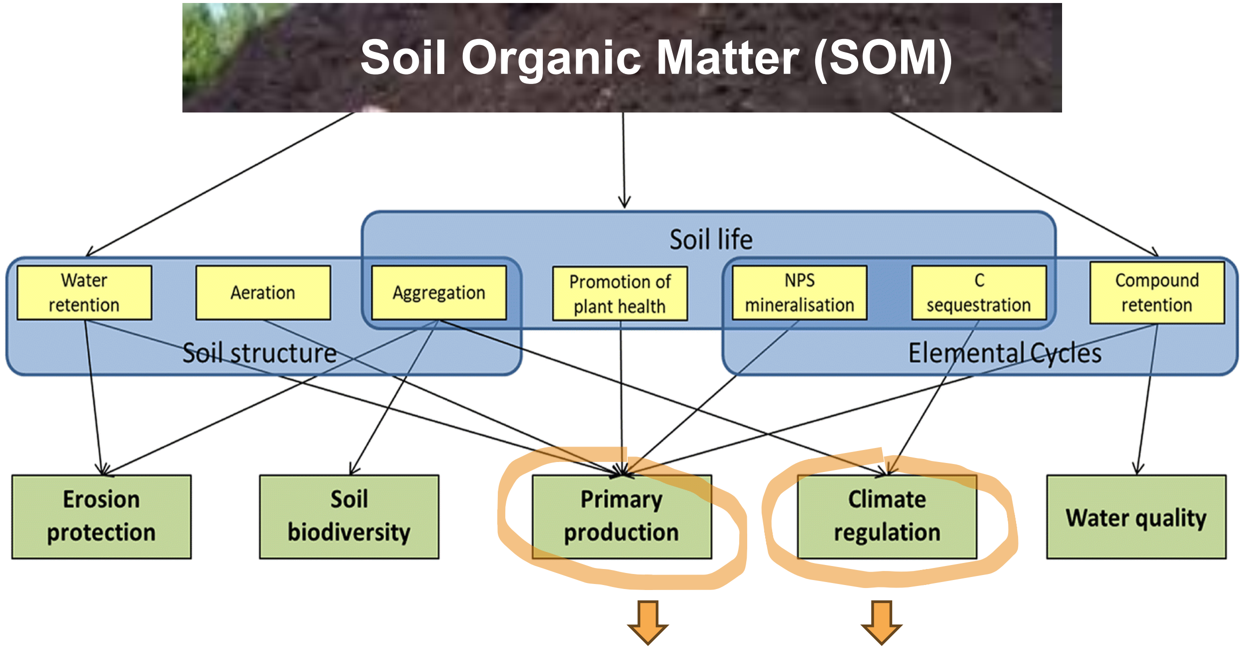
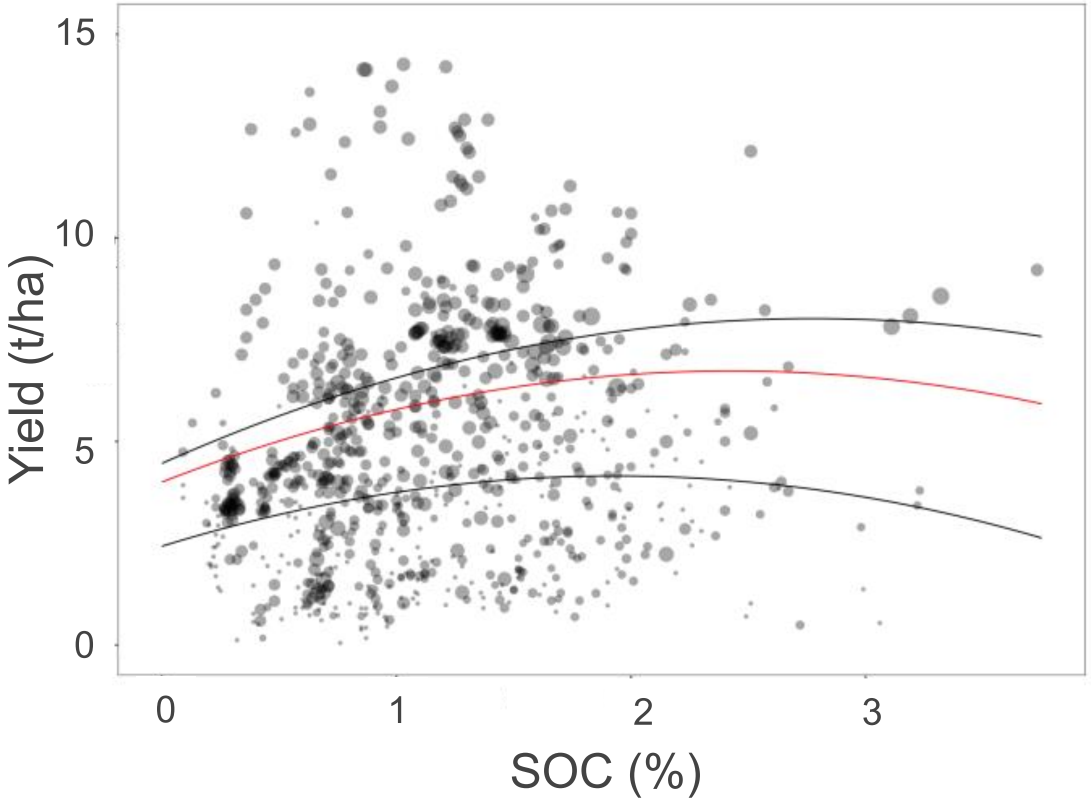


Key outcomes relevant to P-SHEC

(Hoffland et al., 2020)

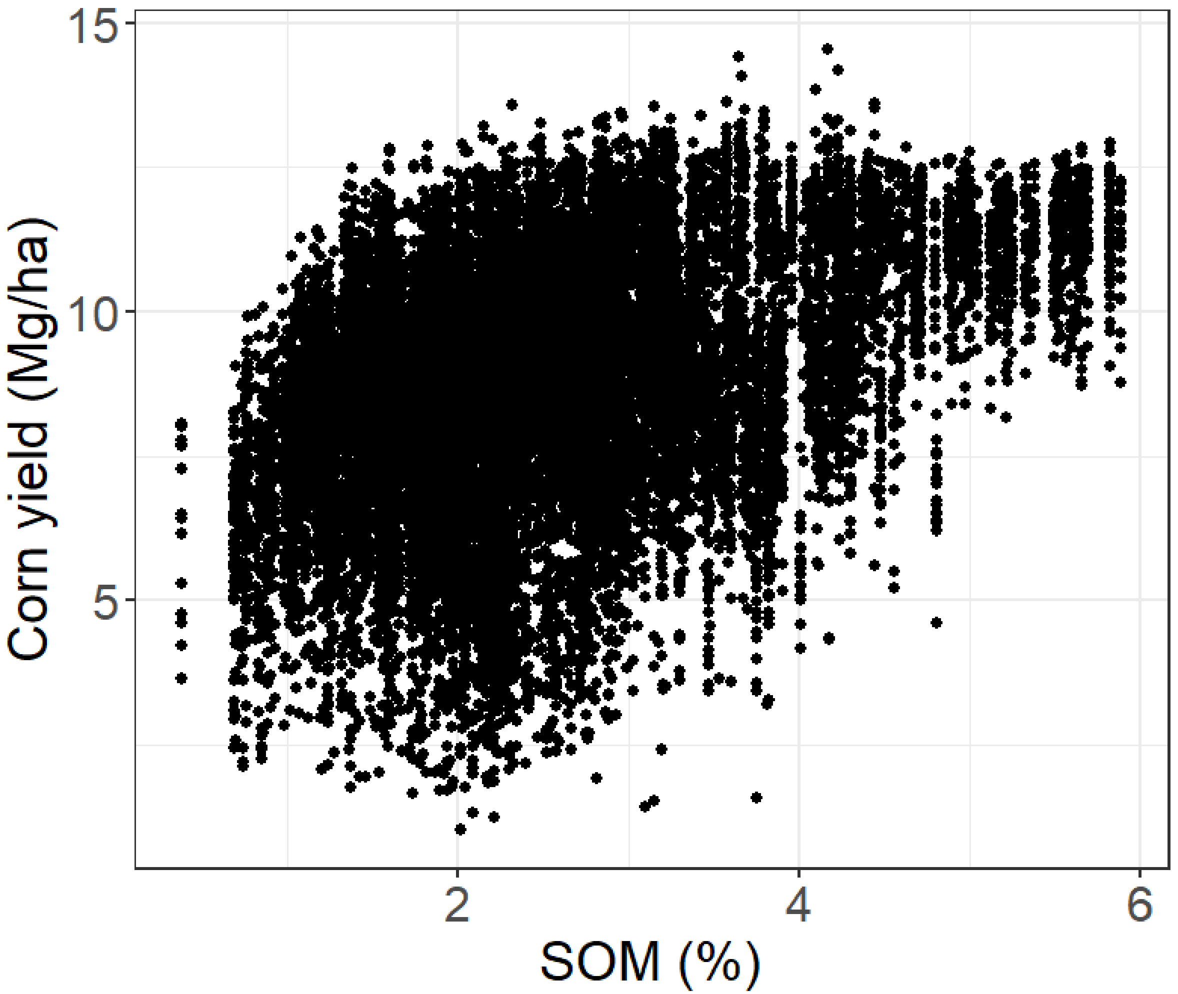
- Globally, higher SOM is associated with higher yields



Note: SOC shown here; can be converted to SOM

(Oldfield et al., 2019)

How P-SHEC estimates county-level yield changes based on SOM gains from soil health practices



- A general positive relationship between SOM and corn yield across U.S. counties -- aligns with global pattern

(Maples et al., 2026)

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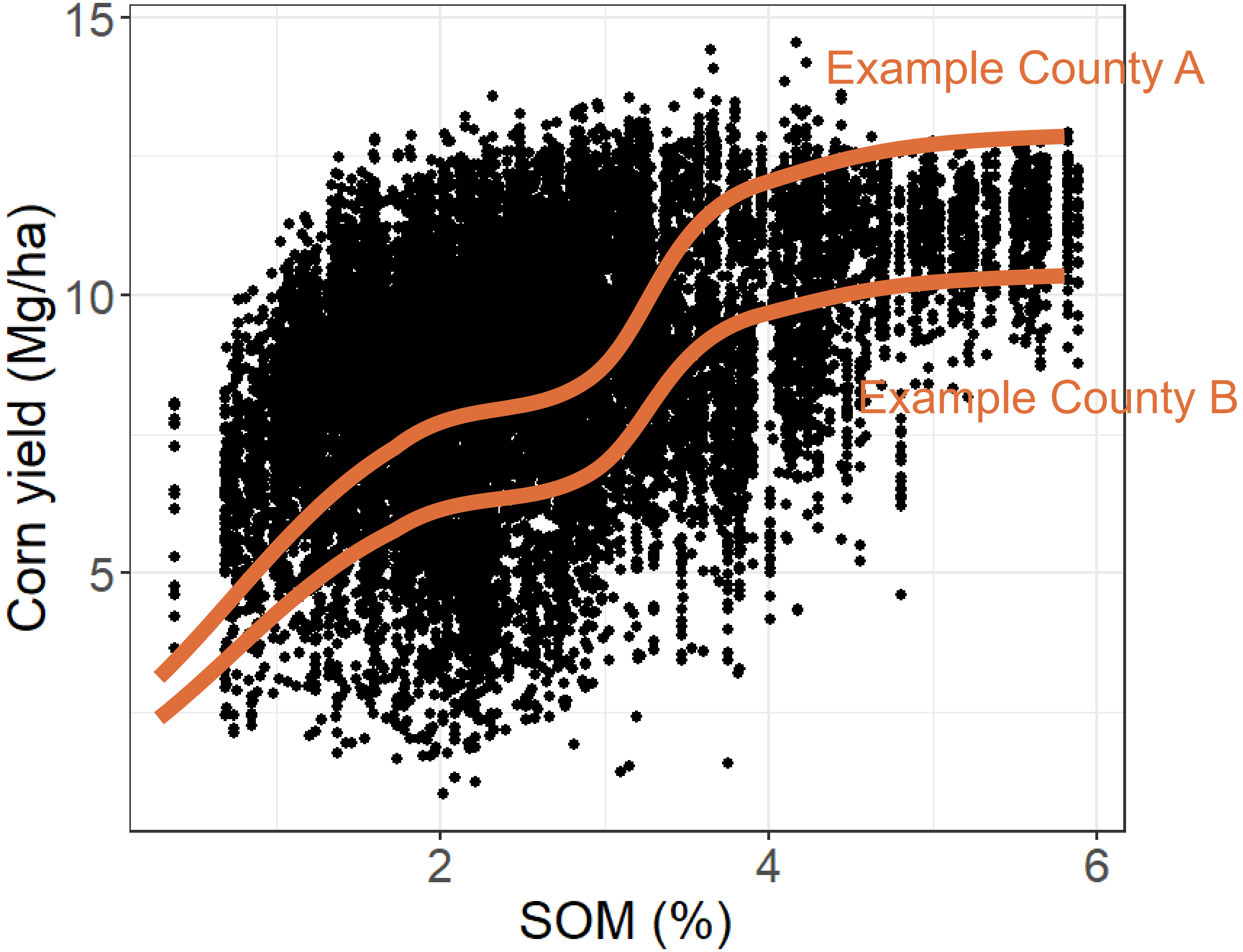

- A general positive relationship between SOM and corn yield across U.S. counties -- aligns with global pattern

- P-SHEC estimates county-specific yield-SOM curves based on local soil and climate conditions
    - Counties respond differently

(Maples et al., 2026)

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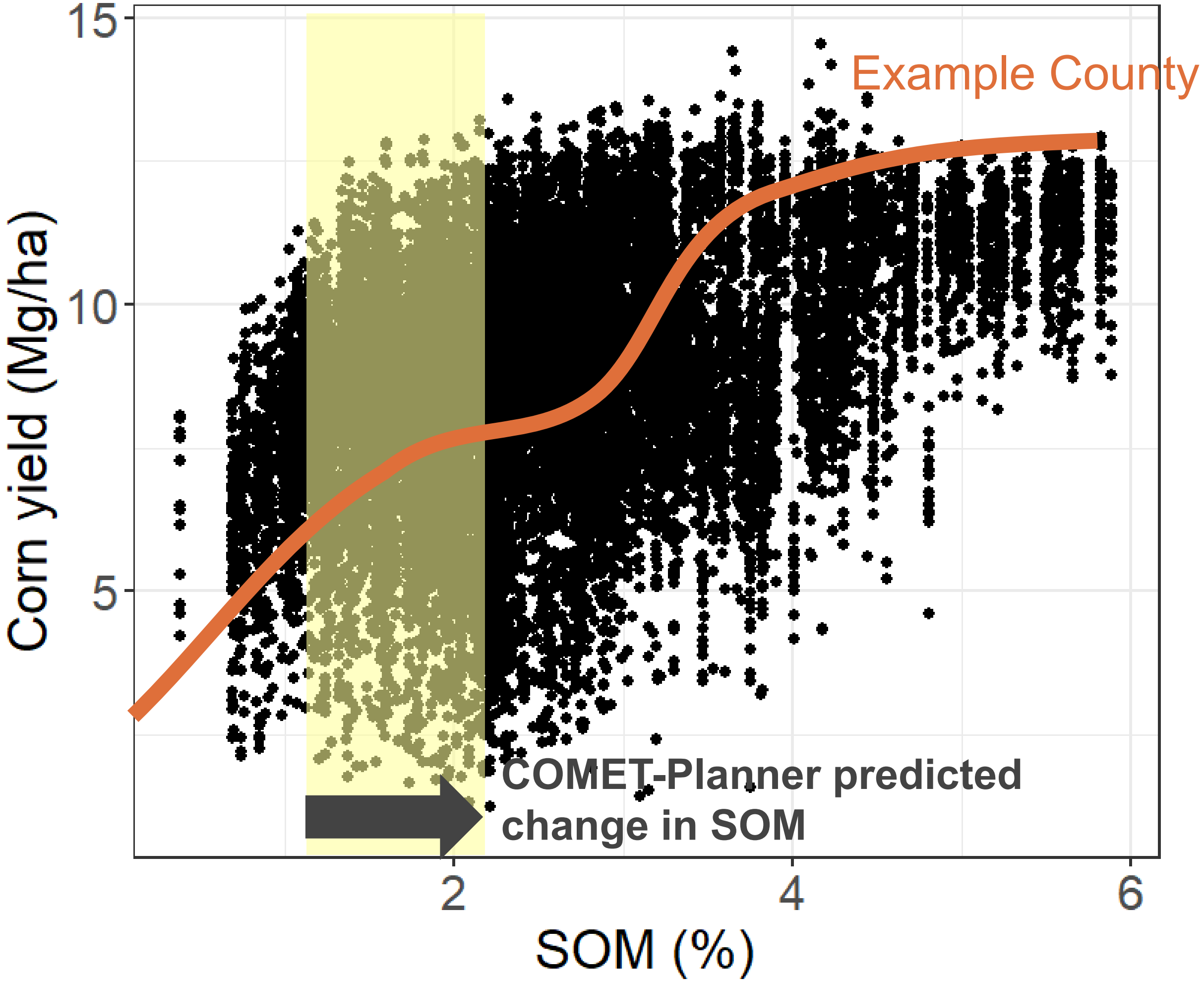

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- Use **COMET-Planner** derived estimates of 10-year SOM increases from practice adoption

(Maples et al., 2026)

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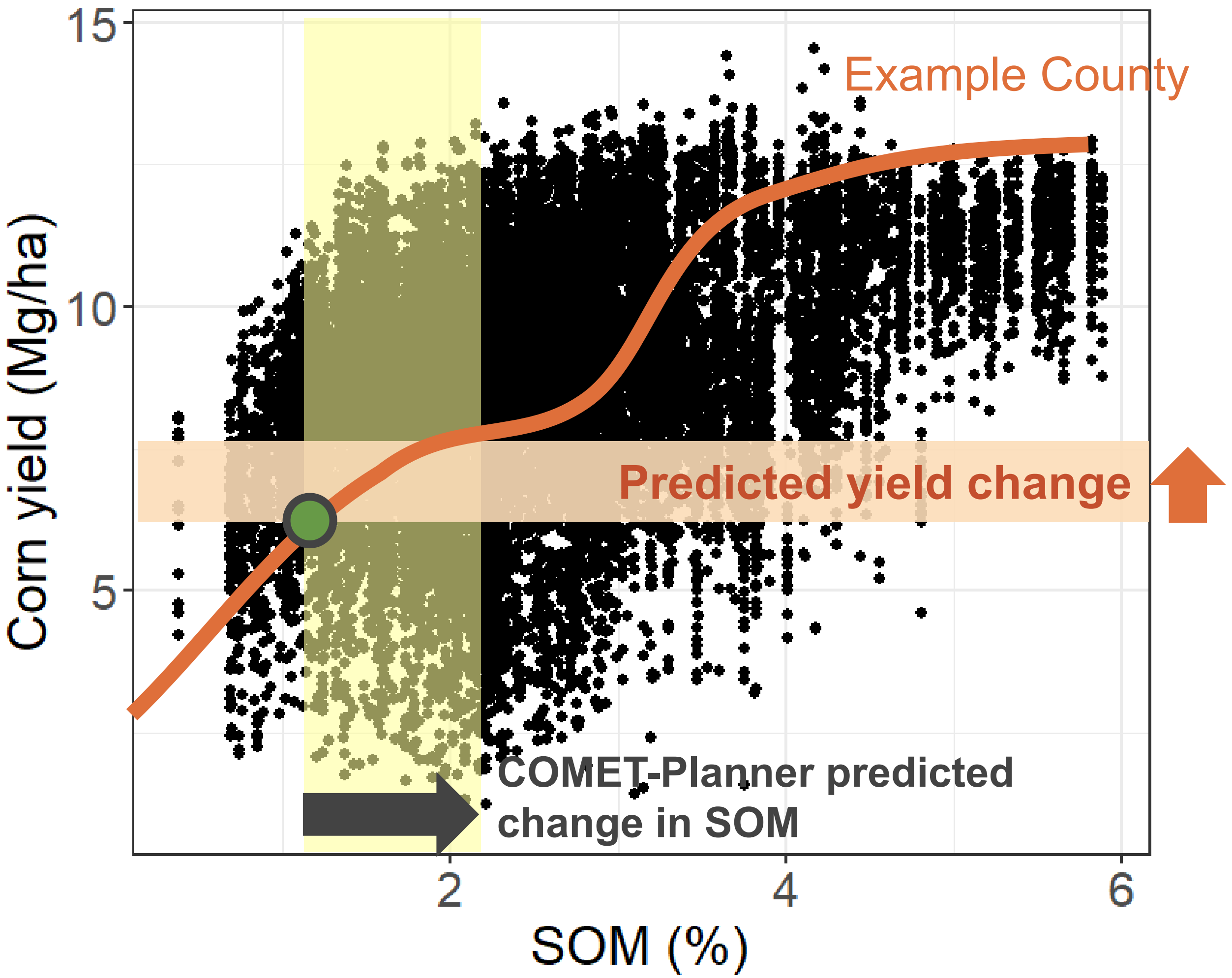

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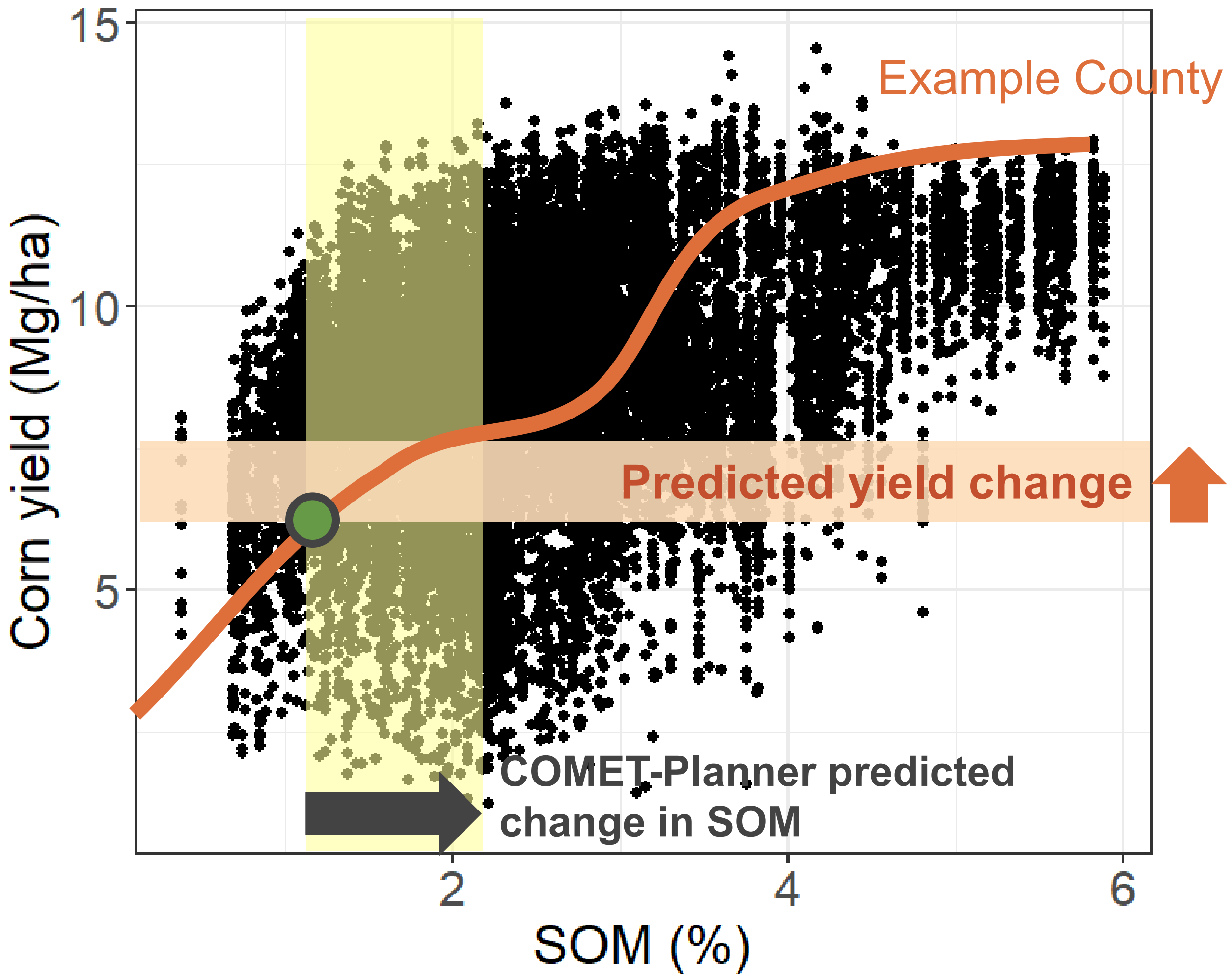
  - Counties respond differently
- Use **COMET-Planner** derived estimates of 10-year SOM increases from practice adoption
- P-SHEC integrates SOM estimates with modeled county-specific yield-SOM relationships to generate 10-year yield estimates

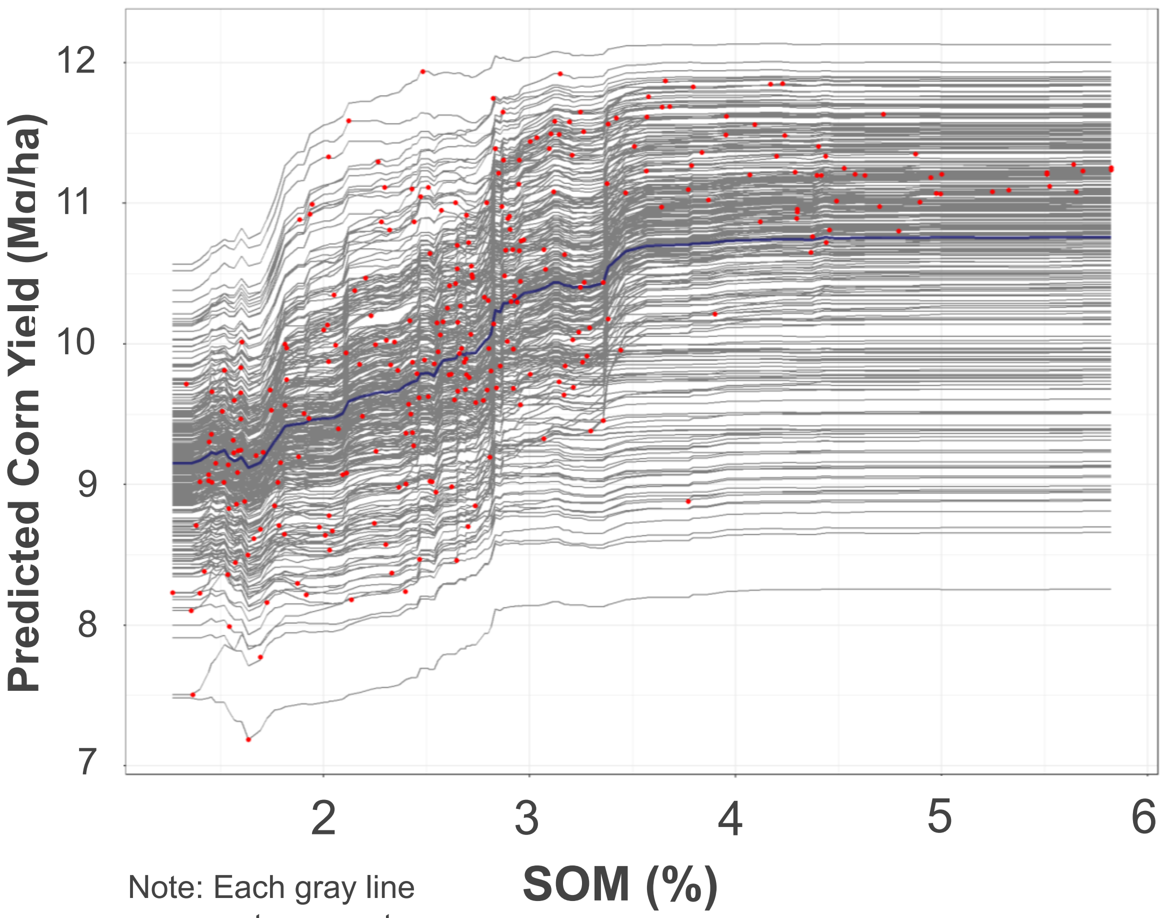
(Maples et al., 2026)

What the modeled yield results look like in practice

One example county



Modeled results across counties in IA, IL, IN, OH (Corn)



Note: Each gray line represents a county; red dots show baseline SOM.

(Maples et al., 2026)

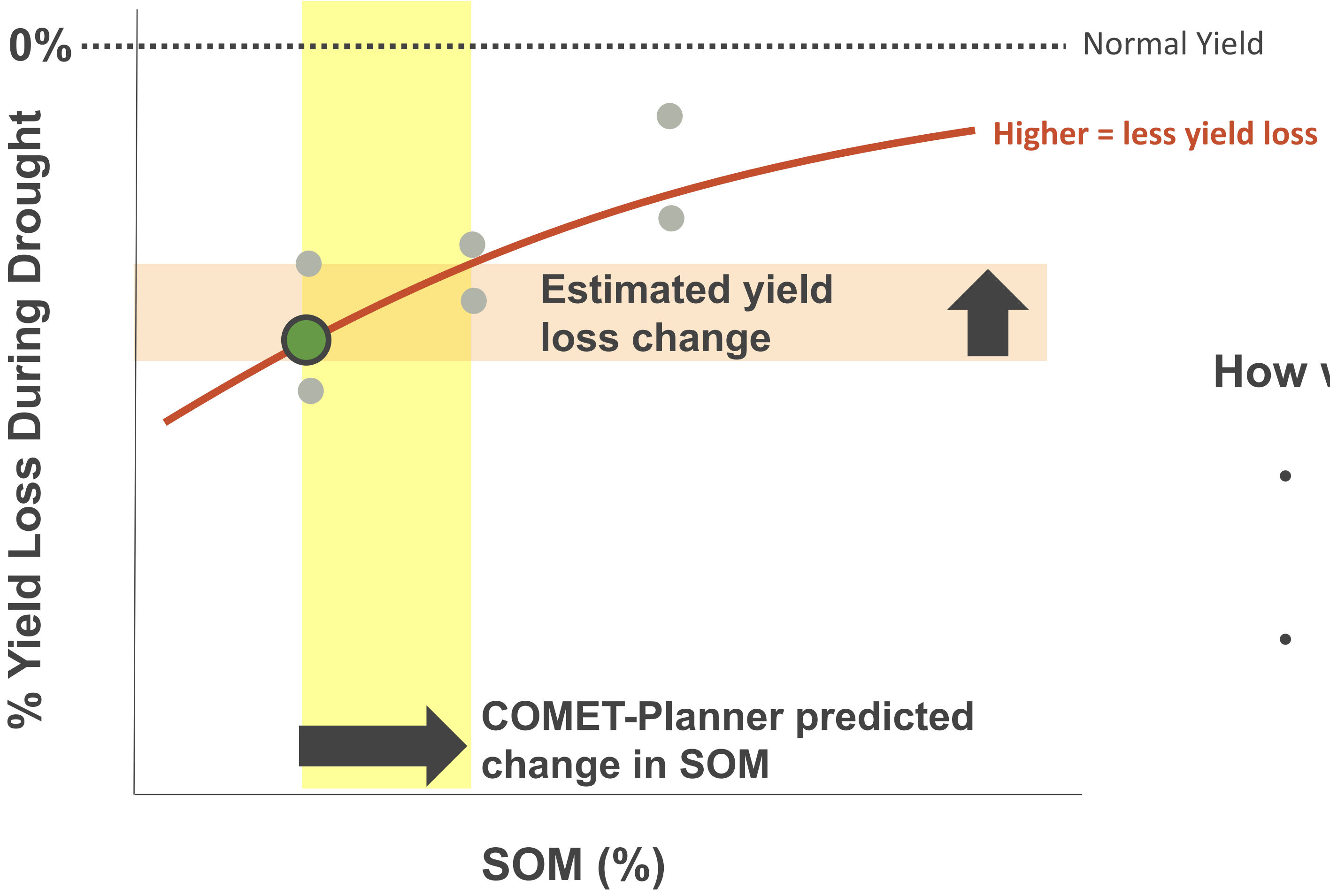
Outcomes of Soil Health Practices

Provides crop yield resistance from drought
(Carroll, Ohio 2012)

40 yrs No-till & Winter Cover Crops:
144 bu/ac - Dave Brandt

>20 yrs Conventional Tillage:
40-80 bu/ac - Neighbor

P-SHEC estimates how increased SOM can reduce DROUGHT yield loss

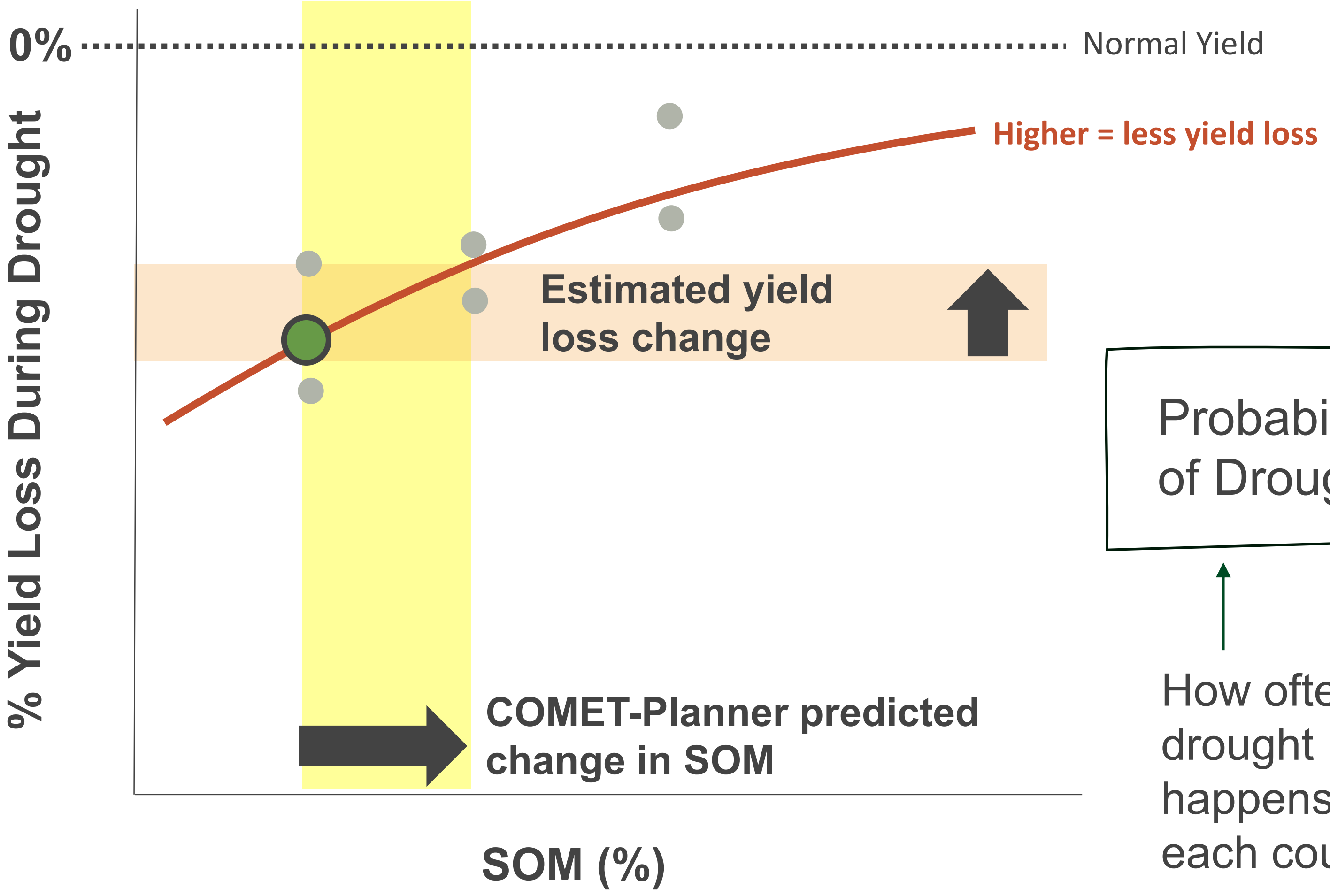


How we estimate drought benefits:

- Focus only on yield changes during drought years
- Compare yield loss before and after SOM increases

(Maples et al., 2026)

P-SHEC estimates how increased SOM can reduce DROUGHT yield loss



Probability of Drought × Estimated Yield Loss Change = Drought Resistance Benefits

- Probability of Drought: How often drought happens in each county
- Estimated Yield Loss Change: Yield loss before and after SOM increases
- Drought Resistance Benefits: Avoided drought yield loss over 10 years

(Maples et al., 2026)

Variables in the Crop Yield Model

- **Crop yield** (NASS)

- **Soil** (gSSURGO)
  - Soil organic matter
  - Available water capacity
  - Soil texture
  - pH
  - Wilting point
  - CEC
- **Nitrogen input** (Zhang et al., 2021)
- **Climate** (PRISM, Oregon State U.)
  - Growing season cumulative precipitation
  - Growing season mean temperature
  - Growing degree days
- **Additional environmental covariates**
  - Irrigation area
  - Soil drainage class
  - Slope

Crops & practices selected based on criteria

Criteria

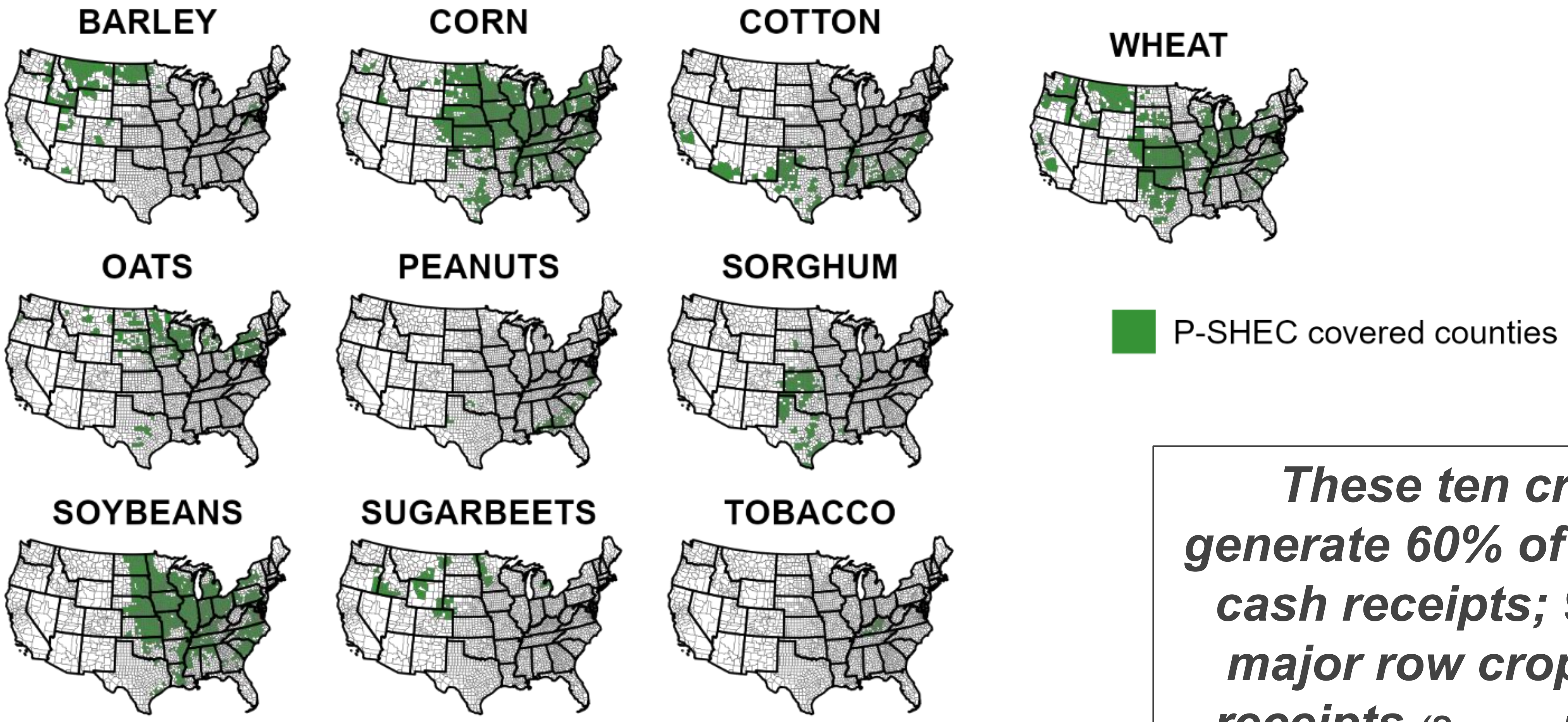
- **County-level yield data**
- **Consistent growing counties**
  - >= **15** of **24** years, 2000-2023
- **Geographically representative crops**
  - >= **50 counties** nationwide
  - >= **1,000** yield observations
- **Align with COMET-Planner**
  - Crops: e.g., **rice**, have unique cultivation methods and are not included in COMET-Planner, and these are **not included** in P-SHEC.
  - Practices are those available in COMET-Planner.

Examples of crops that do not meet the model's criteria

Crop	County-level yield	# of consistently growing counties (>= 50)	# of observations (>= 1000)
Cranberries	X	**NA**	**NA**
Sugarcane	✓	X **(3 counties)**	X **(57 obs)**
Processing tomatoes	✓	X **(7 counties)**	X **(105 obs)**

Only crops meeting both yield and practices criteria are included in P-SHEC. Crops like cranberries, sugarcane, and processing tomatoes are excluded.

P-SHEC Tool crop coverage maps

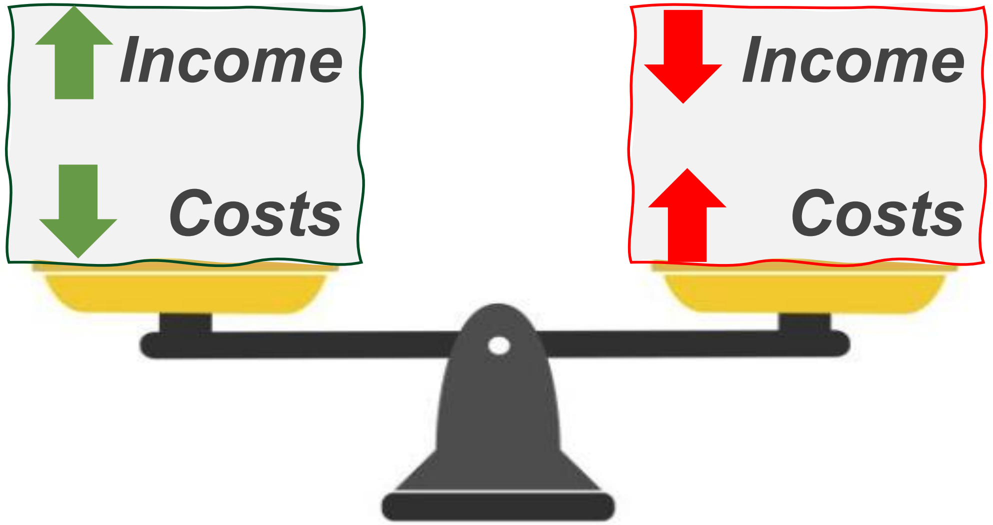


***These ten crops generate 60% of all crop cash receipts; 91% of major row crop cash receipts** (Source: ERS 2025)*

(Maples et al., 2026)

Economic Analysis – (1) Recurring Costs

Use Partial Budget Analysis

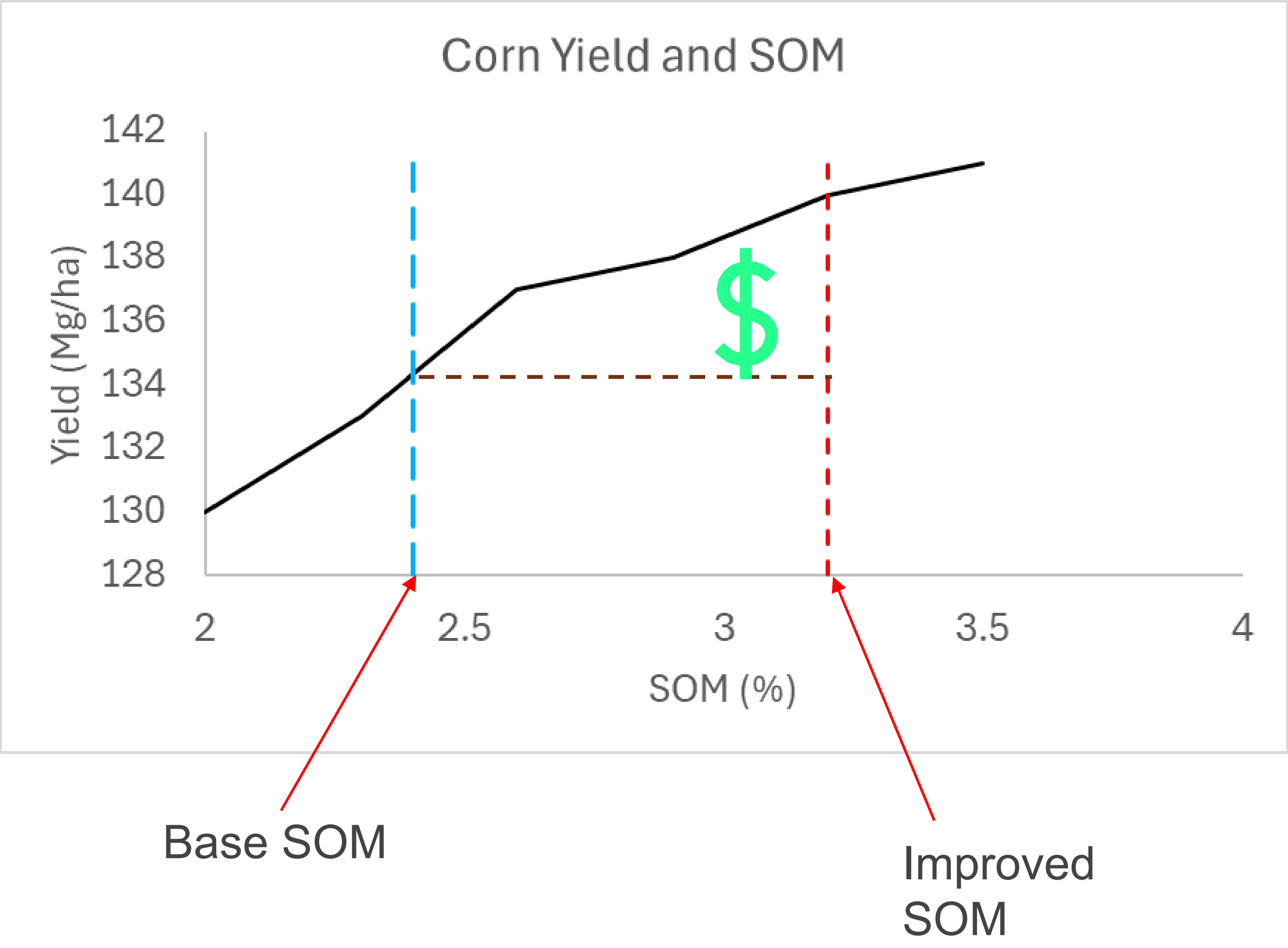


Budget data from University of Georgia, Louisiana State University, University of Minnesota, University of Illinois, & Mississippi State University

Examples of recurring cost categories:

- Equipment changes
- Cover crop seed costs
- Cover crop termination costs
- Changes in N, P, K
- Changes in chemical use

Economic Analysis – (2) Yield Changes



Long-Term: Yield Revenue Changes

- Identify baseline yield prediction at base SOM
- Identify ending yield prediction at improved SOM
- Calculate the yield difference

Pilot Testing

Overview

12 pilot testers:
Farmers, Researchers, Extension/Outreach, and Conservation Professionals

Karl Anderson, NRCS Natural Resource Specialist, conducted pilot testing

Process:
1. Each tester was asked to enter 1 of 3 scenarios
2. Karl asked follow-up questions
3. Testers were asked to take a post-test online survey

Key Takeaways

Results averaged **4.1 out of 5** across all overall useability questions

9 out of 12 would recommend the tool

User mentioned a desire for more field specific results. Working on ways to incorporate this in a future version

Key Tool Changes

Redesigned results section to increase interpretability

Changed general info to have more strict filtering rule

Overall, testers wanted **more detailed instructions and user tips in the tool**

P-SHEC Demonstration

Location: Saline, IL

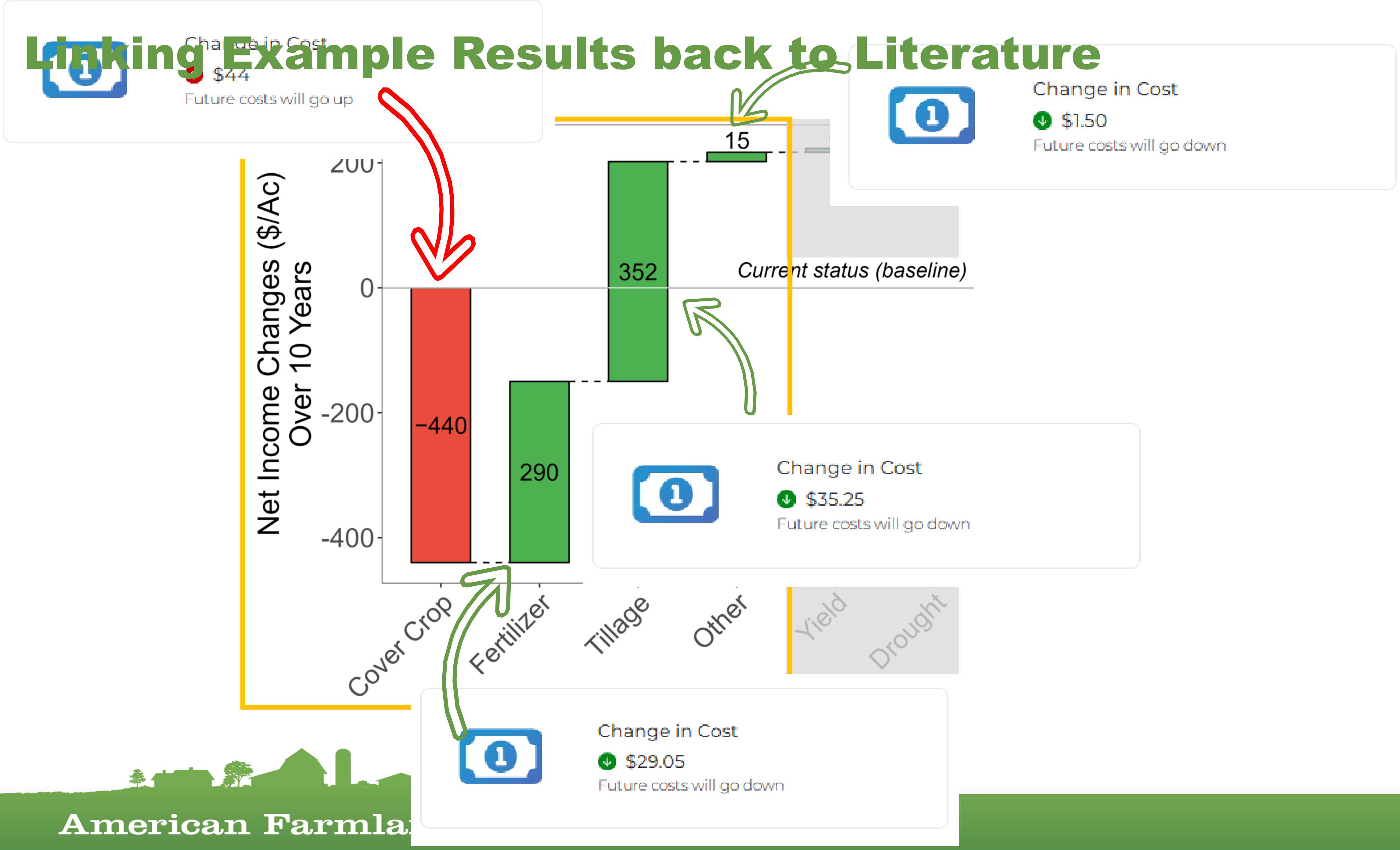
Crops: corn

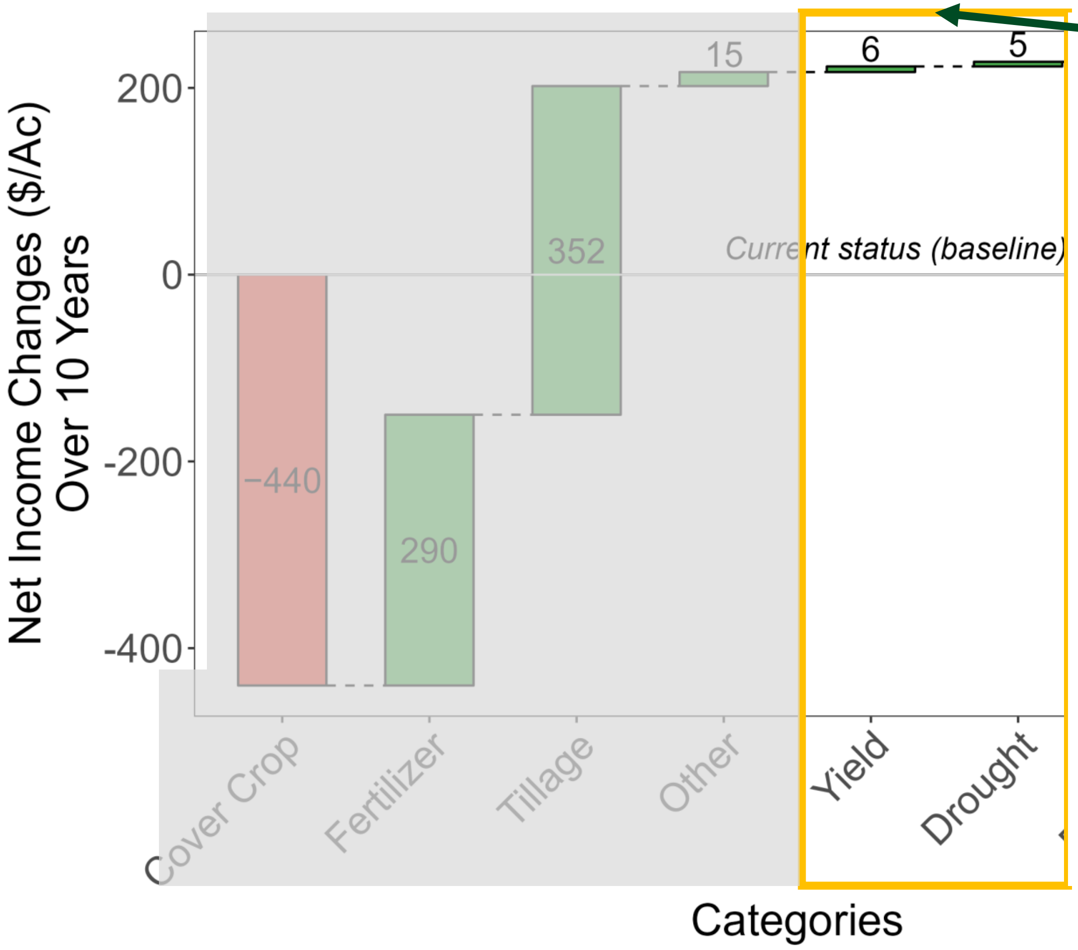
Transition scenario:
Conventional tillage → no-till
No cover crops → non-legume cover crop

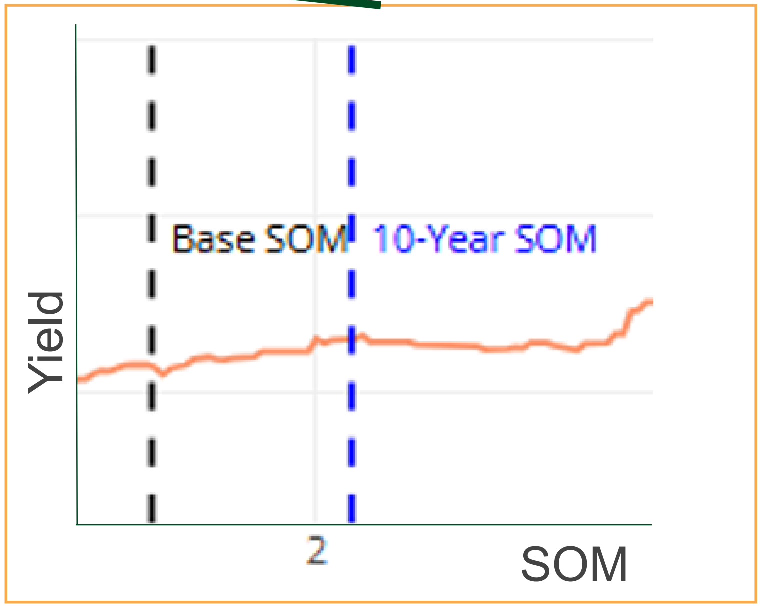
To access the tool: https://farmlandinfo.org/predictive-soil-health-economic-calculator/

P-SHEC peer-reviewed journal article: https://doi.org/10.1016/j.atech.2026.101834

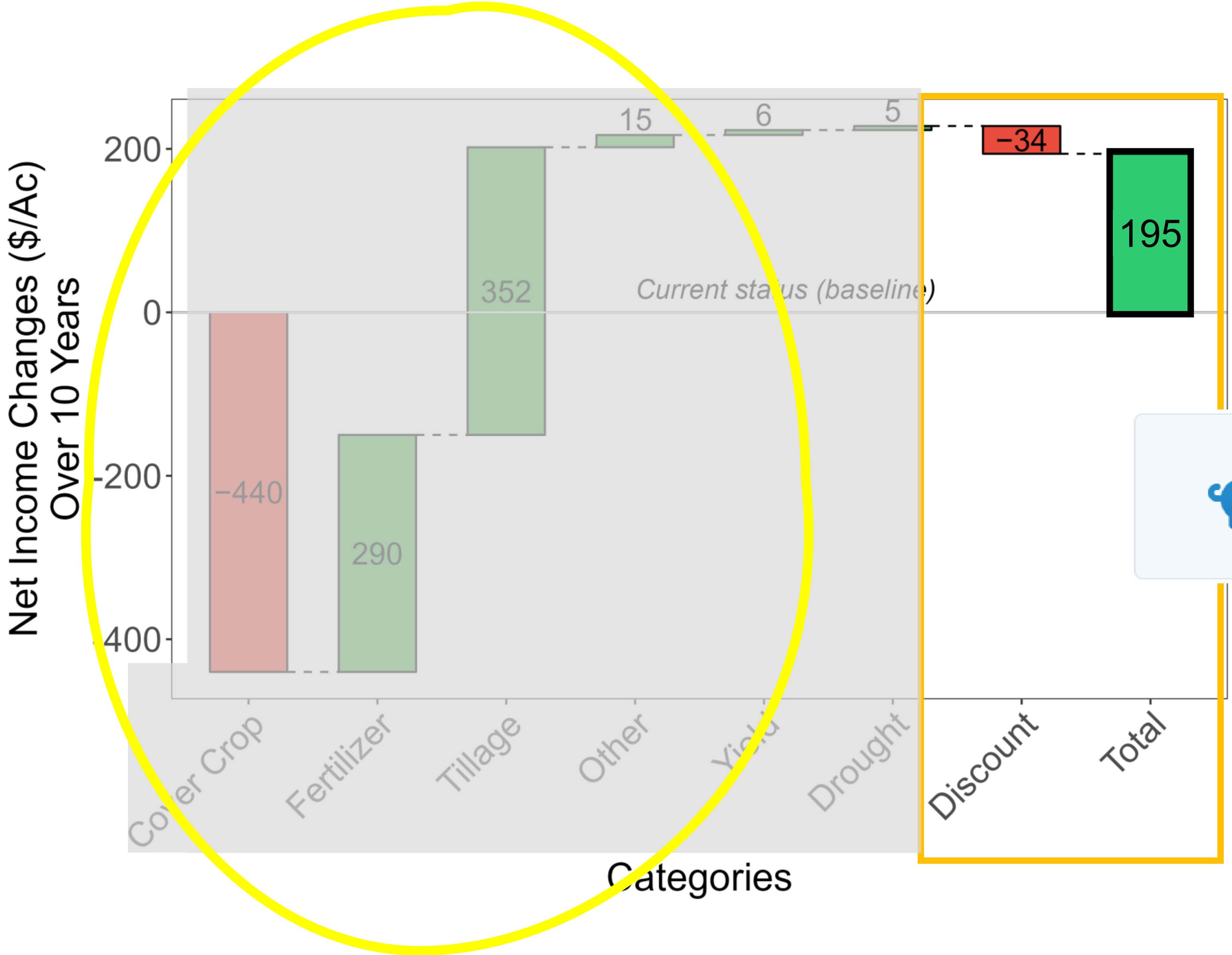
Linking Example Results back to Literature

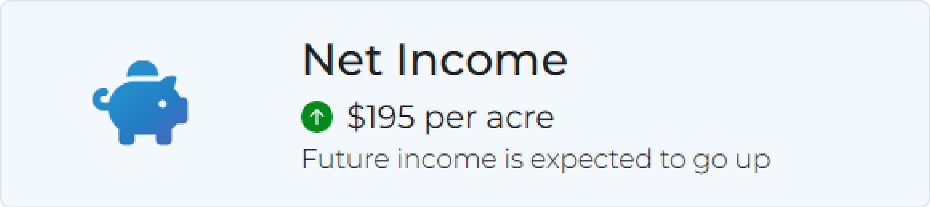






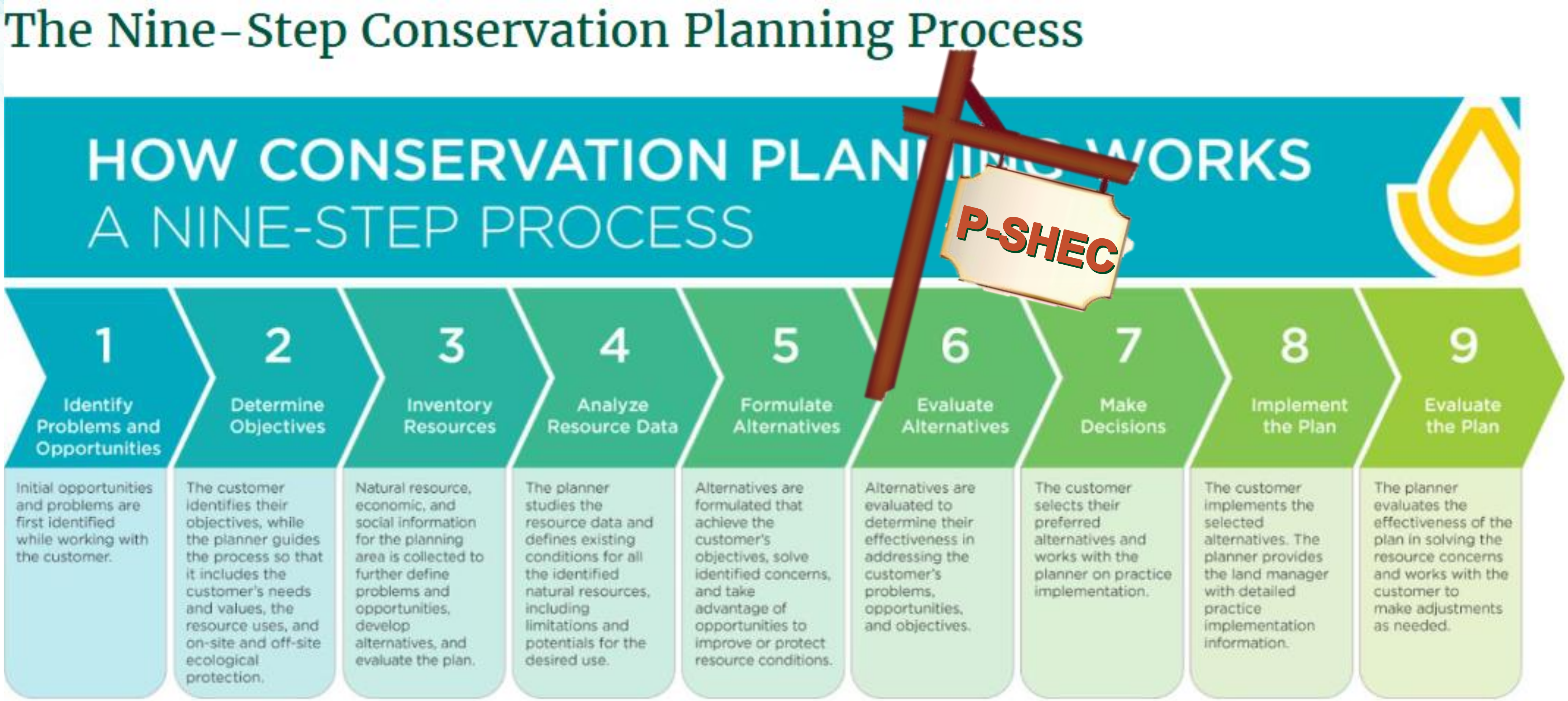
Predicted Yield under Severe Drought	Yield Difference Due to SOM Increase Under Drought	Drought Yield Revenue Difference ($/Ac)
63.47	27.41	127.77





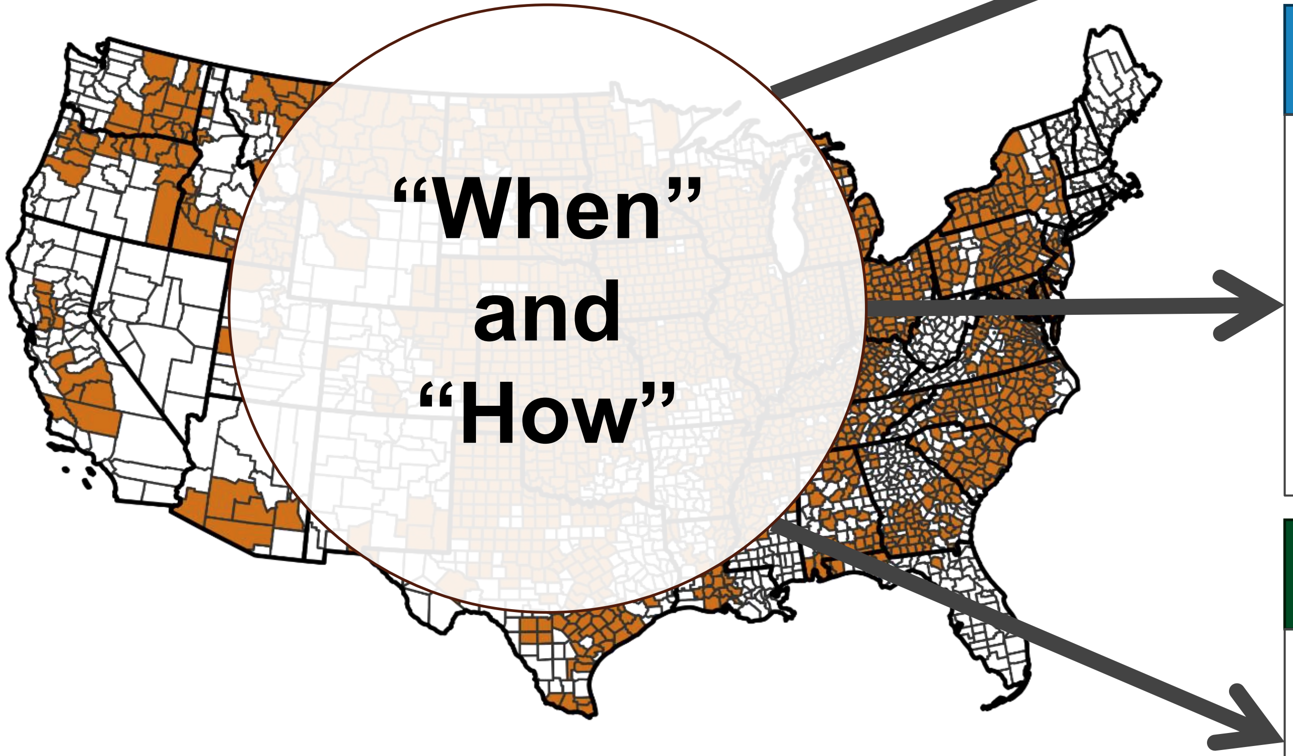
- Findings track with literature:
  - Large $ changes related to recurring cost changes
  - Relatively lower yield gains

Where P-SHEC fits in conservation planning process



Michelle

P-SHEC Uses



Economic Analysis

- Use PSHEC projections to investigate and understand the financial viability of various conservation efforts

Decision-Making Facilitation

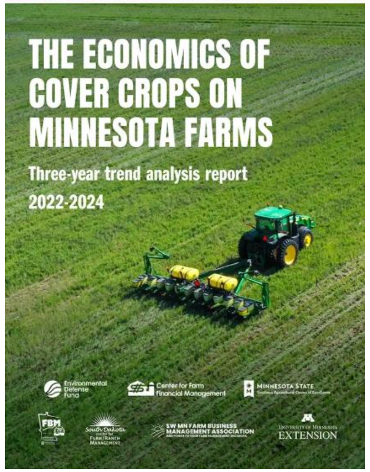
- PSHEC simplifies economic and agronomic modelling into user-friendly outputs meant to support decision-making.
- Empowers professionals to guide farmers through scenario planning of necessary changes and potential outcomes associated with soil health practice implementation.

Stakeholder Engagement

- Outputs from PSHEC can be used in presentations, workshops, and consultations to increase knowledge and build trust and transparency.

Use P-SHEC in conjunction with other economic resources

- NACD Soil Health Champions Network
- NACD & Datu Case Studies
- U. of Minnesota Extension Soil Health Case Studies featuring 9 farms
- USDA Northeast Climate Hub Soil Health Economic projects page
- Soil Health Nexus
- EDF-UMN FB: The economics of cover crops on 41 Minnesota Farms over 3 years (2022 to 24)



Next steps

More in depth training desired?

Troubleshooting support?

Interpretation of results support?

Thank You!

Please reach out!

Dr. Michelle Perez, Senior Liaison between Research & On the Ground Practice (former Water Initiative Director)

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Dr. Meng Li, Senior Soil Health Scientist, Research Team

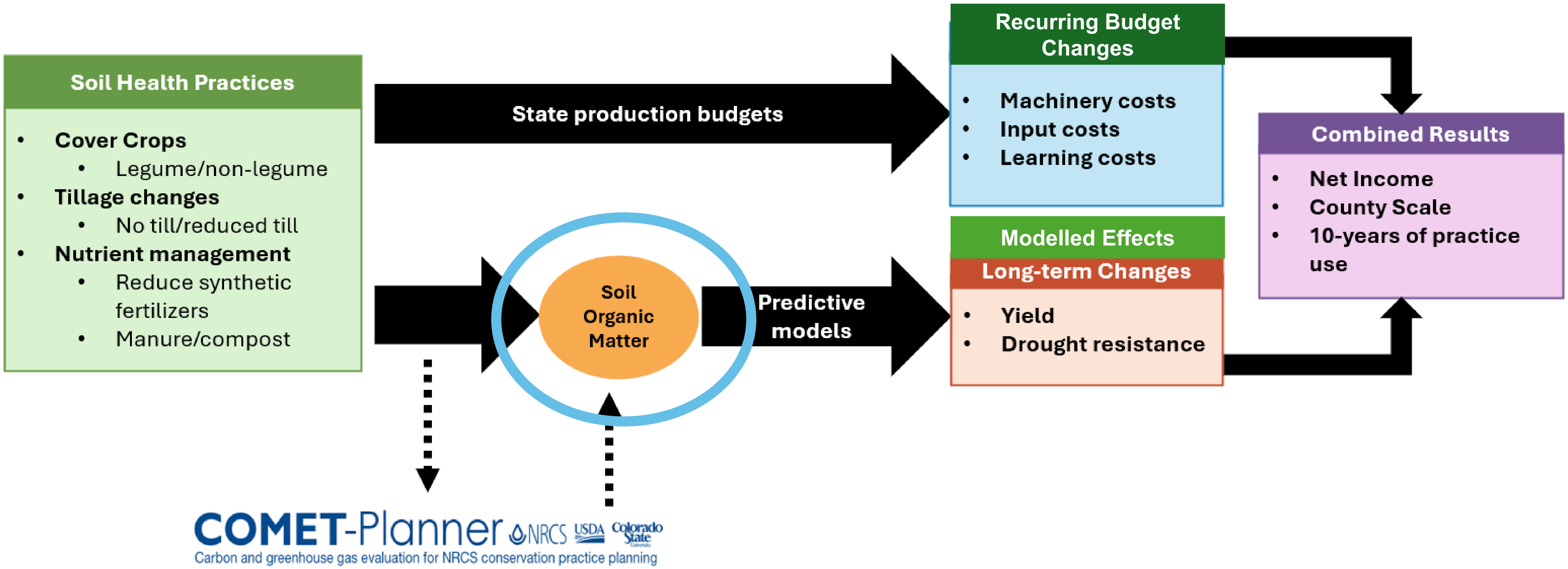
MLi@Farmland.org

Dr. Chellie Maples, Agricultural Economist, Research Team

Cmaples@Farmland.org

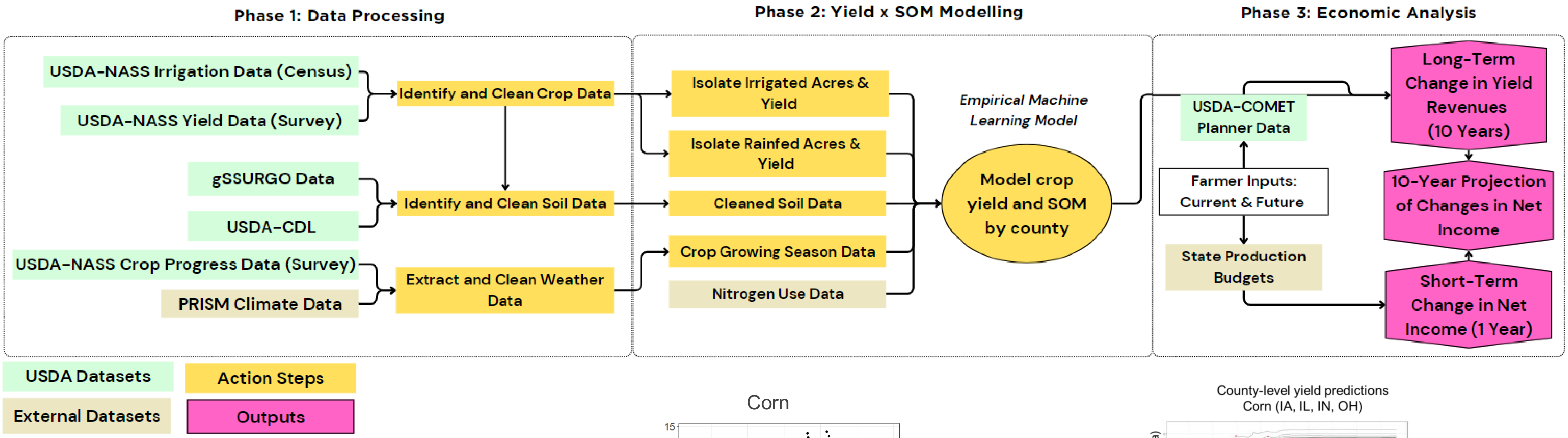
Predictive Soil Health Economic Calculator (P-SHEC)

What is it? A web-based decision-aid tool that generates 10-year Net Present Value (NPV) of soil health practice adoption at the county scale.



Bonnie

PSHEC – "Under the Hood"



Note: The tool is based on national datasets. Field level experimental data will be used to validate model results.