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2022
CARBON IN
AGRICULTURE
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2022 Carbon in Agriculture

WELCOME

Michael J. Boehm
Vice President and
IANR Harlan Vice Chancellor
University of Nebraska - Lincoln

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2022 Carbon in Agriculture

HOST

Michael J. Boehm
Vice President and
IANR Harlan Vice Chancellor
University of Nebraska - Lincoln

Ronald Yoder
IANR Senior Associate Vice Chancellor
University of Nebraska - Lincoln

Welcome

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2022 Carbon in Agriculture

Morning Agenda

8:30-9:00 am	Sign in
9:00-9:30 am	Welcome & Scoping
9:30-10:30 am	**Carbon: Building Block of Agriculture** Moderator: Caro Cordova Panel: Rhae Drijber, Dave Vetter, Homer Buell, Amy Schmidt
10:30-11:00 am	Virtual Keynote Complexities in Soil Carbon Reservoirs *Jonathan Sanderman, Woodwell Climate Research Center*
11:00-noon	**Carbon: A Complex Cycle that Sustains Agriculture** Moderator: Andy Suyker Panel: Michael Kaiser, George Burba, John Gamon
Noon-12:45 pm	Lunch

Afternoon Agenda

12:45-1:00 pm	NRCS Perspective on Carbon *Aaron Hird, USDA-NRCS*
1:15-2:15 pm	**Carbon Sequestration: What is Possible?** Moderator: Chuck Rice Panel: Adam Liska, Chuck Rice, David Wedin, Galen Erickson
2:15-2:30 pm	Break
2:30-3:00 pm	What About Carbon Markets in Agriculture? *Alejandro Plastina, Dept. of Economics, ISU*
3:00-3:30 pm	Looking to the Future
3:30 pm	Adjourn

All sessions will be available by live stream. The website for the live stream is https://ianr.unl.edu/carbon-agriculture-summit. From this webpage you will find where you are able to submit questions and/or provide comments to the meeting moderator.

Who is here today to talk about soil carbon?

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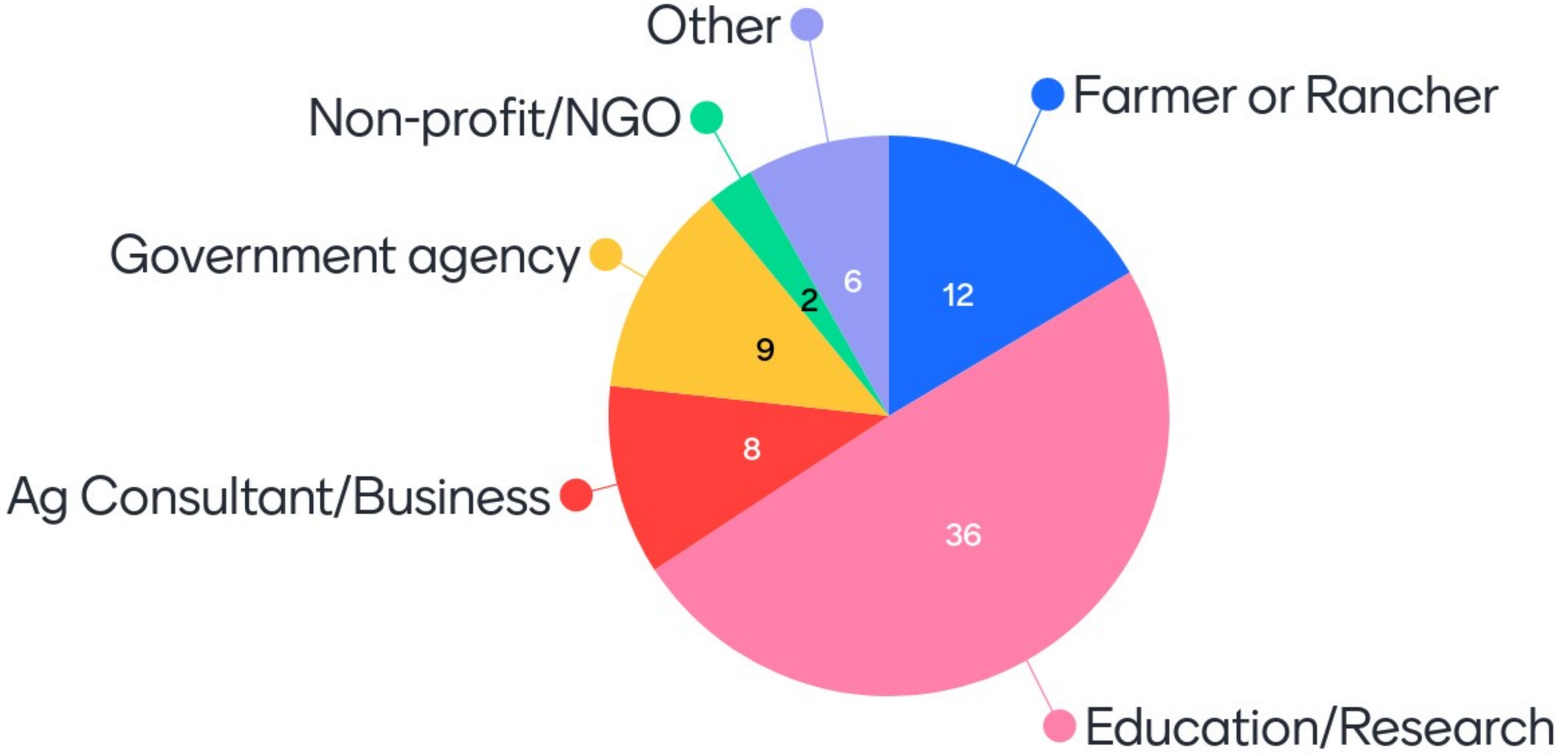

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Where do you call home:

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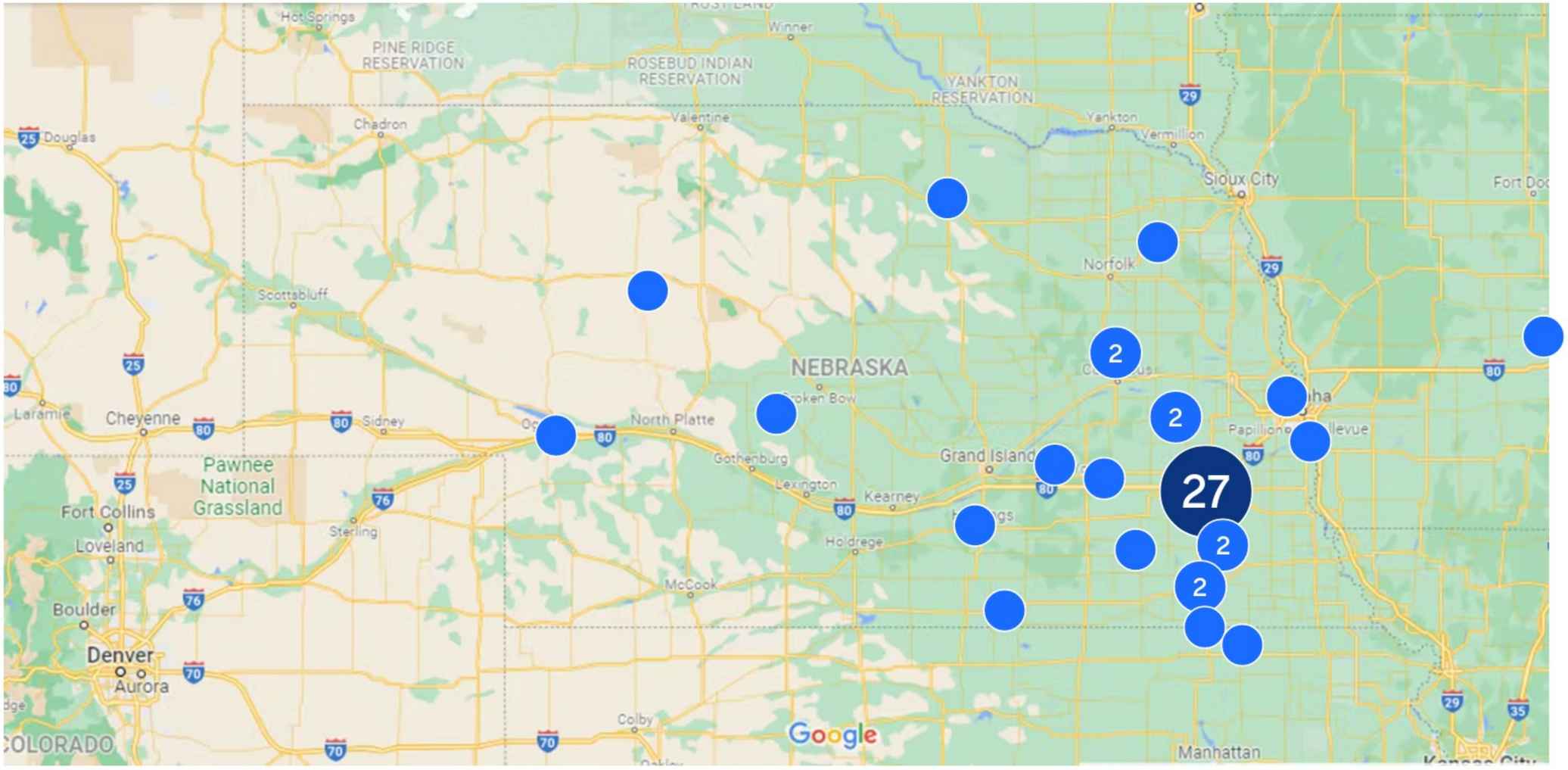

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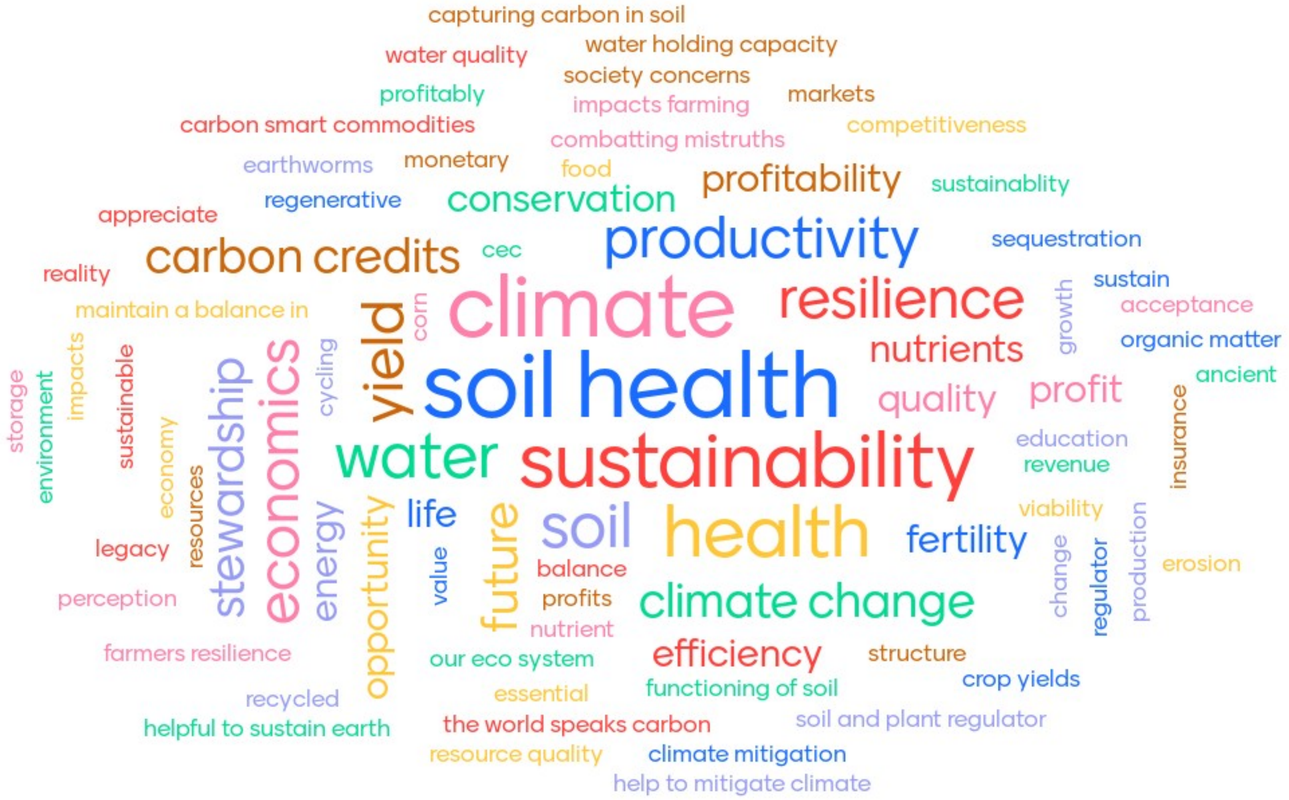
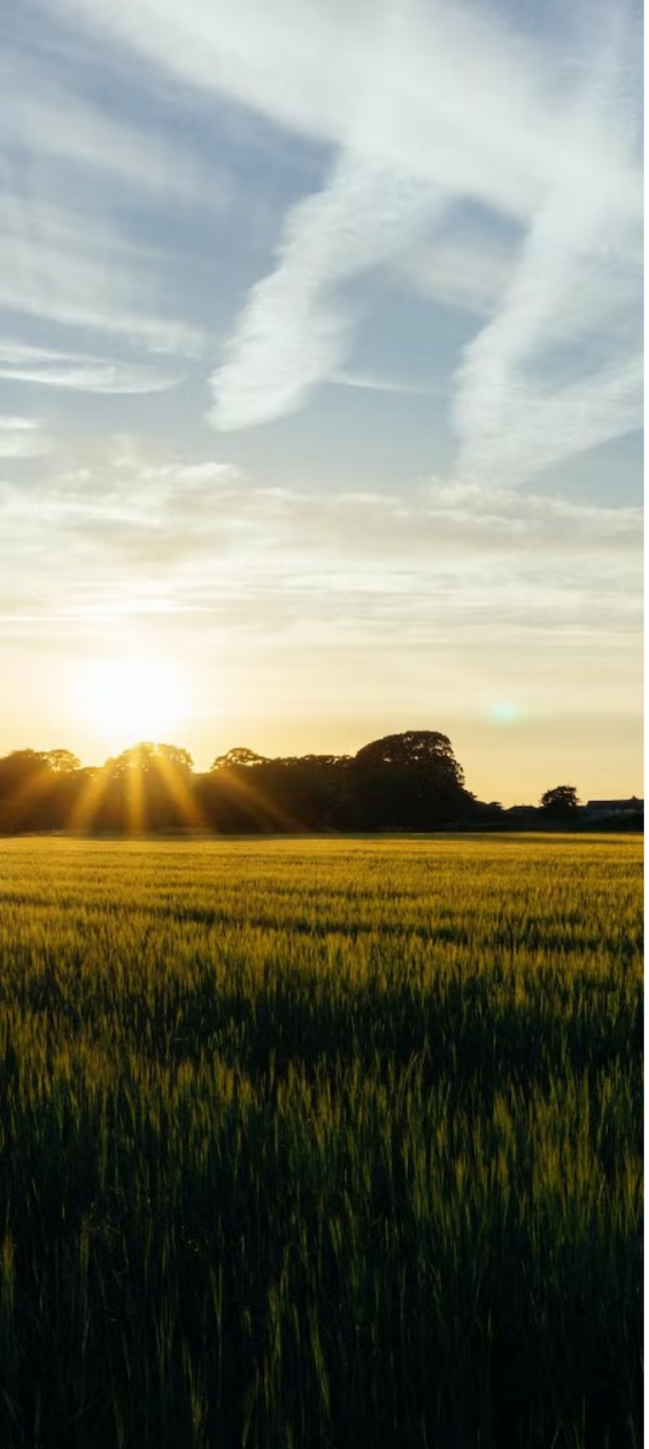
Why is understanding carbon in agriculture important?





How important are each of these factors for agricultural production?

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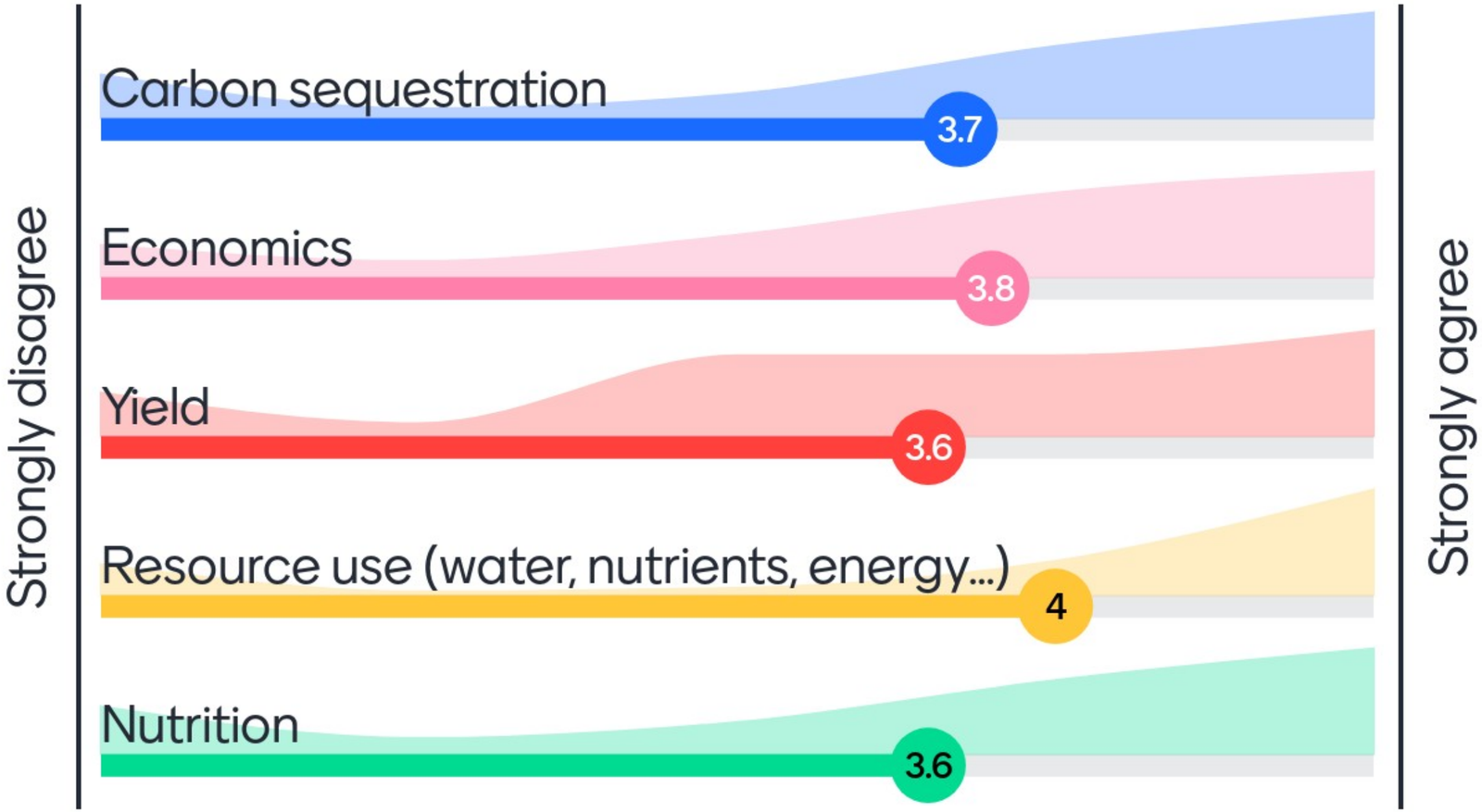

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Questions? Ideas? Share them at any time with Q&A button or from the livestream link

21 questions
1 upvotes

Panel Discussion

Carbon| Building Block of Agriculture

Moderator

Caro Cordova

Assistant Professor

Agronomy & Horticulture

Carbon in Soil

Rhae Drijber

Professor

Agronomy & Horticulture

Carbon in Crop Production

David Vetter

CEO

Grains Place Foods

Carbon in Grazing Lands

Homer Buell

Co-Owner/Rancher

Shovel Dot Ranch

Carbon in Livestock Systems

Amy Schmidt

Associate Professor

Biological Systems Engineering

Carbon: Building Block of Agriculture

Carbon Inputs

1) Photosynthesis
   Plants absorb carbon dioxide (CO_2) and water to produce biomass and oxygen

2) Plant residue and root-carbon biomass

3) Soil organic matter (~50% Organic carbon)

4) Organic amendments rich in **Carbon** (e.g., mulch, cover crops, diverse rotations, manure)

Carbon Losses

1) Fossil fuel combustion (CO_2 emissions)

2) Land clearing, deforestation

3) Animal, root & soil respiration

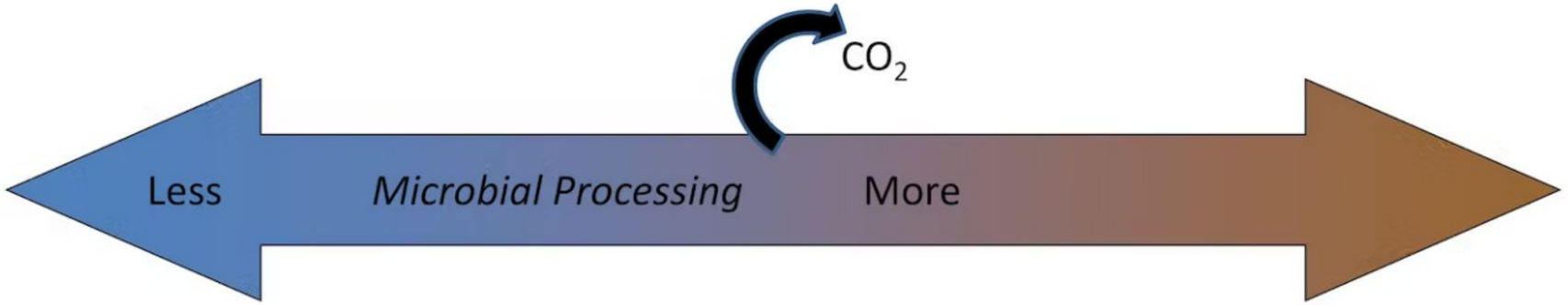
4) Organic matter decomposition

5) Soil erosion (wind, rain, tillage)

AGRONOMY AND HORTICULTURE
Institute of Agriculture and Natural Resources

S. Carolina Córdova, PhD.
Assistant Professor & Statewide Soil Health Specialist

Soil Organic Matter – A Continuum



Fresh plant and animal residues	Particulate organic matter 'POM'	POM protected within aggregates	Mineral-Associated OM 'HUMUS'

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Panel Discussion

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Carbon in Agriculture

Complexities in Soil Carbon Reservoirs

Panel Discussion

Carbon| A Complex Cycle that Sustains Life

Moderator

Andy Suyker

Associate Professor

School of Natural Resources

Measuring Carbon - Soil

Michael Kaiser

Assistant Professor

Agronomy & Horticulture

Measuring Carbon - Fluxes

George Burba

Science & Strategy Fellow

LI-COR

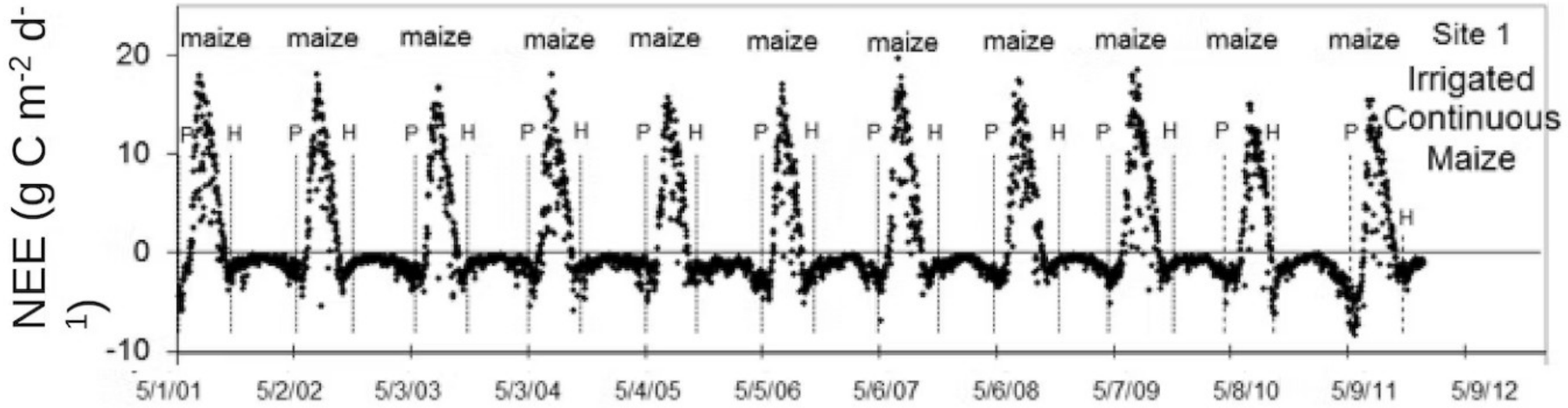
Measuring Carbon – Remote Sensing/Modelling

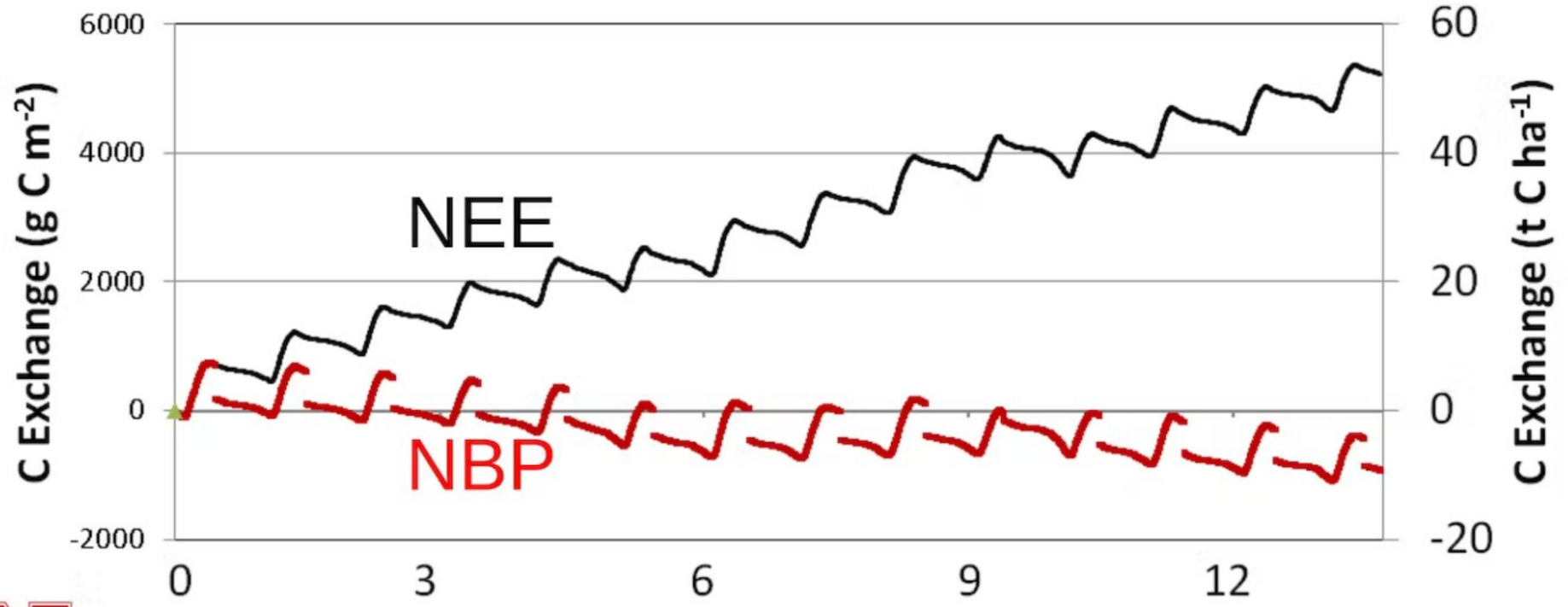
John Gamon

Professor

School of Natural Resources

US-Ne1 Site 1 Irrigated Continuous Maize





Positive number – carbon uptake
Negative number – carbon loss

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Photosynthesis & Carbon Sequestration (ΔC)

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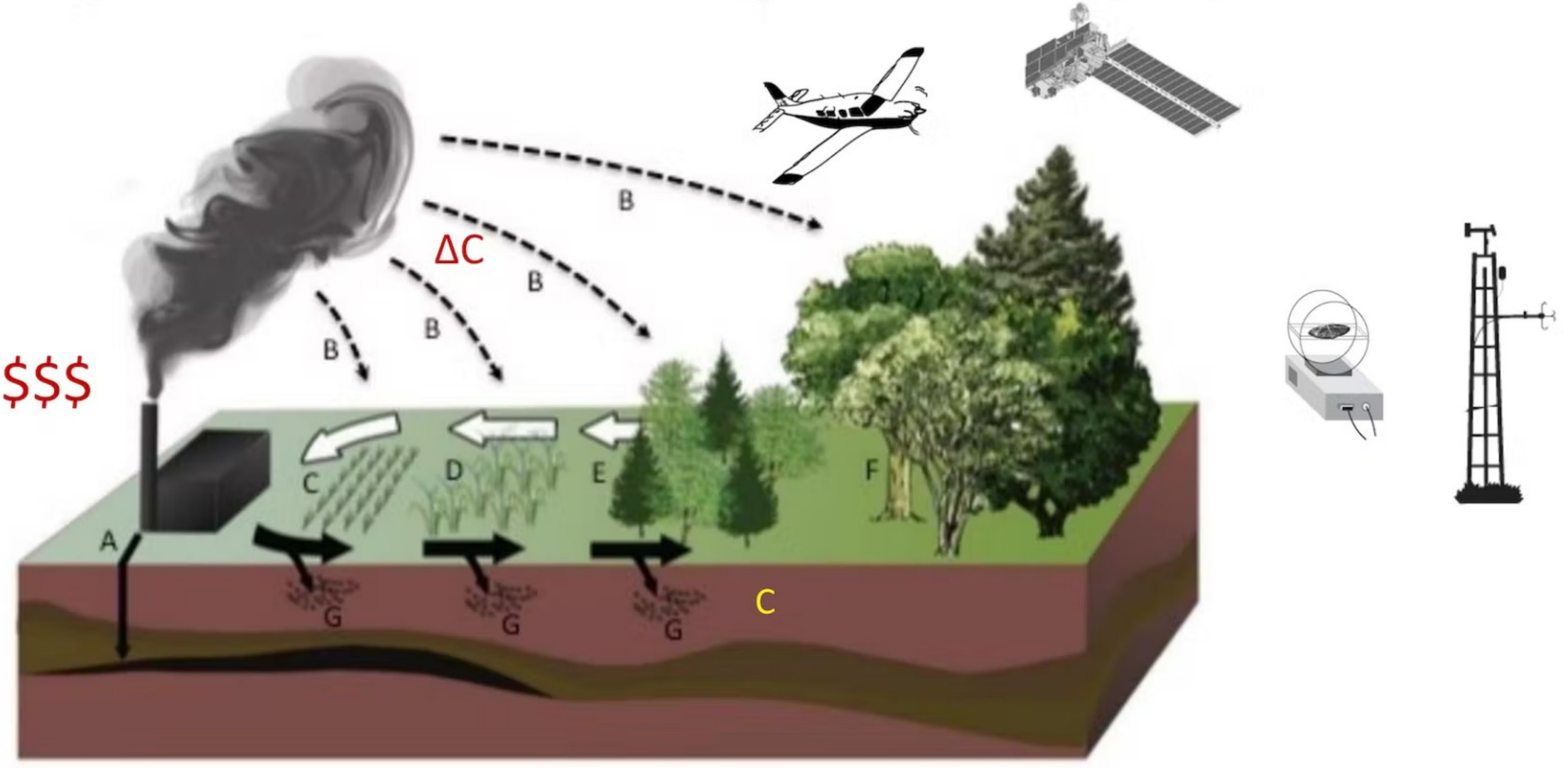
ΔC = $$$



http://biosphericcarbonnetwork.org/

Figure 2: Geologic and Biospheric Carbon Sequestration

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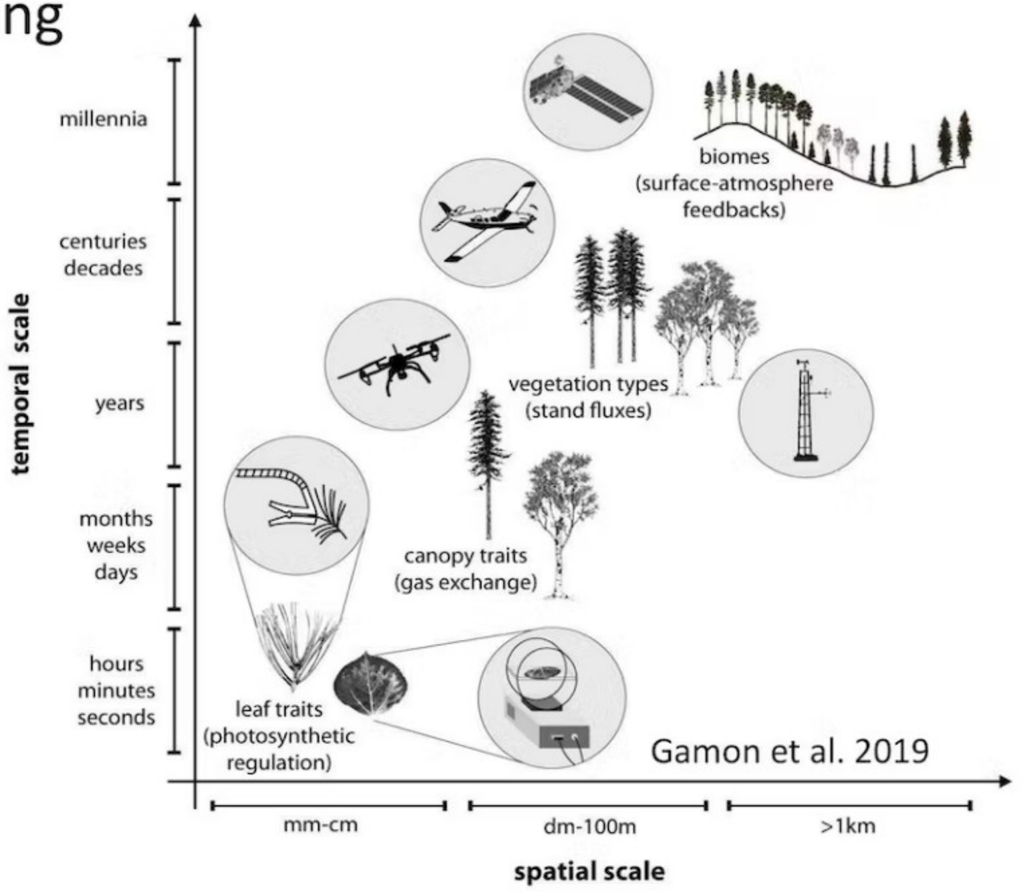
Conclusions:

1) We know how to measure carbon fluxes and stocks with remote sensing*
2) These methods can be applied across scales, with accurate results
3) Below-ground carbon stocks can be challenging

Challenges & Opportunities:

1) Informatics needed – open science
2) Expensive & time-consuming
3) Economic and policy incentives
4) Cultural change
5) Engagement between academia, industry, extension, & stakeholders



→ *Universities and conferences like this can address these challenges.*

Panel Discussion

Carbon| A Complex Cycle that Sustains Life

Moderator

Andy Suyker

Associate Professor

School of Natural Resources

Measuring Carbon - Soil

Michael Kaiser

Assistant Professor

Agronomy & Horticulture

Measuring Carbon - Fluxes

George Burba

Science & Strategy Fellow

LI-COR

Measuring Carbon – Remote Sensing/Modelling

John Gamon

Professor

School of Natural Resources

What are the key issues surrounding carbon in agriculture?

Afternoon Agenda

12:45 pm	NRCS Perspective
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Aaron Hird

USDA-NRCS

Carbon in Agriculture

NRCS Perspective on Carbon

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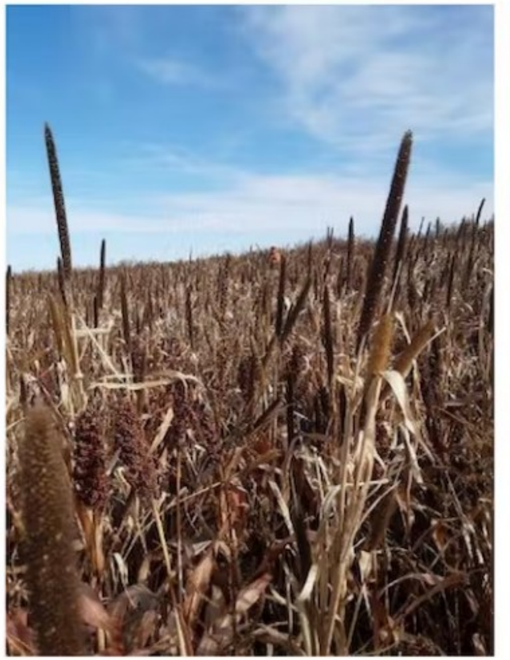

Understanding Soil Health

Regenerating Soil Structure By Sinking Carbon into the Soil Ecosystem

By Aaron Hird, NE NRCS Soil Health Specialist, Lincoln, NE

Soil Health Defined:

The continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals, and humans.

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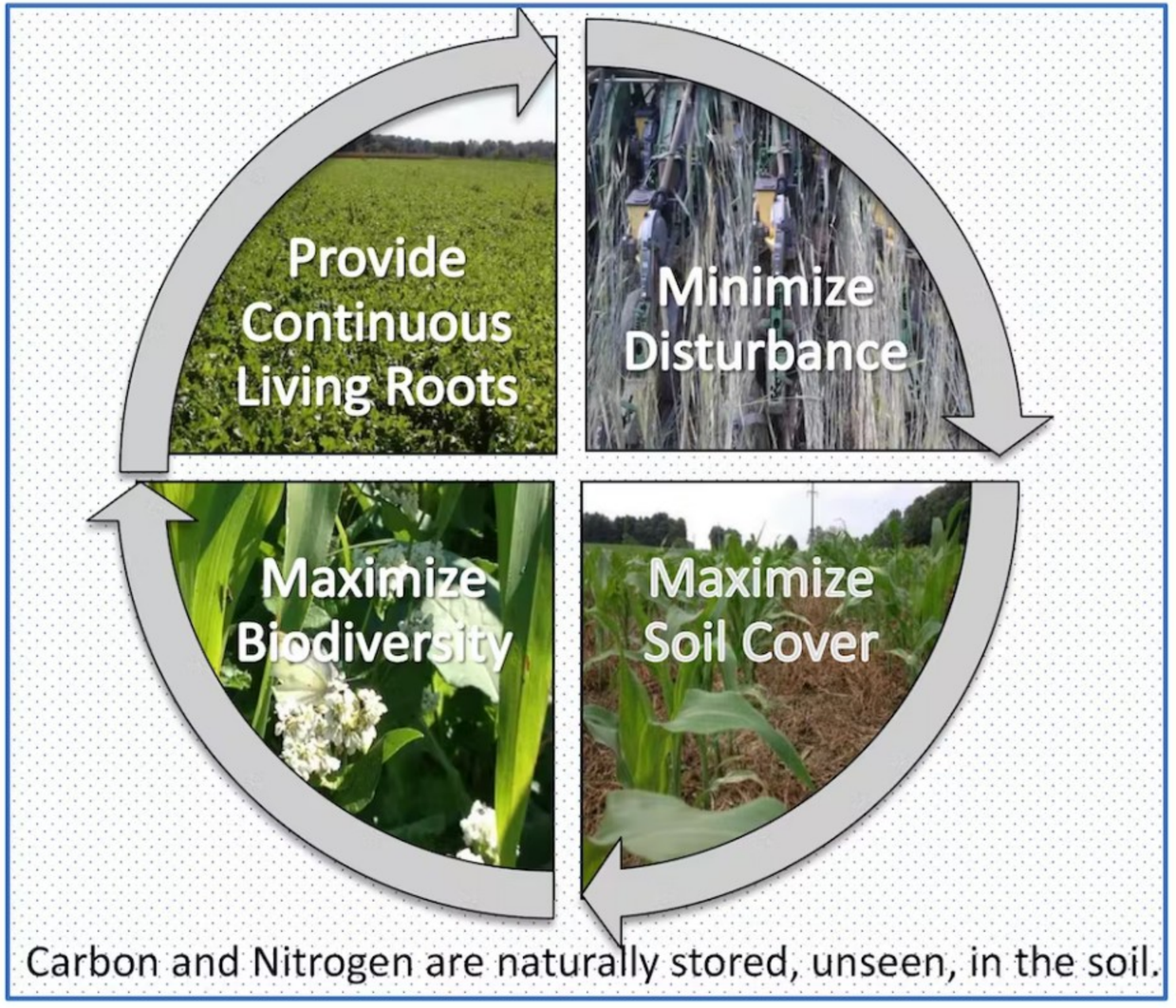
Soil Health Principles



USDA United States Department of Agriculture

We need to …

… Regenerate and Retain Habitat!

USDA United States Department of Agriculture

Is the Soil Healthy?

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Is the habitat healthy?

Habitat:

- Food
- Water
- Air
- **Space**
- **Shelter**

- **Management should support biological activities to store carbon and nitrogen and build habitat**
- Soil Habitat = Soil Structure
- Soil Structure = Healthy Soil
- Is there proper Soil Structure?

The Work to be done in Nebraska: Eliminate Tillage-Induced, Root-Restricting, Compaction Layers

Figure 1. Compaction layer from tillage on wet soils.

GoldenHarvestSeed.com

Pic by Aaron

USDA United States Department of Agriculture

- NRCS can alleviate risk & decrease cost during the learning curve when establishing a Soil Health Management System.
- The USDA/NRCS continues to administer conservation programs to partner with landowners and managers to address natural resource concerns.
- Building conservation partnerships while “Helping People Help the Land.”

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SOIL HEALTH TESTING AND SOIL HEALTH RESOURCE CONCERN ASSESSMENT

Measuring, Assessing, and Understanding the Health of the Soil is the Key to Success!

NRCS can help monitor soil health with you and understand the dynamic properties that change with management.

Conservation Enhancement Monitoring Activity (CEMA) #216 “Soil Health Testing” is now available for funding.

USDA United States Department of Agriculture

Nebraska NRCS Conservation Practices
Top 25 Practices Applied 2014 – 2022 – Composite #'s

Practice	Count	Amount	Obligations
Cover Crop	4632	640679.4	$ 23,395,338.46
Livestock Pipeline	1930	10061025.4	$ 15,445,573.18
Sprinkler System	383	31549.5	$ 13,313,867.15
Conservation Crop Rotation	2262	88927.1	$ 11,782,863.61
Terrace	1474	8128520.2	$ 10,216,479.68
Irrigation System, Microirrigation	235	12831.4	$ 9,778,032.65
Brush Management	2234	107764.2	$ 9,748,693.33
Watering Facility	3308	37651.5	$ 9,523,631.68
Pumping Plant	1719	1833.5	$ 9,041,159.01
Fence	2029	7219837.5	$ 8,854,276.17
Irrigation Water Management	4171	599997.4	$ 8,227,341.77
Underground Outlet	1101	1856950.7	$ 6,705,788.06
Water Well	1223	3062	$ 4,958,182.01
Waste Storage Facility	57	62	$ 3,824,389.78
Nutrient Management	626	173242.6	$ 3,557,348.03
Irrigation System, Sprinkler	87	9647.2	$ 3,001,929.05
Irrigation Pipeline	461	523604.9	$ 2,764,352.22
Prescribed Grazing	593	125043	$ 2,748,983.70
Pasture and Hay Planting	302	21482.5	$ 2,144,798.28
Forest Stand Improvement	184	3739.8	$ 1,772,369.40
Grassed Waterway	269	1028.2	$ 1,396,931.67
Prescribed Burning	443	97327.8	$ 1,273,119.06
Mulching	551	38040.8	$ 1,265,119.62

Natural Resources Conservation Service

nrcs.usda.gov/

The Inflation Reduction Act

- The Act provides unprecedented funding levels in USDA/NRCS's conservation programs for farmers, ranchers and private forest landowners targeted to maximize climate benefits.
- Agriculture is at the forefront of this national effort, and USDA wants to hear from stakeholders.
- USDA published a Federal Register request for information requesting public input on implementation of more than $19 billion in funding provided by the Inflation Reduction Act.

Source: News Release IRA USDA Requests Public Input on Implementation of Inflation Reduction Act Funding_111722_Updated

To learn more, visit usda.gov.

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The increased funding levels for NRCS begin in FY 2023 and rapidly build over 4 years, totaling an additional:

- $8.45 billion – Environmental Quality Incentives Program (EQIP)
- $3.25 billion – Conservation Stewardship Program (CSP)
- $4.95 billion – Regional Conservation Partnership Program (RCPP)
- $1.4 billion – Agricultural Conservation Easement Program (ACEP)
- $1 billion – Conservation Technical Assistance (CTA)
- $300 million – Greenhouse Gas (GHG) Monitoring
- $100 million – Administrative Costs

USDA United States Department of Agriculture

Source: News Release_IRA_USDA Requests Public Input on Implementation of Inflation Reduction Act Funding_111722_Updated

To learn more, visit usda.gov.

- NRCS is seeking to benefit the climate, farmers and ranchers by improving access to programs while continuing to provide financial & technical assistance

If you have questions, contact NRCS.IRA.Input@usda.gov.

Public comment open until December 21, 2022 within the Federal Register Notice

USDA

U.S. DEPARTMENT OF AGRICULTURE

PARTNERSHIPS FOR CLIMATE-SMART COMMODITIES - 2022

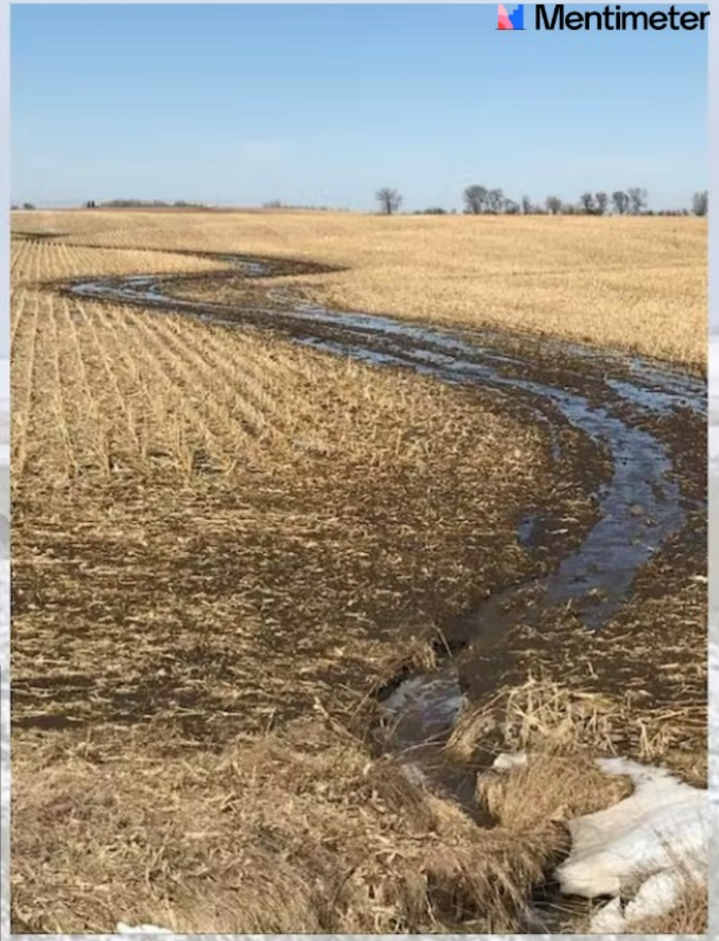
BY THE NUMBERS

The U.S. Department of Agriculture is investing up to **$2.8 billion** in **70 selected** projects under the first funding pool of Partnerships for Climate-Smart Commodities.

17 involve Nebraska Partnerships with $936 million in funding

PROJECTS BY COMMODITY

Source: https://www.usda.gov/climate-solutions/climate-smart-commodities



- Amplifying and leveraging biologic activity will build soil structure, expand soil function and boost soil productivity.
- This can result in compounding and cascading improvements in Soil Health that can change Nebraska and the World.

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How can you improve Soil Health?
Dig a Hole and Learn A Lot!

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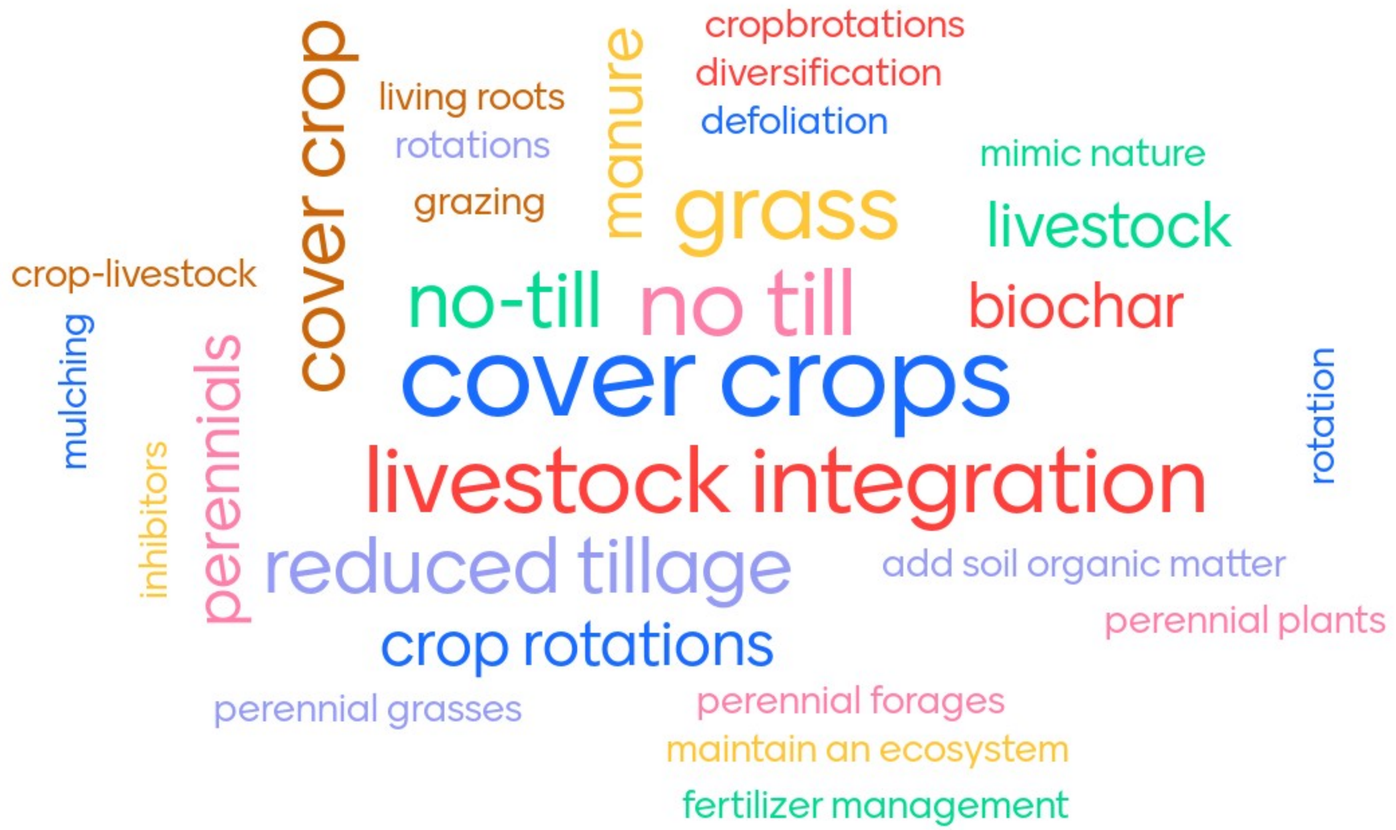
Contact Info

- Aaron Hird, State Soil Health Specialist, Nebraska - USDA/NRCS
- 100 Centennial Mall North, Room 152
- 1-402-437-4053
- **Aaron.Hird@usda.gov**
- farmers.gov
- GovDelivery.com
- Twitter @NebraskaNRCS

USDA United States Department of Agriculture

USDA is an equal opportunity provider, employer, and lender.

What practices can maximize carbon sequestration in agriculture?



Are these practices ready for the field?

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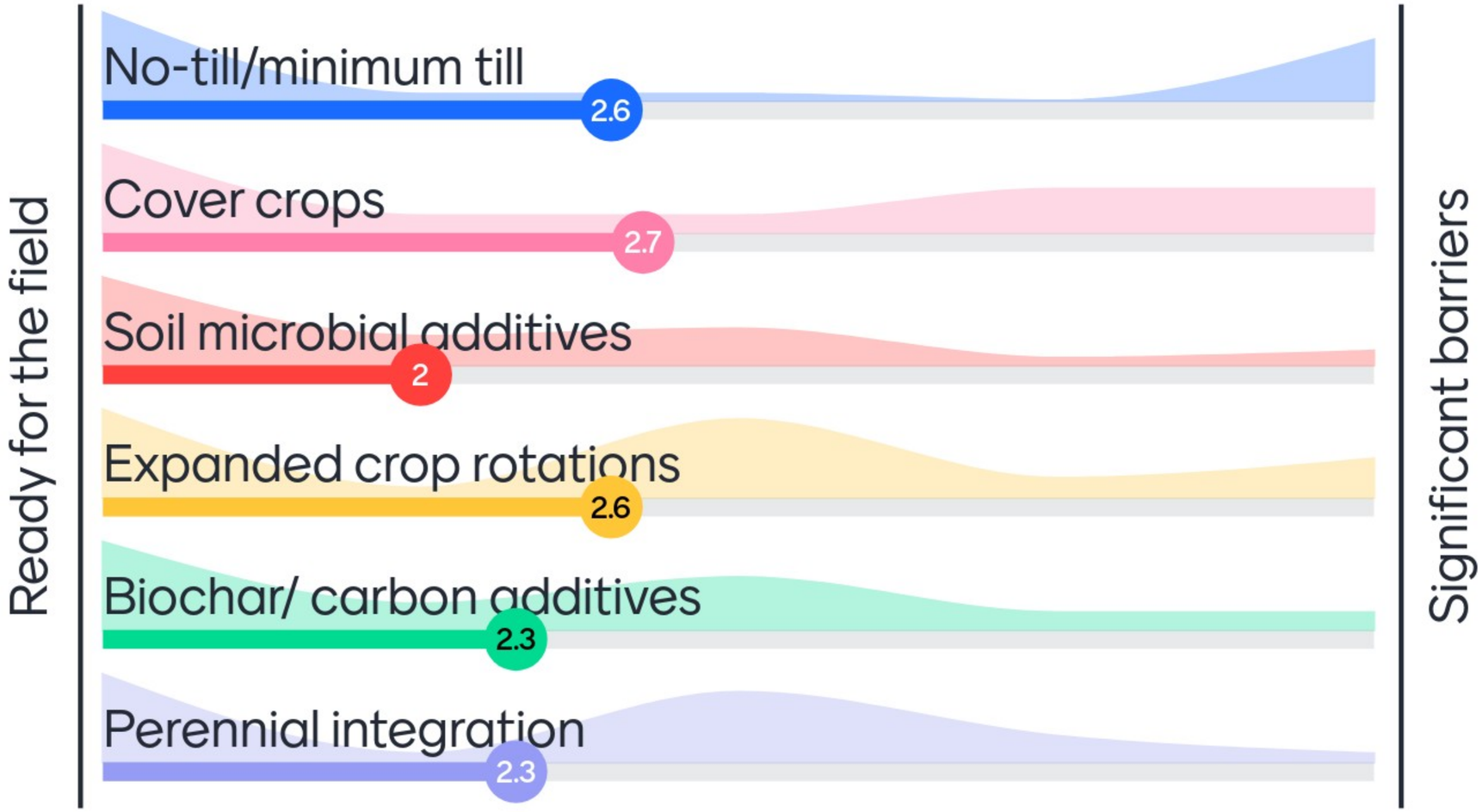

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Creative Approaches in Carbon Farming in Agriculture
CHARLES W. RICE
University Distinguished Professor
Mary L. Vanier Professor
Soil Microbiology, Department of Agronomy
Chair, National Academies Board on Agriculture and Natural Resources
KANSAS STATE
UNIVERSITY

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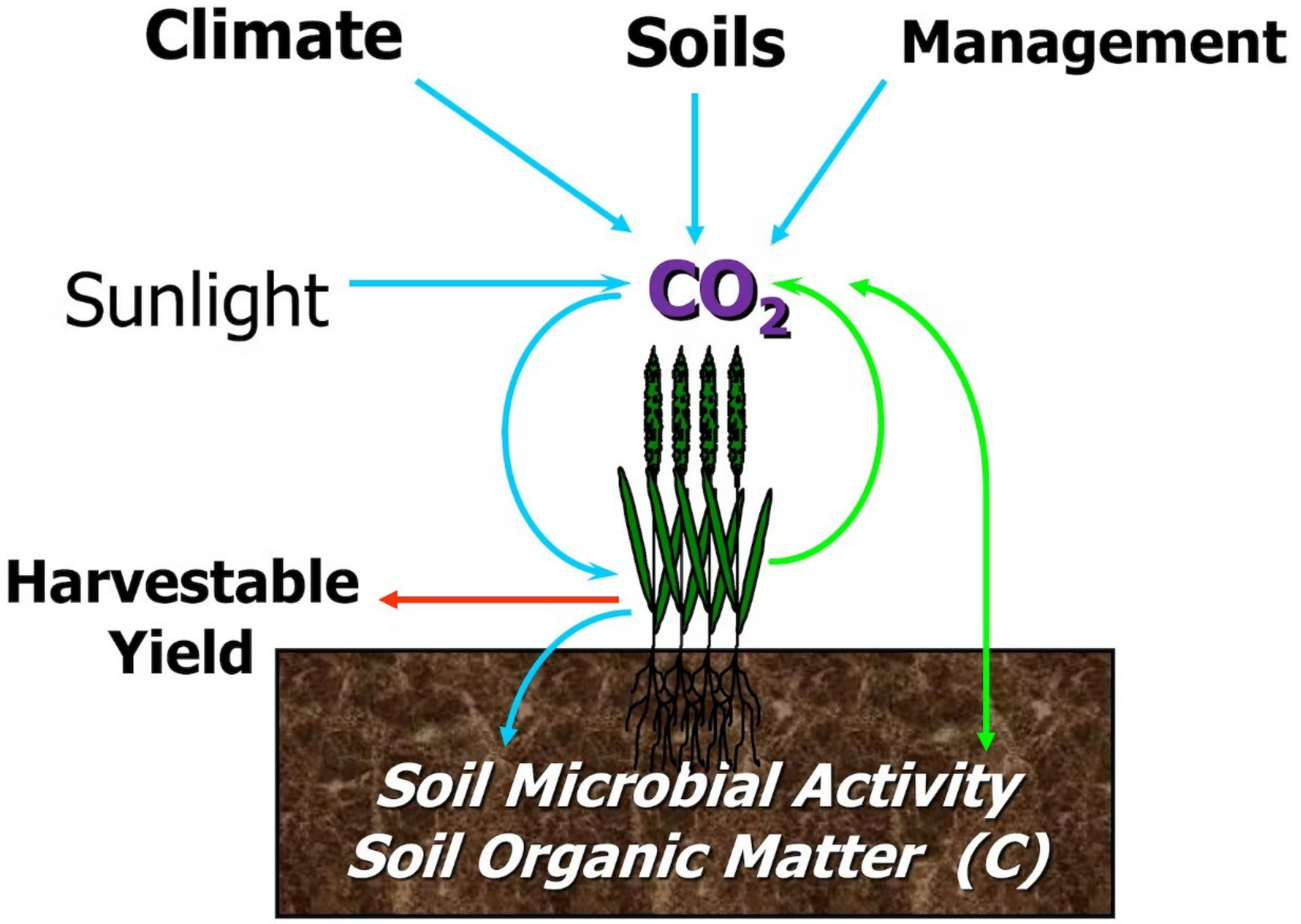

Climate
Soils
Management
Sunlight
CO_2
Harvestable Yield
Soil Microbial Activity
Soil Organic Matter (C)

Panel Discussion

Carbon Sequestration | What is Possible?

Moderator
Carbon – Row Crop Systems

Chuck Rice

Professor

Agronomy, KSU

Carbon – Life Cycle Analysis

Adam Liska

Assistant Professor

Biological Systems Engineering

Carbon – Natural Grassland Systems

David Wedin

Professor

School of Natural Resources

Carbon – Non-Grazing Livestock Systems

Galen Erickson

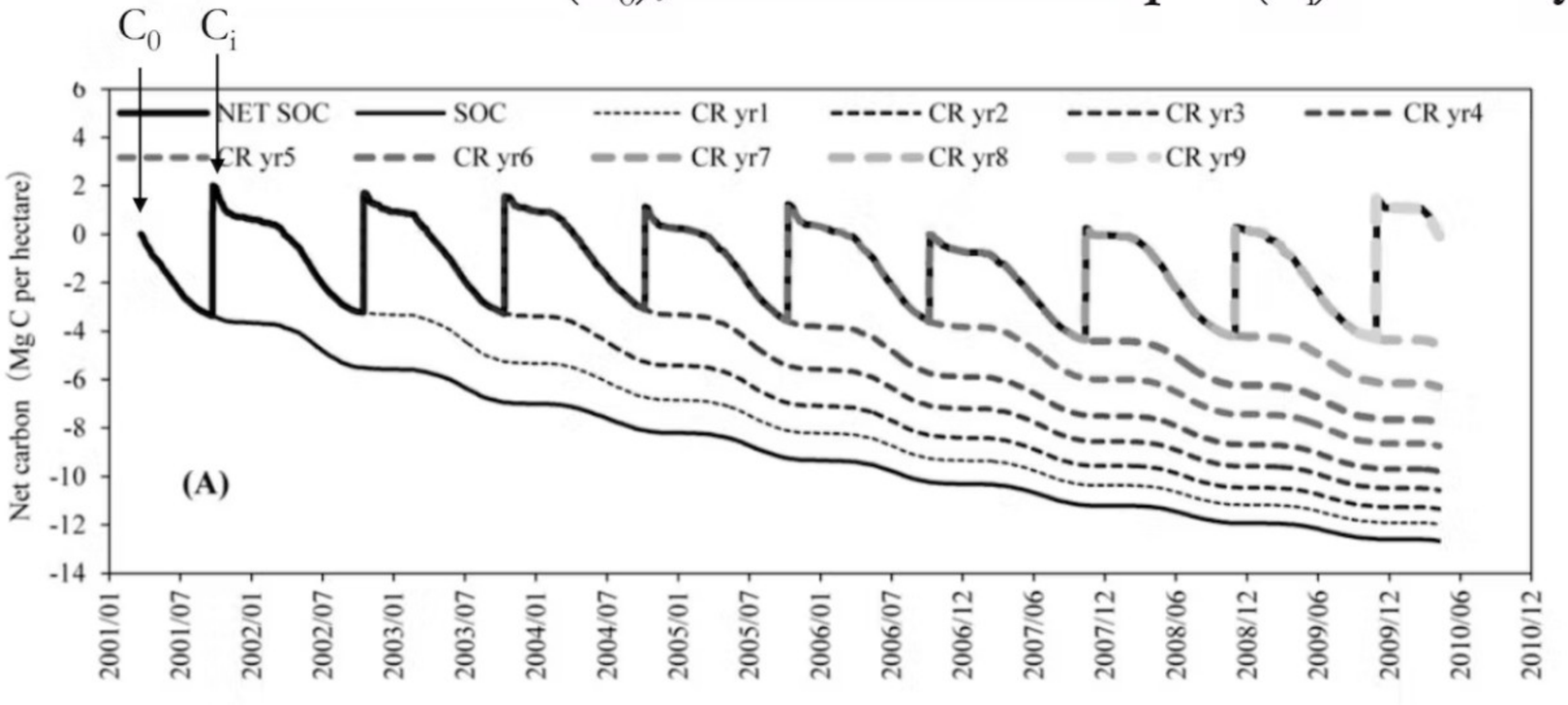
Professor

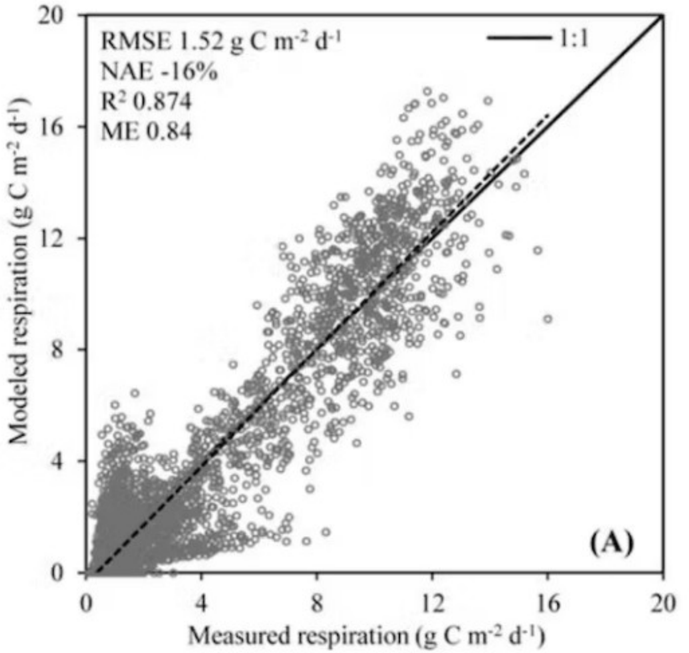
Animal Science

No change in soil organic carbon over 10 years

Modeled daily oxidation of SOC and crop residue to CO_2 for no-till continuous corn (2001-2010, Mead, NE) based on field measurements of initial **SOC** (C_0), annual **biomass input** (C_i) and **daily temperature** (T_a)

C_0 is for top 30 cm of soil





$$C_t = C_0 \cdot e^{-k_s \cdot \left(\Sigma Q_{10}^{\frac{T_a - T_r}{10}} \cdot t \right)^{1-S_s}} + C_i \cdot e^{-k_r \cdot \left(\Sigma Q_{10}^{\frac{T_a - T_r}{10}} \cdot t \right)^{1-S_r}}$$

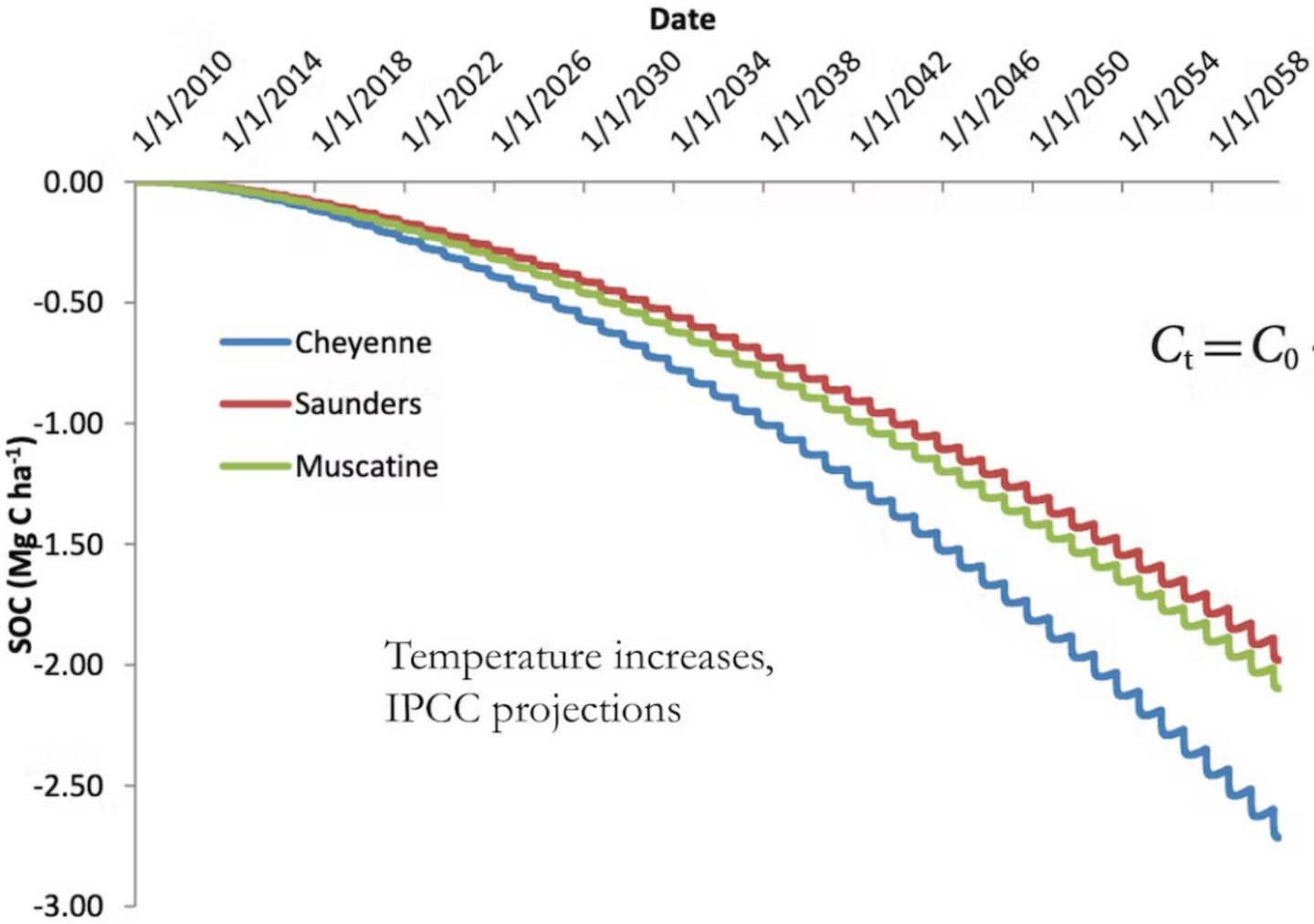
Modeled *daily* SOC oxidation to CO_2 (plus crop model) compared to *daily* eddy covariance measurements

Zhan M, Liska AJ, Nguy-Robertson T, Suyker AE, Pelton MP, Yang H. Modeled and Measured Ecosystem Respiration in Maize-Soybean Systems Over 10 Years. *Agronomy Journal*, 111: 49–58, 2019.

Simulation of future SOC loss with IPCC climate change (RCP8.5) projections

~5% net loss compared to baseline/control by 2060 (0.1%/yr)

Continuous corn increases to 90% yield potential for three counties in Nebraska and Iowa



$$C_t = C_0 \cdot e^{-k_s \cdot \left(\Sigma Q_{10}^{\frac{T_a - T_r}{10}} \cdot t \right)^{1-S_s}}$$

Pelton MP, 2013, MS. Soil Organic Carbon Dynamics in Agriculture: Model Development and Application from Daily to Decadal Timescales. Environmental Engineering, Univ. Nebraska.

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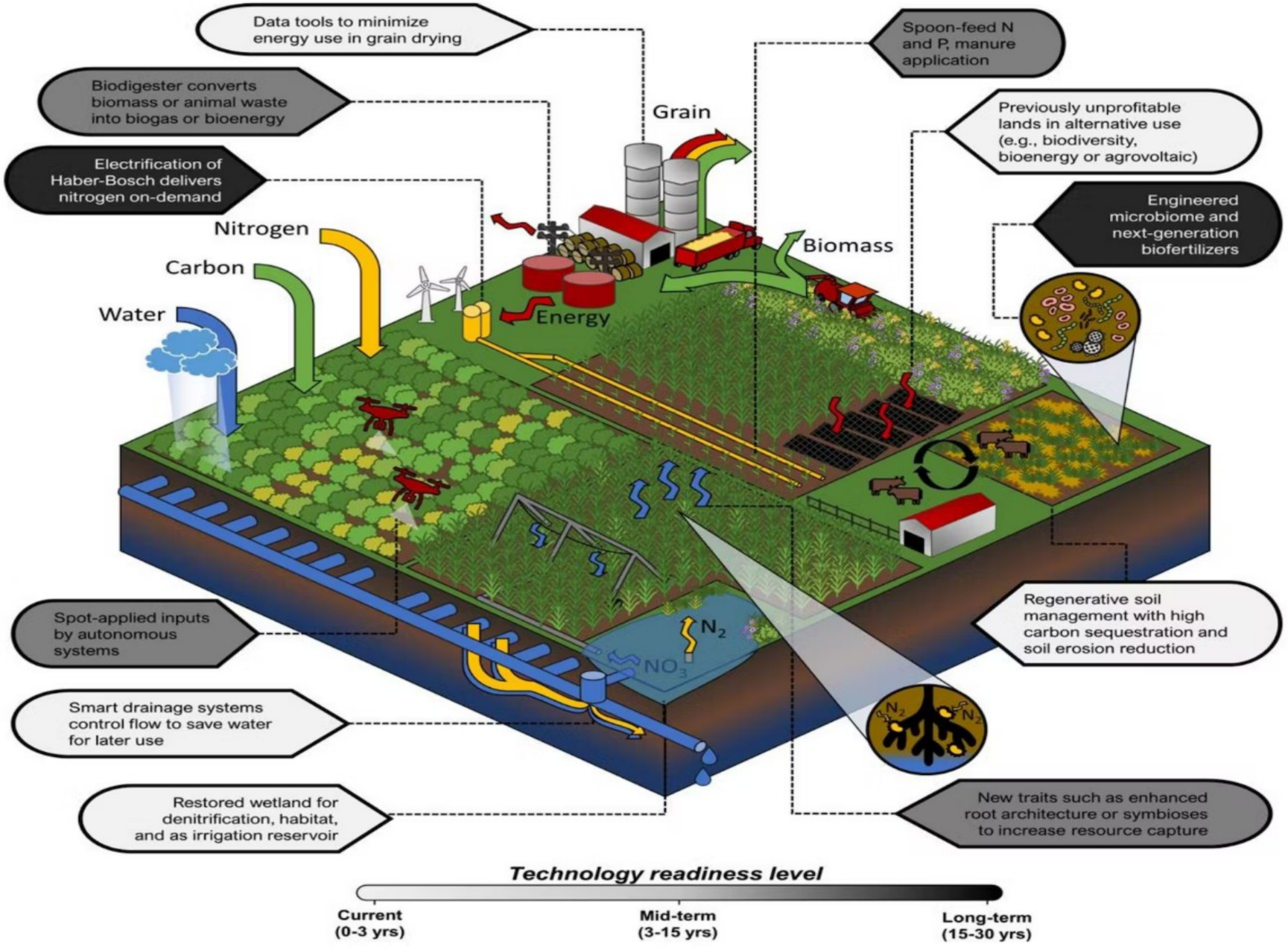

Basso et al., 2021, Agric. Syst

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Panel Discussion

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BREAK TIME
We will resume at 2:30 pm
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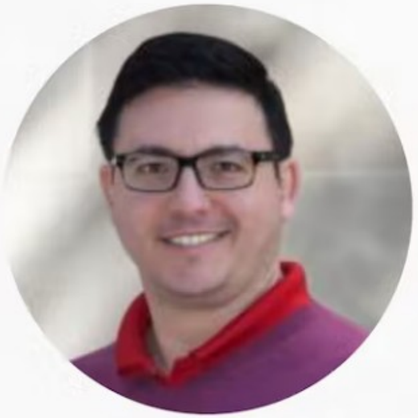

Alejandro Plastina

Associate Professor
Dept. of Economics
Iowa State University

Carbon in Agriculture

What About Carbon Markets in Agriculture?

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What About Carbon Markets in Agriculture?

Alejandro Plastina
Associate Professor of Economics
2021 Farm Foundation Ag Economics Fellow

IOWA STATE UNIVERSITY
Extension and Outreach

2022 IANR Carbon in Agriculture Summit
University of Nebraska-Lincoln
November 29, 2022

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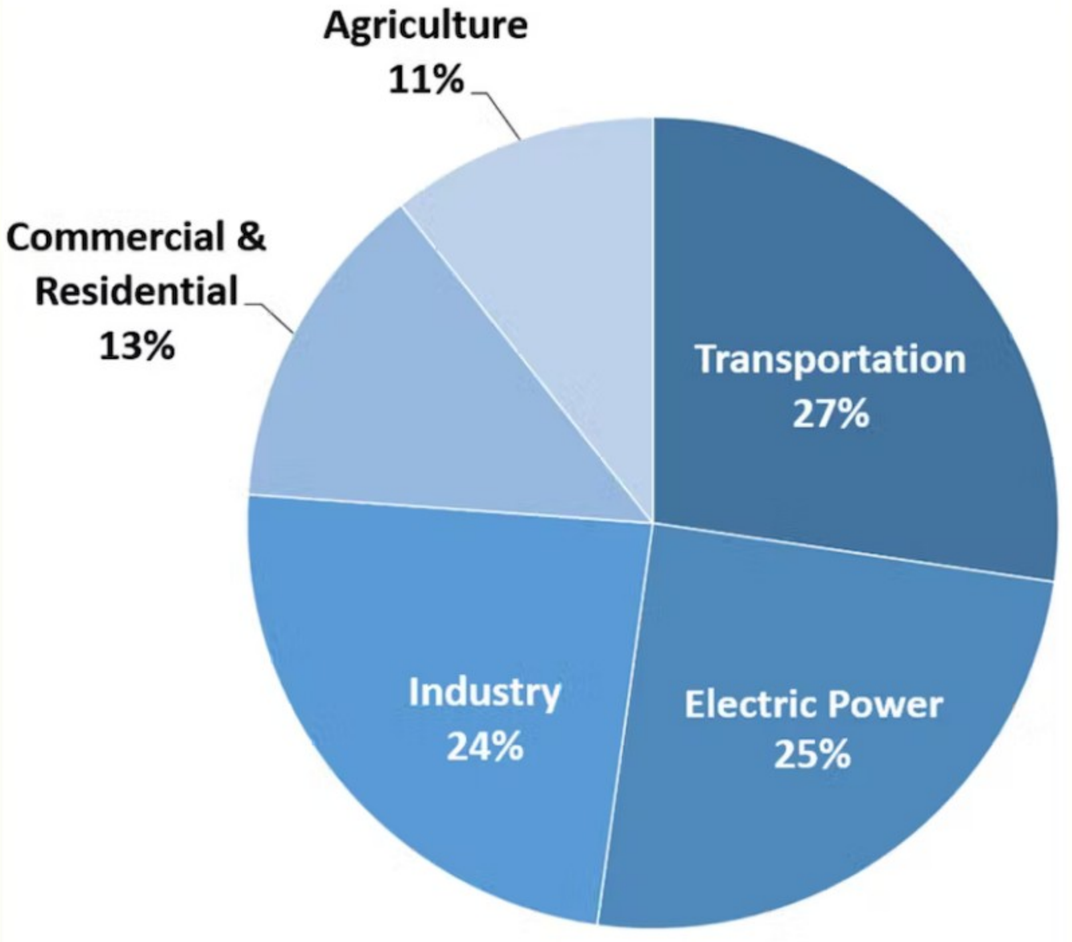
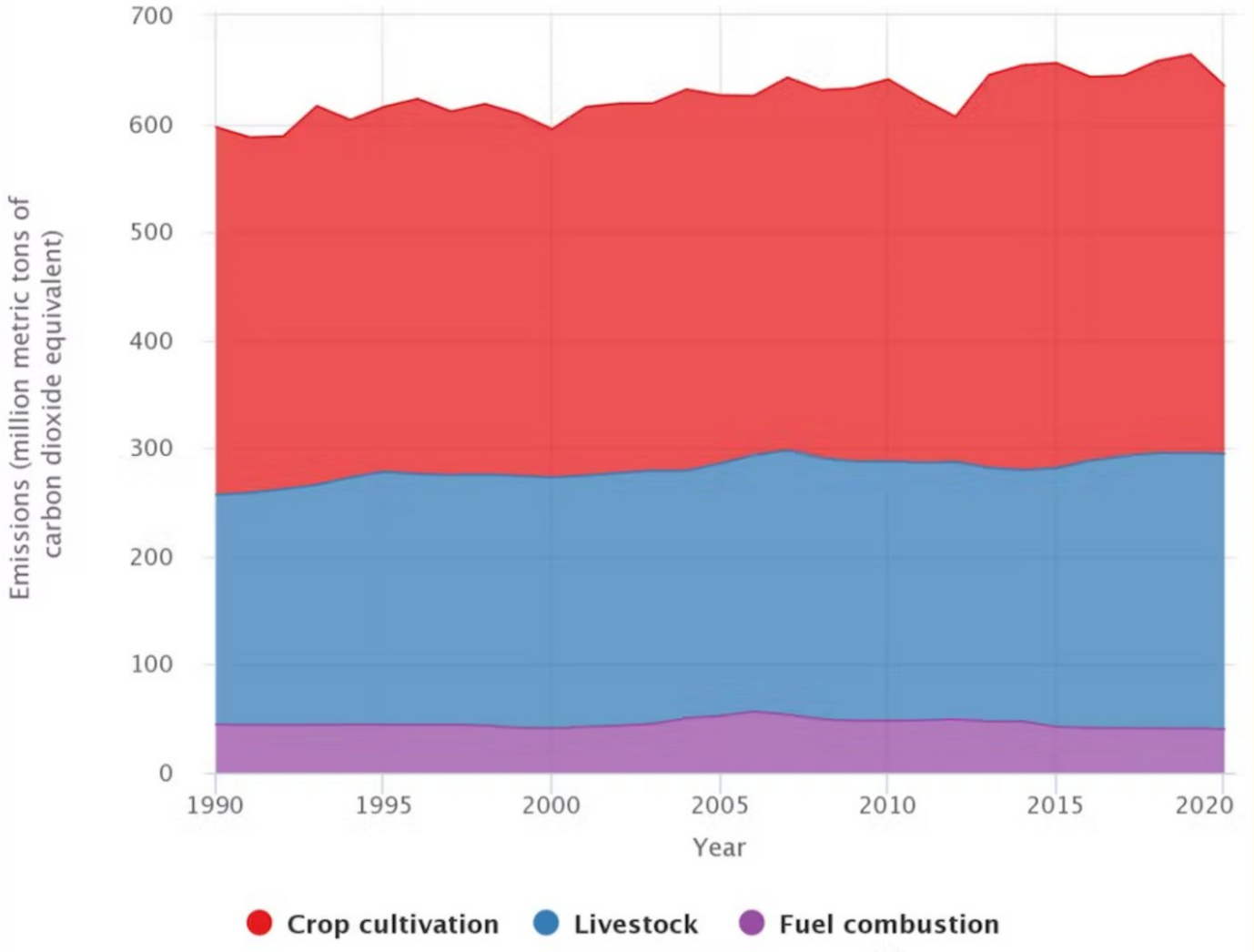
Total U.S. Greenhouse Gas Emissions by Economic Sector in 2020



U.S. Environmental Protection Agency (2022). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2020

U.S. Greenhouse Gas Emissions from the Agriculture Sector, by Category, 1990–2020



Source: U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2020. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks

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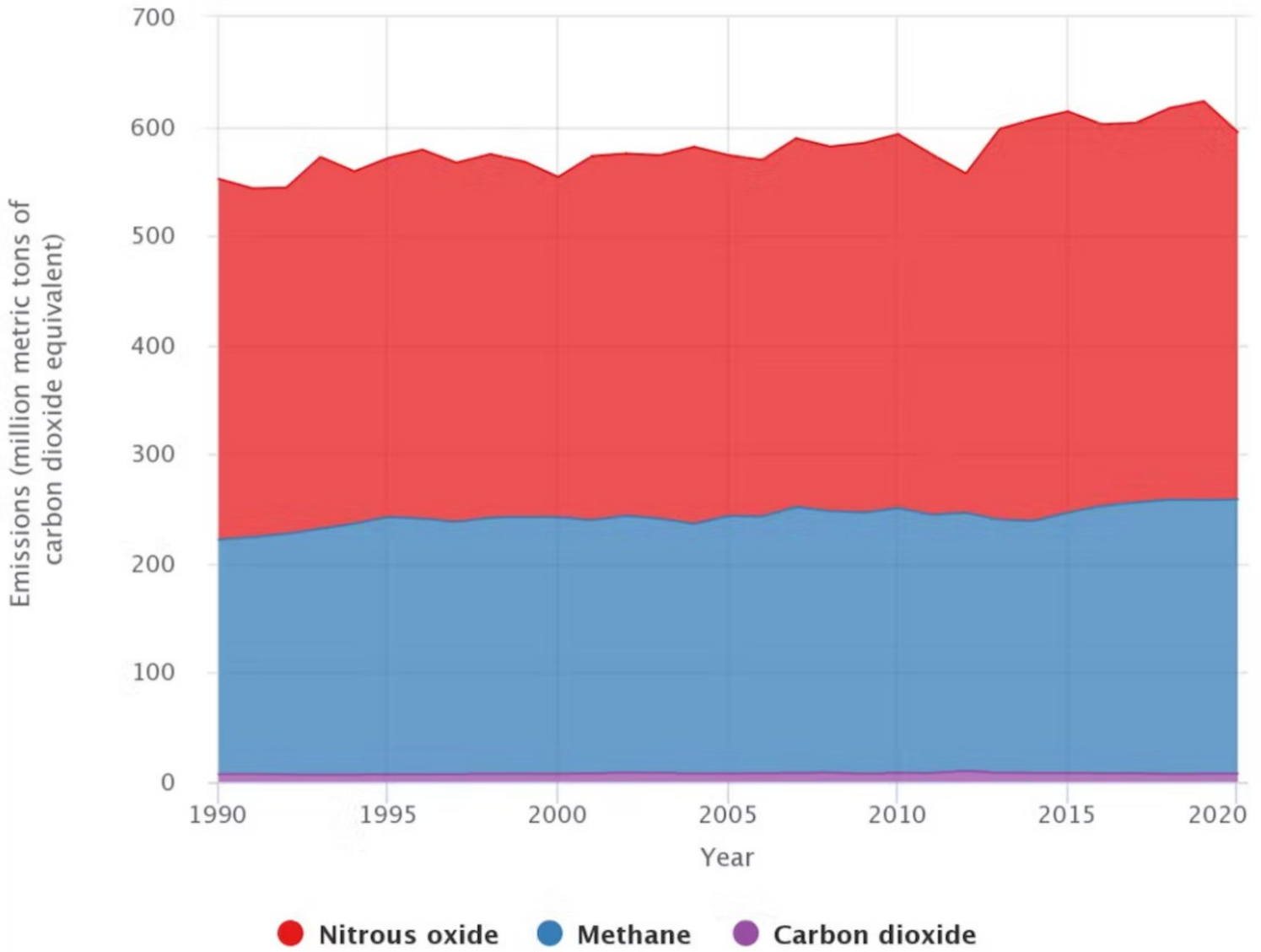
U.S. Greenhouse Gas Emissions from Agricultural Activities, by Gas, 1990–2020



Source: U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2020.
https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks

Carbon Credits

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- A tradable asset (like a certificate or permit) that gives the buyer the right to offset the emission of GHGs into the atmosphere
- Created when entities reduce their carbon emissions or remove carbon from the atmosphere (compared to a set baseline)
- 1 credit = one metric ton (2,204 pounds) of CO2e removed or avoided

How much CO_2 do you need to remove from the atmosphere to create **1 carbon credit**?

100-year Global Warming Potentials (GWP)

→Methane GWP = 25 x CO_2 GWP

→Nitrous Oxide GWP = 298 x CO_2 GWP

Photo credits: Alexis Stevens
2022 Farm Progress Show

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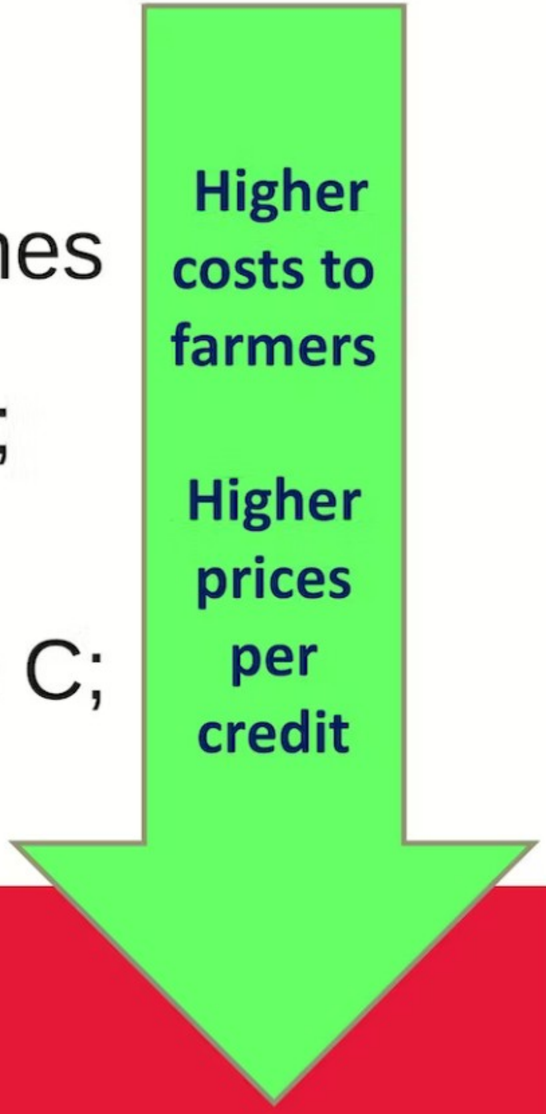
Carbon Credits in Agriculture

Agricultural producers can create Carbon Credits in a variety of ways:

- Reducing tillage intensity
- Planting cover crops
- Reducing fertilizer rates, switching from commercial fertilizer to compost
- Converting marginal cropland to grassland
- Planting trees
- Reducing stocking rates on pastures
- Etc.

But not all carbon credits are created equal, or used for the same purposes…

- Carbon insets: < $15/acre; scope 3
- Carbon-intensity credits: <$15/acre; LCFS & pipelines
- Carbon offsets for voluntary market: $20-$40/ton C; net zero pledges, scope 1 for non-regulated entities
- Carbon offsets for regulated markets: $25-$110/ton C; CA, RGGI, EU ETS, scope 2 (power plants)



Categories of GHG Emissions

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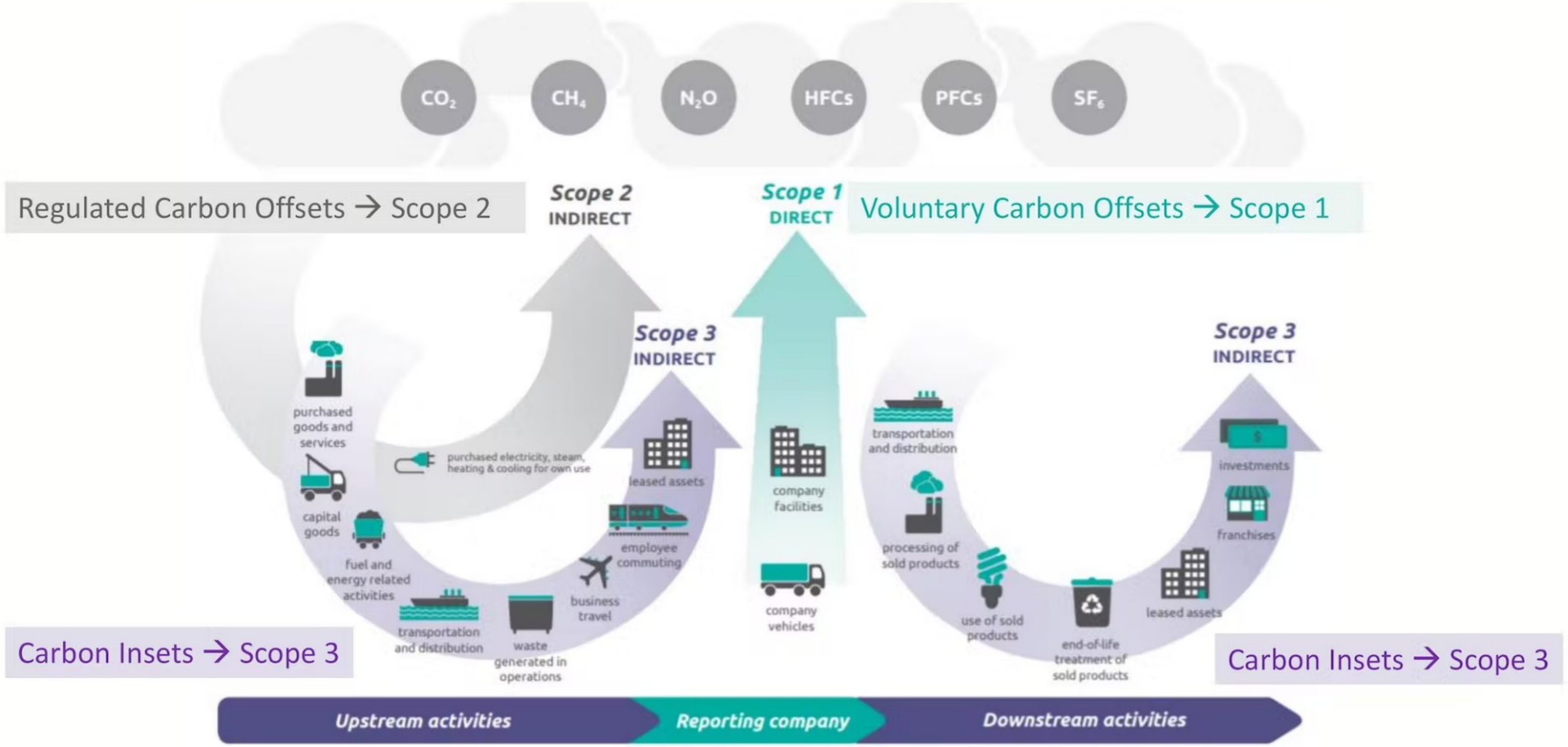

Adapted from https://www.epa.gov/climateleadership/scope-1-and-scope-2-inventory-guidance

Carbon Credits vs. Carbon-Intensity Credits

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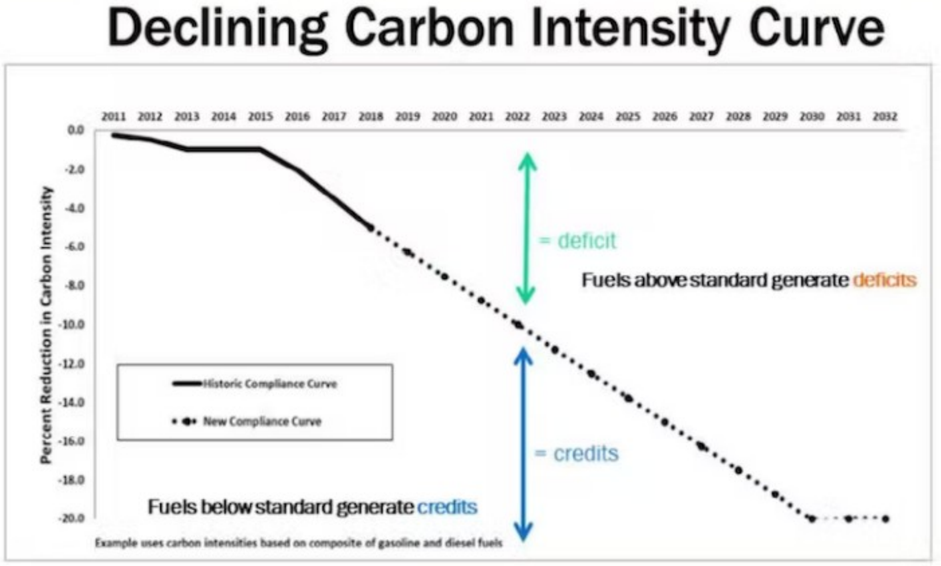
Carbon Credits:

- Entities remove GHGs from the atmosphere or avoid emissions to generate **carbon credits (tons of CO2e)**:
  - **Agriculture**
  - Forestry
  - Wind turbines
  - Industrial carbon capture and sequestration (→pipelines)
  - Other
- Entities buy **carbon credits to offset** scope 1 and 2 emissions

Carbon-Intensity Credits:

- California LCFS: Change fuel production practices to reduce **fuel carbon intensity (grams of CO2e/ Megajoule of energy)**

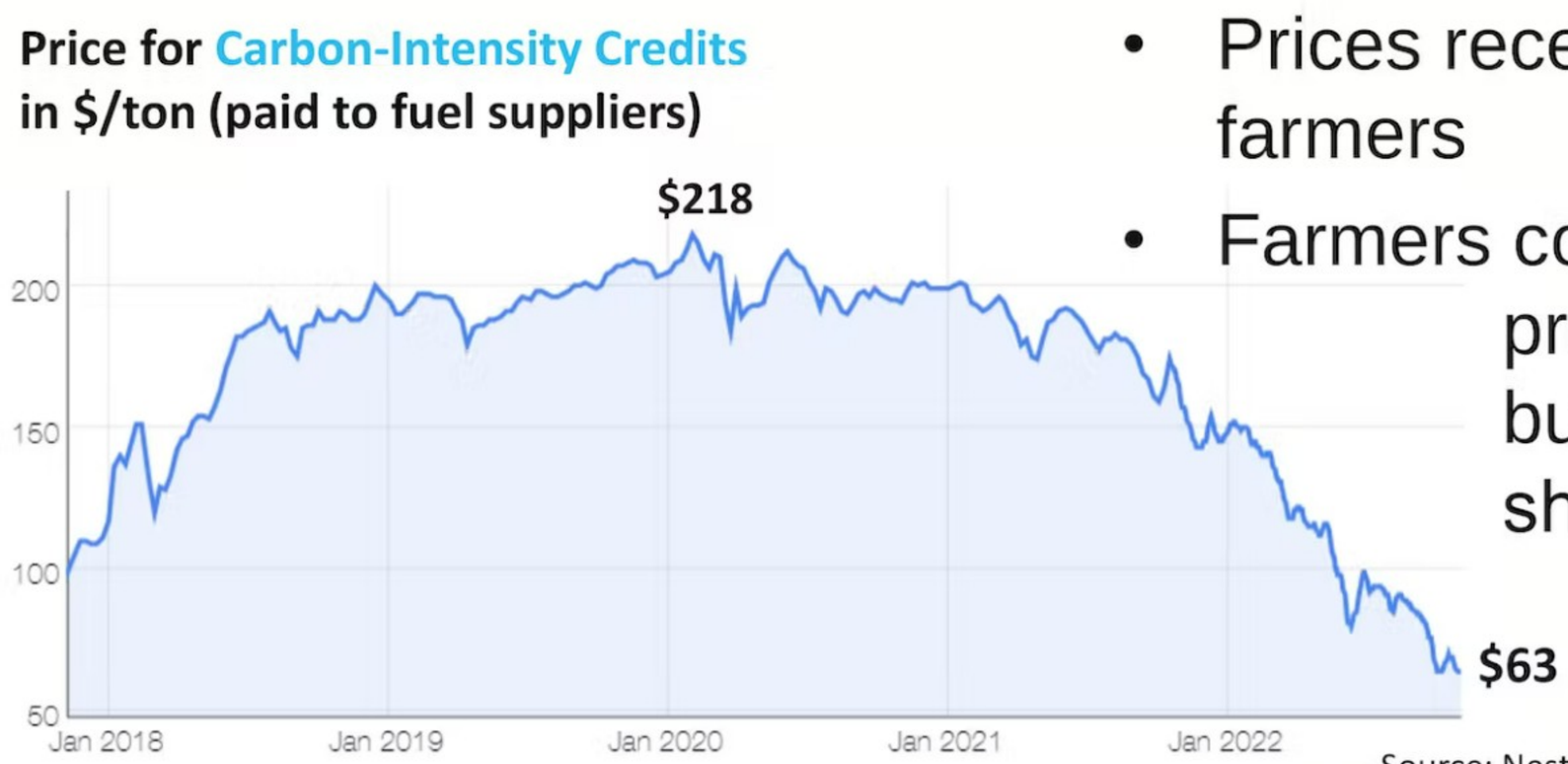


- Fuels below standard generate **carbon intensity credits**

ww2.arb.ca.gov

California Low Carbon Fuel Standard

Carbon-Intensity Credit Price



- Prices received by fuel suppliers, not farmers
- Farmers could participate indirectly by producing low-carbon crops, but price premiums and cost-share for "regenerative ag" are a fraction of these prices

Source: Neste.com

Carbon Credits for Regulated Markets

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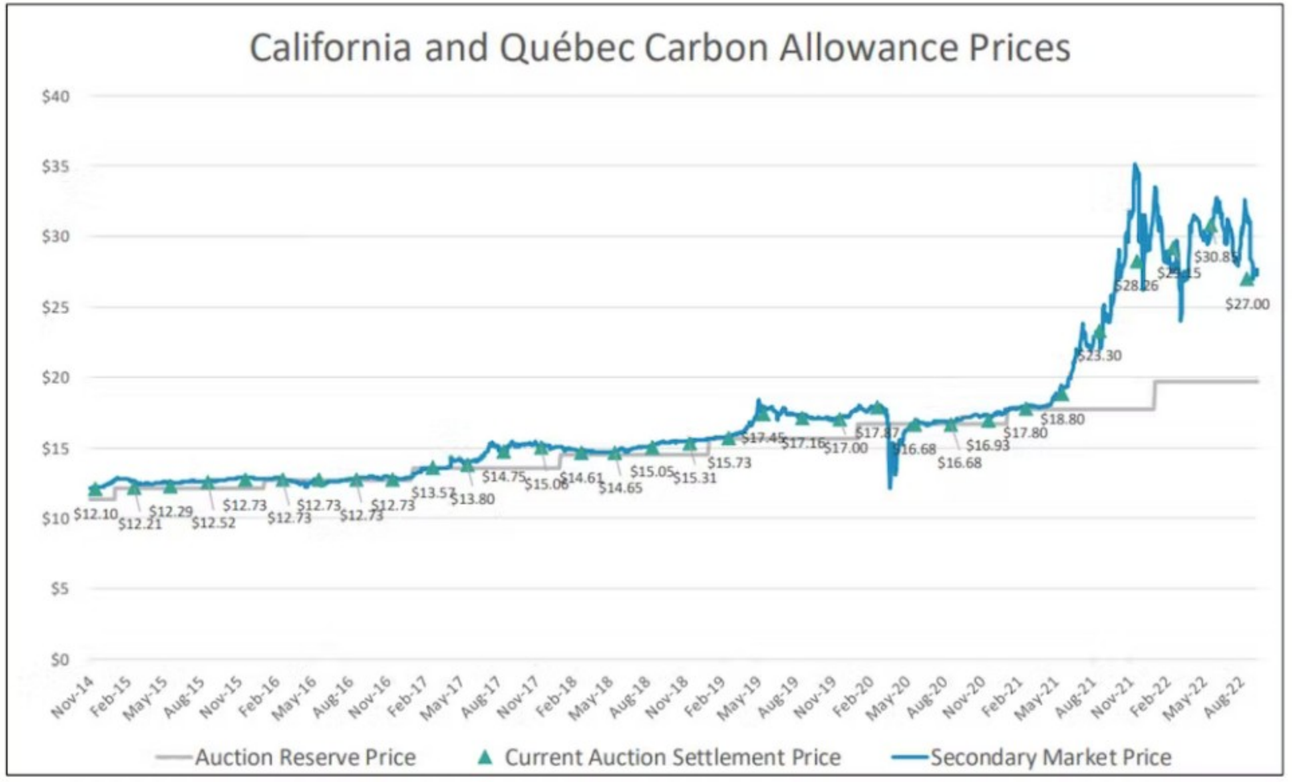
Mandatory Cap-and-Trade programs for power plants (Scope 2):

- Government regulated; small role for crop production; larger role for livestock production (methane capture)
- California, Washington state, Oregon, Regional Greenhouse Gas Initiative



~$27/ton
Aug 2022

RGGI Inc.

Bid Prices:	Sept 2022
Minimum	$2.44
Maximum	$20.00
Average (Median)	$13.03
Average (Mean)	$11.77
Clearing Price:	$13.45

Carbon Credits for Voluntary Markets

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Voluntary market for carbon credits (Scope 1):

- Growing number of carbon programs
- Agriculture can generate credits
- Unregulated
- Lack of standards
- Low(er) prices
  - US prices $15-$30
  - International prices $10

Figure 2. Voluntary Carbon Market Transaction Volumes, Prices, and Values by Category 2020 - 2021

	2020			2021		
	VOLUME (MtCO2e)	PRICE (USD)	VALUE (USD)	VOLUME (MtCO2e)	PRICE (USD)	VALUE (USD)
FORESTRY AND LAND USE	57.8M	$5.40	$315.4M	227.7M	$5.80	$1,327.5M
RENEWABLE ENERGY	93.8M	$1.08	$101.5M	211.4M	$2.26	$479.1M
CHEMICAL PROCESSES / INDUSTRIAL MANUFACTURING	1.8M	$2.15	$3.9M	17.3M	$3.12	$53.9M
WASTE DISPOSAL	8.5M	$2.69	$22.8M	11.4M	$3.62	$41.2M
ENERGY EFFICIENCY / FUEL SWTICHING	30.9M	$0.98	$30.4M	10.9M	$1.99	$21.9M
HOUSEHOLD / COMMUNITY DEVICES	8.3M	$4.34	$36.2M	8.0M	$5.36	$43.3M
TRANSPORTATION	1.1M	$0.64	$0.7M	5.4M	$1.16	$6.3M
AGRICULTURE	0.5M	$10.38	$4.7M	1.0M	$8.81	$8.7M

International Agriculture

Carbon Credit buyers want...

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a. **Additionality**: pay only for new changes in ag practices
b. **Permanence**: long-term removal/avoidance of GHG emissions
c. **Realness**: actual and quantifiable amounts of GHG emission removal/avoidance
d. **Leakage avoidance**: prevent increases in GHG emissions outside of the project area in response to decreases in production within the project area

❖ Challenge: the **quality** of a carbon credit cannot be ascertained by consumers even after consumption ("**credence good**")

→ **Certification** to verify claims on carbon credits

Measurement, Reporting, and Verification (MRV) Systems

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- Robust MRV systems are key to convince buyers that the implemented changes in agricultural practices actually removed carbon from the atmosphere or avoided carbon emissions

- A robust MRV system is a necessary condition for the development of a strong ag carbon market

U.S. Agricultural Carbon Programs...

… connect carbon credit demand and supply

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agoro CARBON™ ALLIANCE

BAYER

CIBO TECHNOLOGIES

CORTEVA™ agriscience

ESMC Ecosystem Services Market Consortium

Soil and Water Outcomes Fund

indigo™

Nori

…using different models to quantify CO2e

Plenty of Private & Public Interest

Source: ESMC

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ESMC/ESMRC Funders

FFAR · McKnight Foundation · The Nature Conservancy · USDA NRCS · USDA · The Ida and Robert Gordon Family Foundation · General Mills · United Soybean Board · Walton Family Foundation · arpa·e · Noble Research Institute

Founding Circle Members

Soil Health Institute · Nestlé · Corteva agriscience · Noble Research Institute · The Nature Conservancy · General Mills · Danone North America · Cargill · TruTerra · Nutrien Ag Solutions · NFWF · Syngenta · Innovation Center for U.S. Dairy · National Indian Carbon Coalition · ADM

Legacy Partner Members

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Carbon Credit Generation through Ecosystem Services Market Consortium (ESMC)

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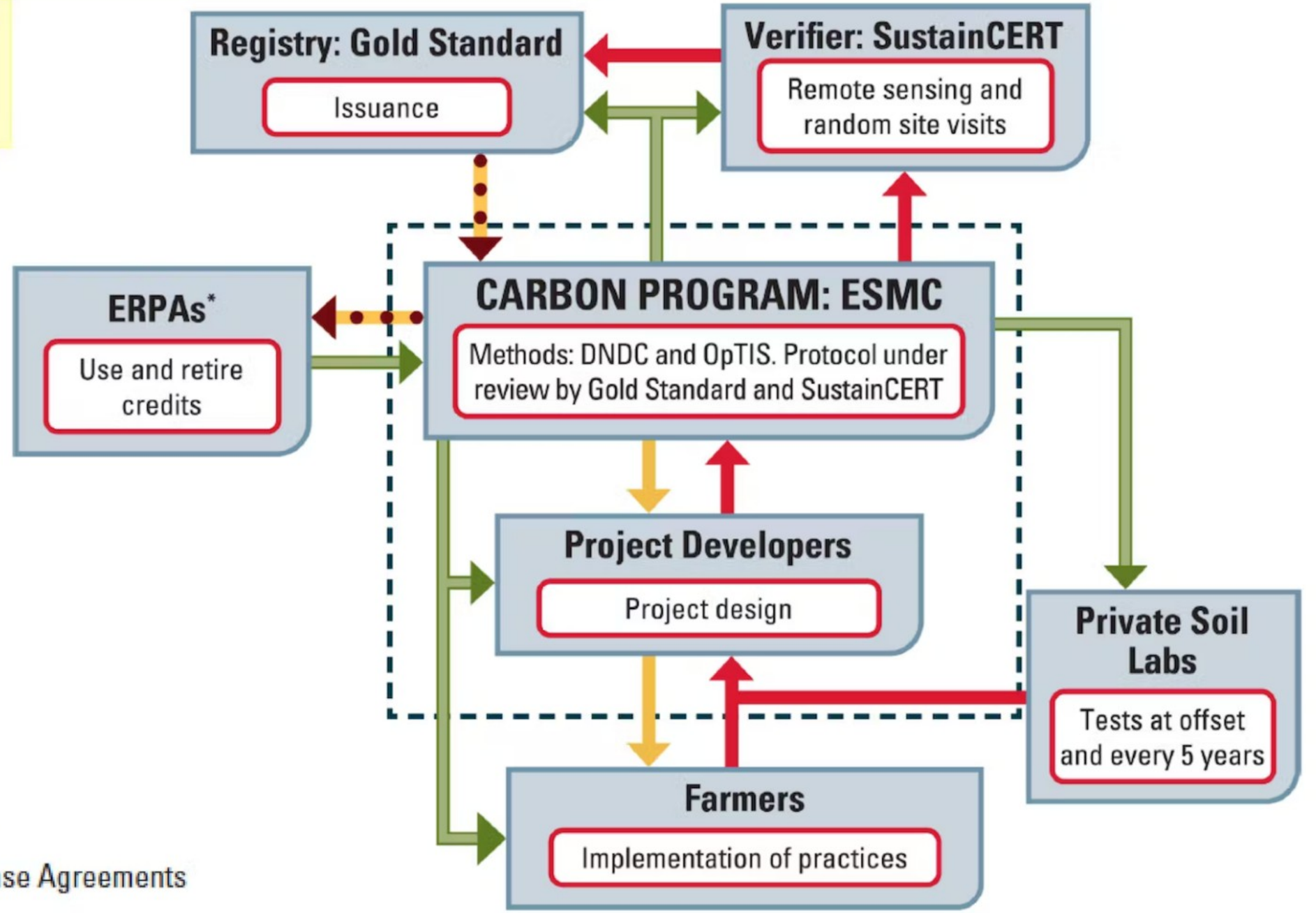
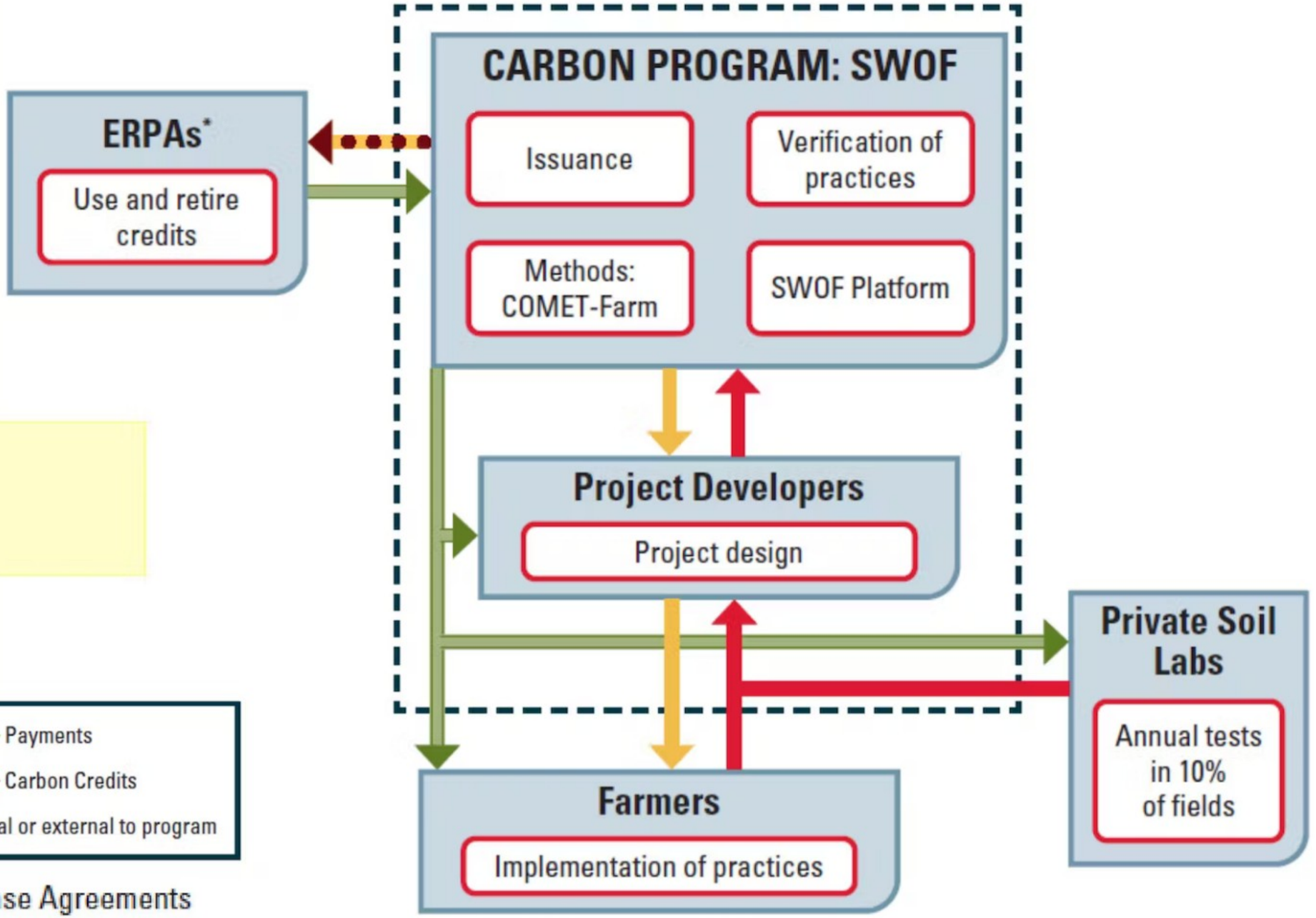
- ✓ Contract length: 10 years
- ✓ Min area: none
- ✓ Payments: annual



* ERPAs: Emission Reduction Purchase Agreements

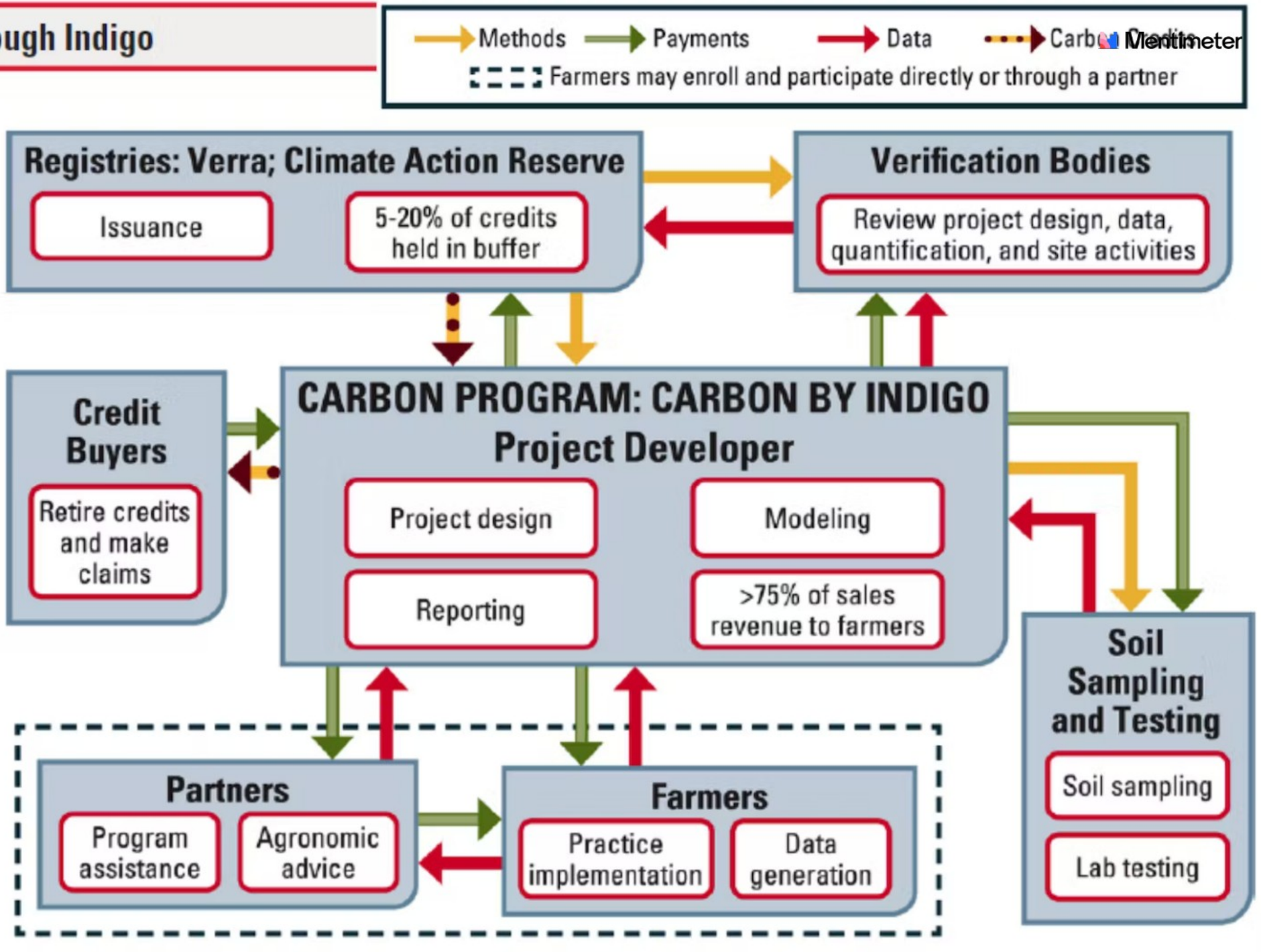
Carbon Credit Generation through Soil and Water Outcomes Fund (SWOF)



- ✓ Contract length: 1 year
- ✓ Min area: none
- ✓ Payments: annual

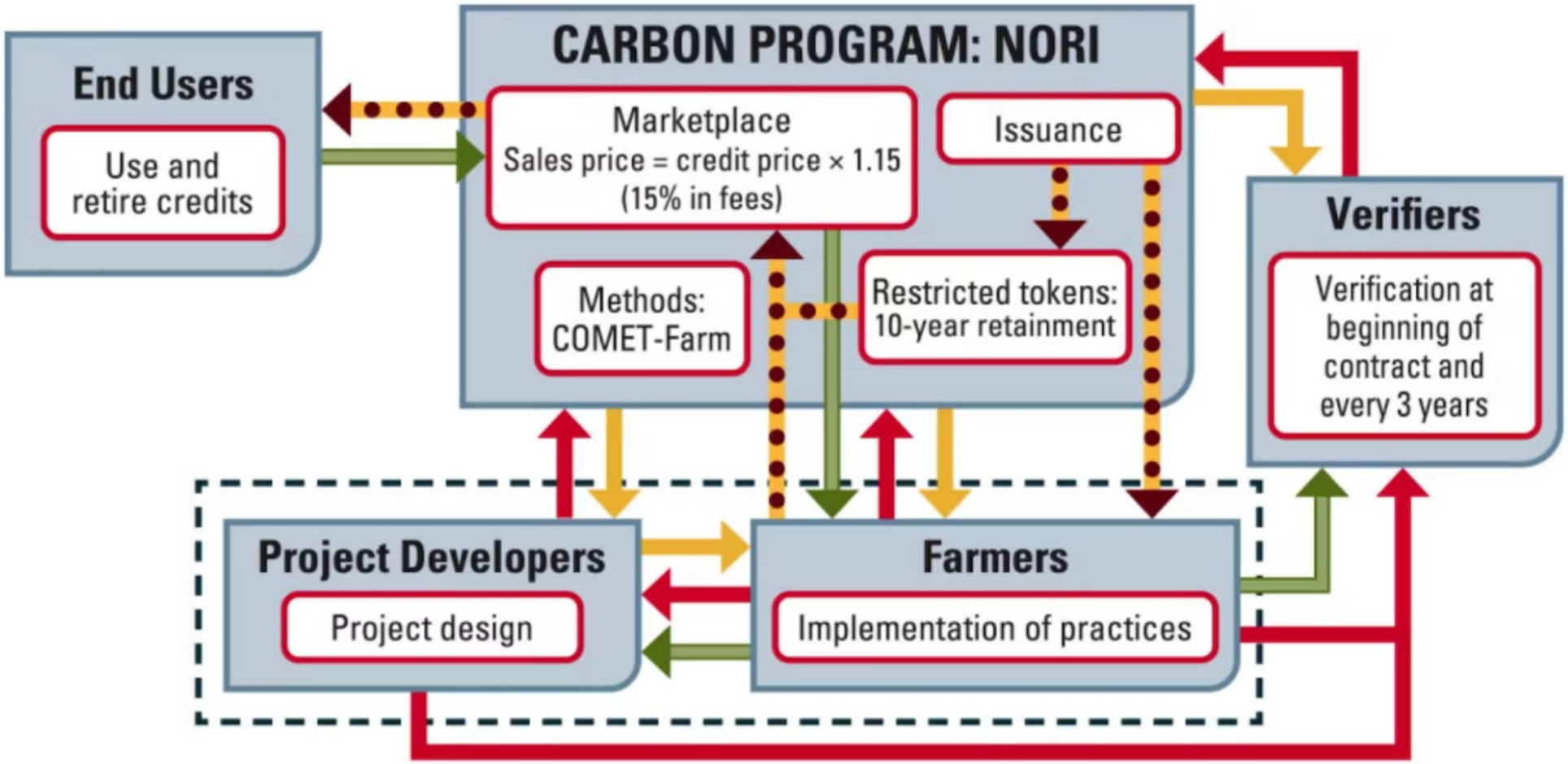
* ERPAs: Emission Reduction Purchase Agreements

Carbon Credit Generation through Indigo



- ✓ Contract length: 5 years
- ✓ Min area: 150 acres per field
- ✓ Payments:
  - 50% y1,
  - 20% y2,
  - 10% y3-y5
- ✓ 5-20% credits held in buffer
- ✓ At least 75% of credit sales revenue to farmers

Carbon Credit Generation through Nori



- ✓ Contract length: 10 years, +10y some retained tokens
- ✓ Min area: none
- ✓ Payments: when Nori Carbon Removal Token (NRT) sold, and 10 years after original sale for restricted tokens
- ✓ Verification cost paid by farmers

Carbon Credit Generation through Bayer Carbon

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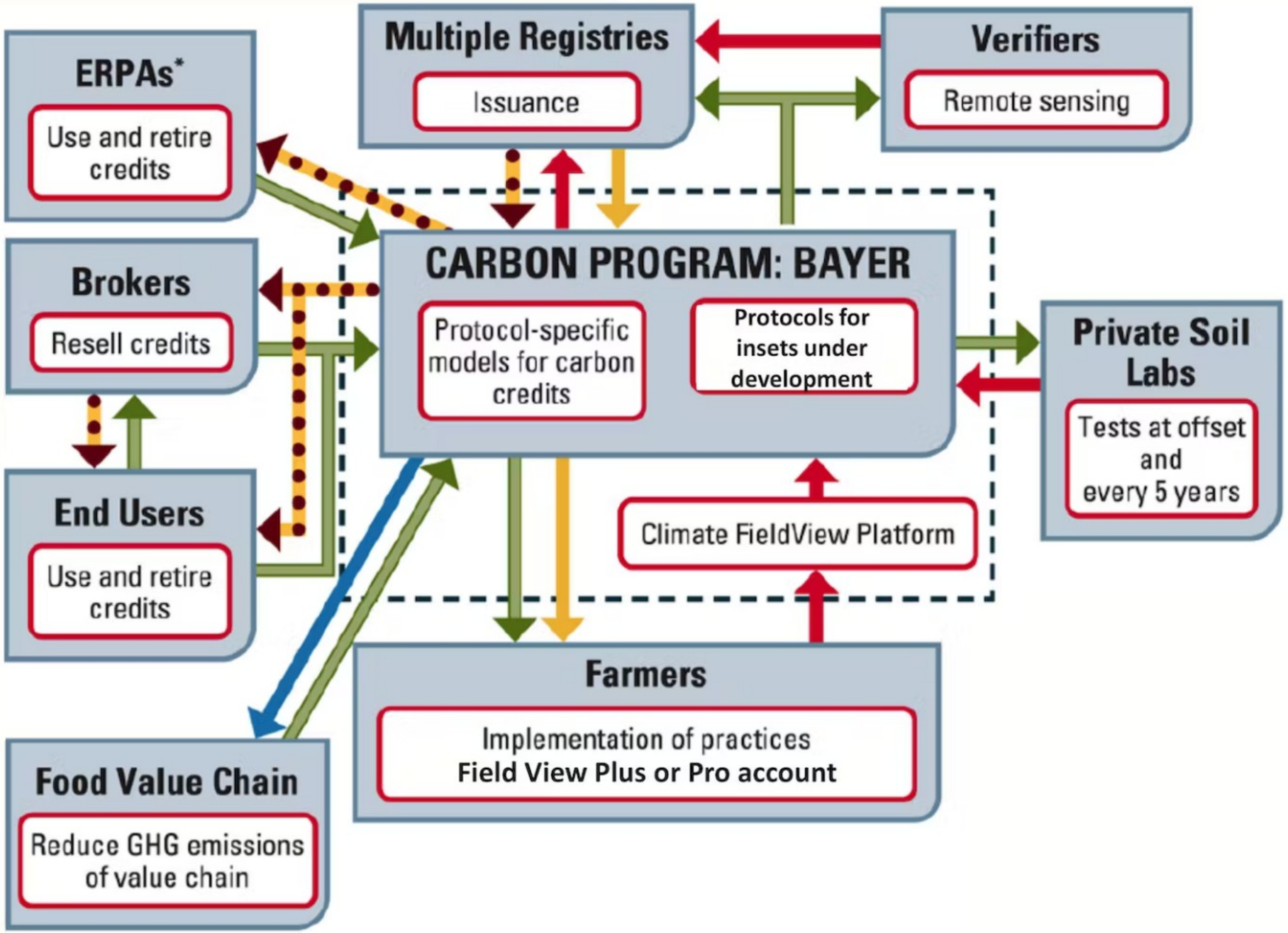
- ✓ Contract length: 5 years
- ✓ Min area: 10 acres per field
- ✓ Payments:
- Up to $6/a/y no-till/ strip-till
- Up to $6/a/y cover crops



Challenges to ag carbon market

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Agriculture-specific

1. Lack of standards
2. Payments based on carbon models
3. High uncertainty from carbon models
4. Estimating the “Actual” CO_2e removal

Other:

5. Competition from other sectors
6. Discredit from greenwashing and fraud

Challenge 1: Lack of Standards

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- Lack of consistent and **uniform guidelines** across measurement, reporting and verification (MRV) systems→ high "search costs" for credit buyers and farmers
  - Core Carbon Principles – The Integrity Council
  - Ag Climate Markets Principles - Keystone Policy Center
- No standardized reporting protocols: credits can overstate real CO2e removal
- Varying degree of **independence** between verifiers and carbon programs → could undermine buyers' trust in certification

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Challenge 2: Model-based Payments

- Farmers sign contracts on **projected** carbon credits (ex-ante), for 1, 3, 5, or 10 years

- Farmers typically paid on **"actual"** carbon credits (ex-post) over the life of the contract

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Table 1. How Voluntary Agricultural Carbon Programs Address Critical Structural Considerations

	Agoro	Bayer	CIBO	Corteva	ESMC	Gradable	Indigo	Nori	SWOF
ESTIMATION METHODS SALUS model		D*	✔						
COMET-farm model		D*						✔	✔
DNDC model		D*		D*	✔				
OpTIS model		D*		D*	✔				
Own proprietary model	✔			D*		✔	✔		
Soil Tests	✔	✔	✔	✔	✔	✔	✔		✔
PRACTICE VERIFICATION Remote sensing	✔	D*	✔	✔	✔	✔	✔		
Random site visits		D*		D*	✔				
Integration with farm machinery		D*		D*			✔		
Third-party verification	✔	✔		✔	✔		✔	✔	
Internal verification			✔			✔			✔
Verification paid by farmers								✔	
PURCHASE AGREEMENT Pre-Issuance of credit		D*		D*	✔				✔
Post-Issuance of credit	✔	D*	✔	D*		✔	✔	✔	
CREDIT BUFFERS < 100-year buffer								✔	
≥ 100-year buffer		D*		D*		✔	✔		
LOOK-BACK PAYMENT		✔				✔		✔	

*D = The answer depends on the registries ultimately used to issue carbon credits.

Projection & Estimation Methods

Practice Verification

Model-dependent

https://bit.ly/3Q4KAIV

Challenge 3: Uncertainty in carbon models

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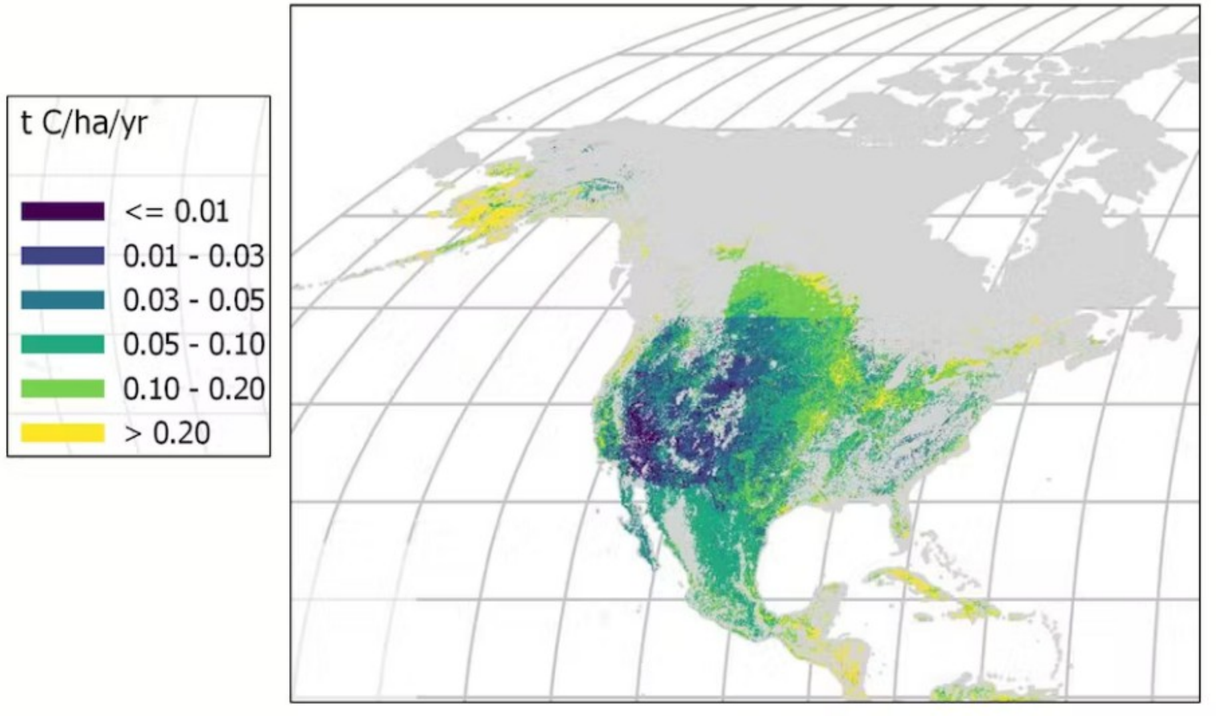
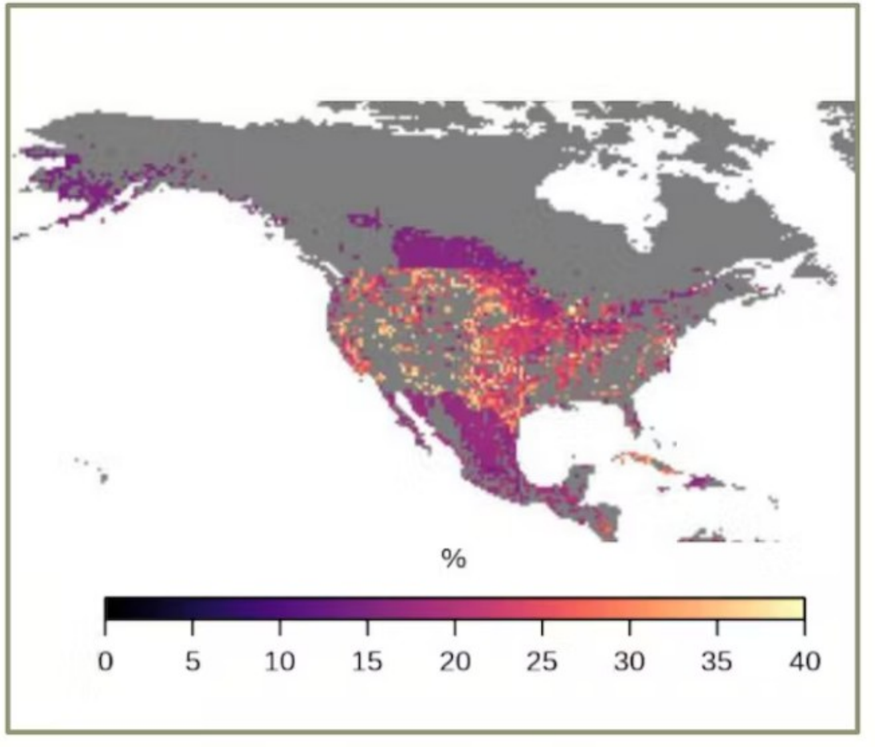
❖ Uncertainty in the **projected** CO2e removal

Relative Soil Organic Carbon Sequestration Rates



Uncertainty in Projection



Global Soil Organic Carbon Sequestration Potential Map – GSOCseq v.1.1 (fao.org)

Example: CO2e removal per acre from No Till (Comet-Planner)

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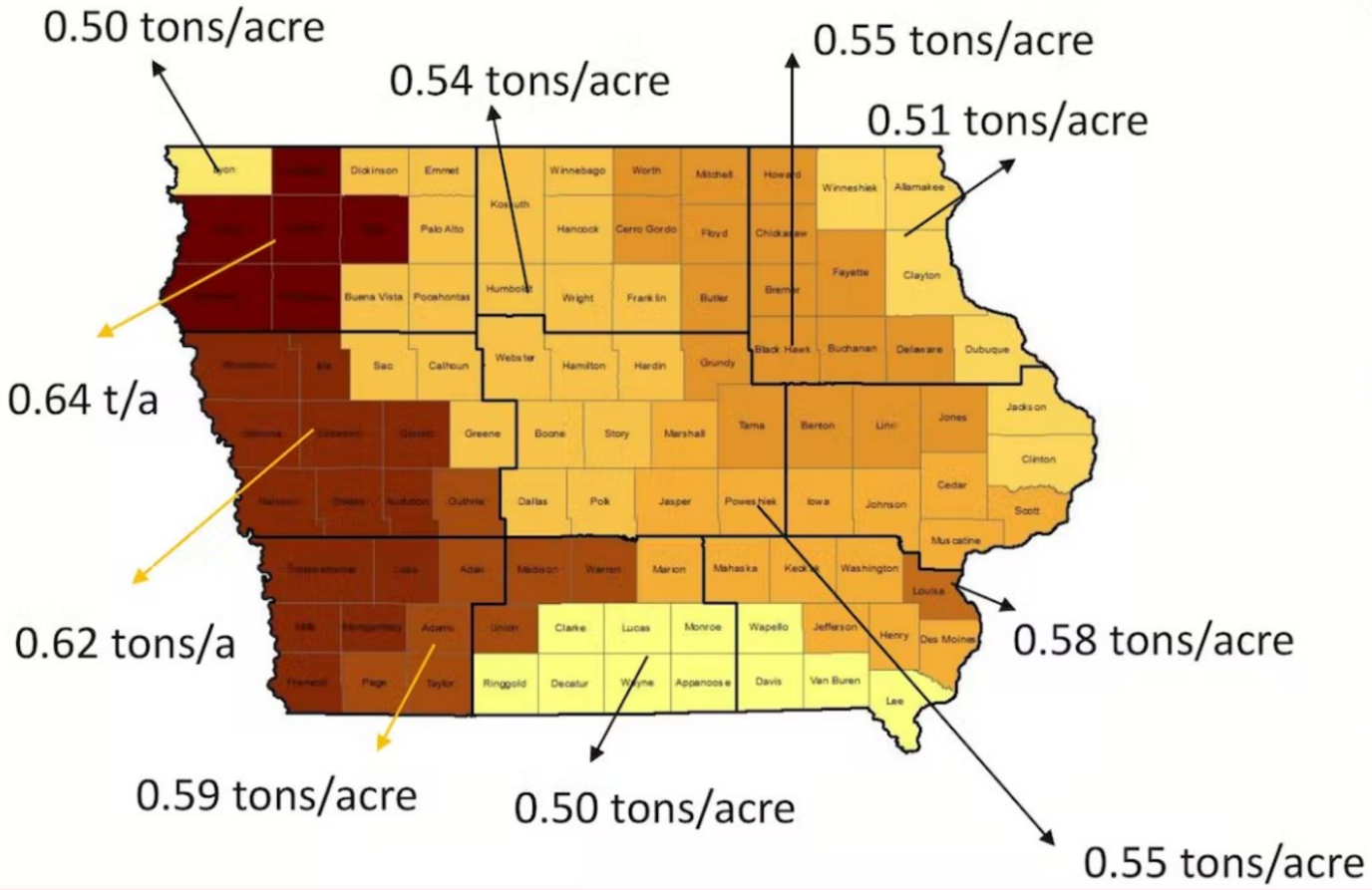

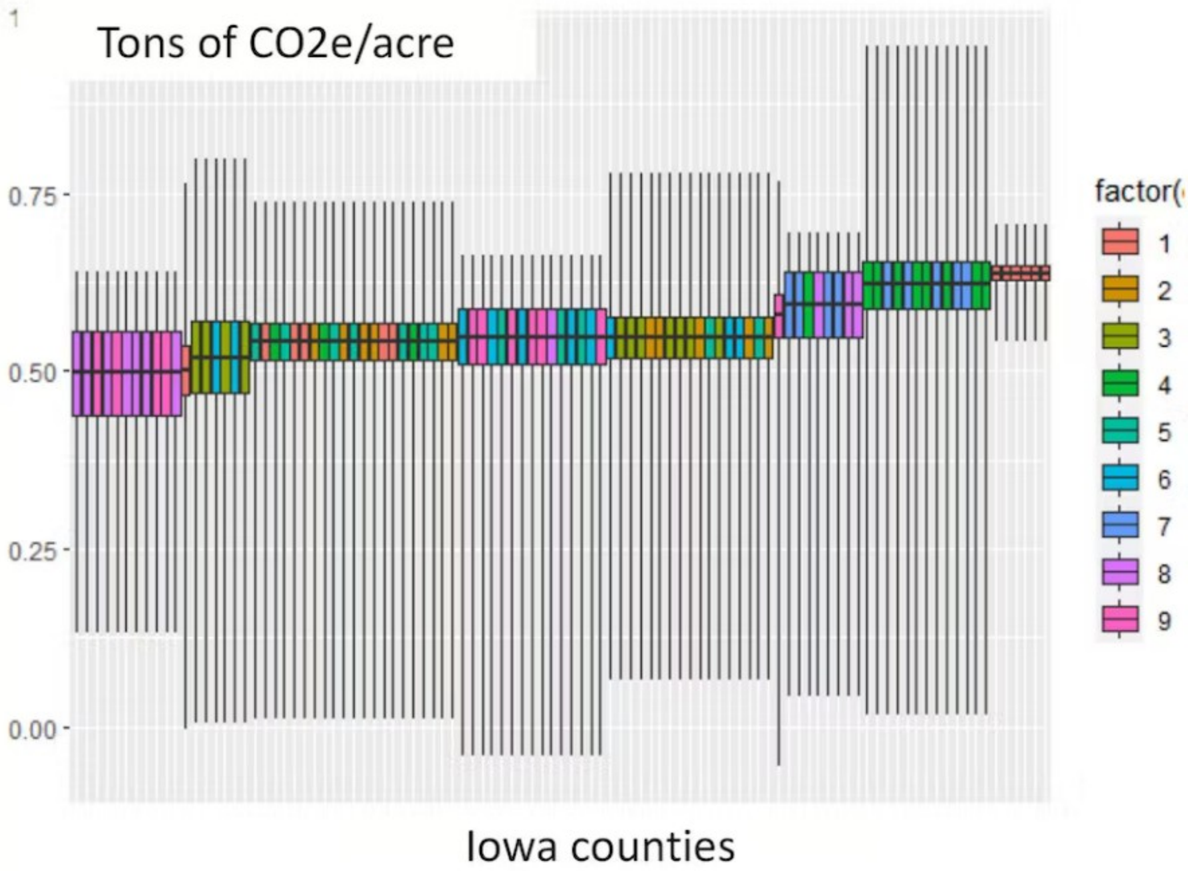

IOWA STATE UNIVERSITY
Extension and Outreach

Source: Haeun Jo and Alejandro Plastina, based on Comet-Planner

Challenge 4: Actual CO2e removal

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- Measuring the **actual** volume of carbon removed/avoided in a farm:
  - **Remote sensing technologies**: very uncertain estimates of actual changes in GHG emissions at farm level, but cheap
  - **Soil tests**: more accurate measurements than remote sensing, but cost-prohibitive at large scale

- Oldfield et al. (2021) reviewed 12 soil carbon protocols, 5th-year soil samples:

  modeled “actual” changes > measured rates of SOC accrual

Challenge 5: Competition from other sectors

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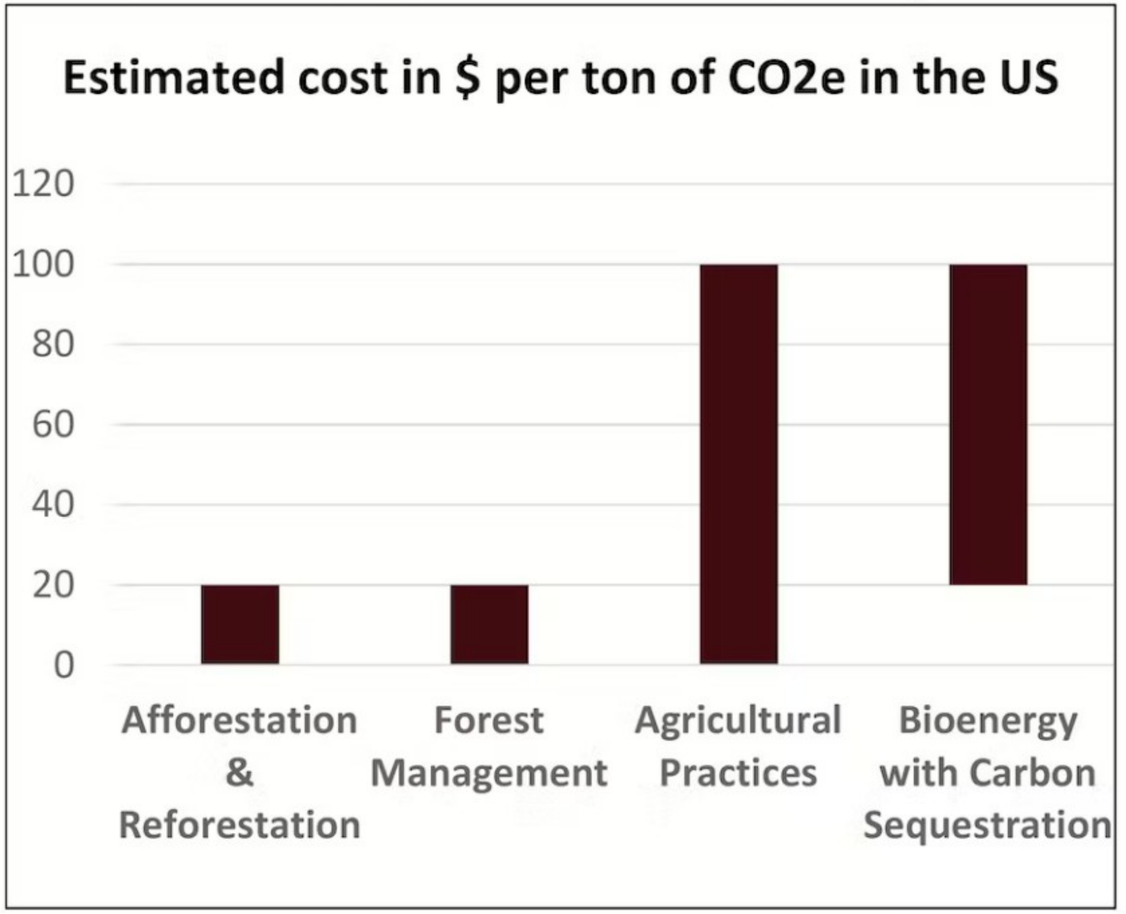
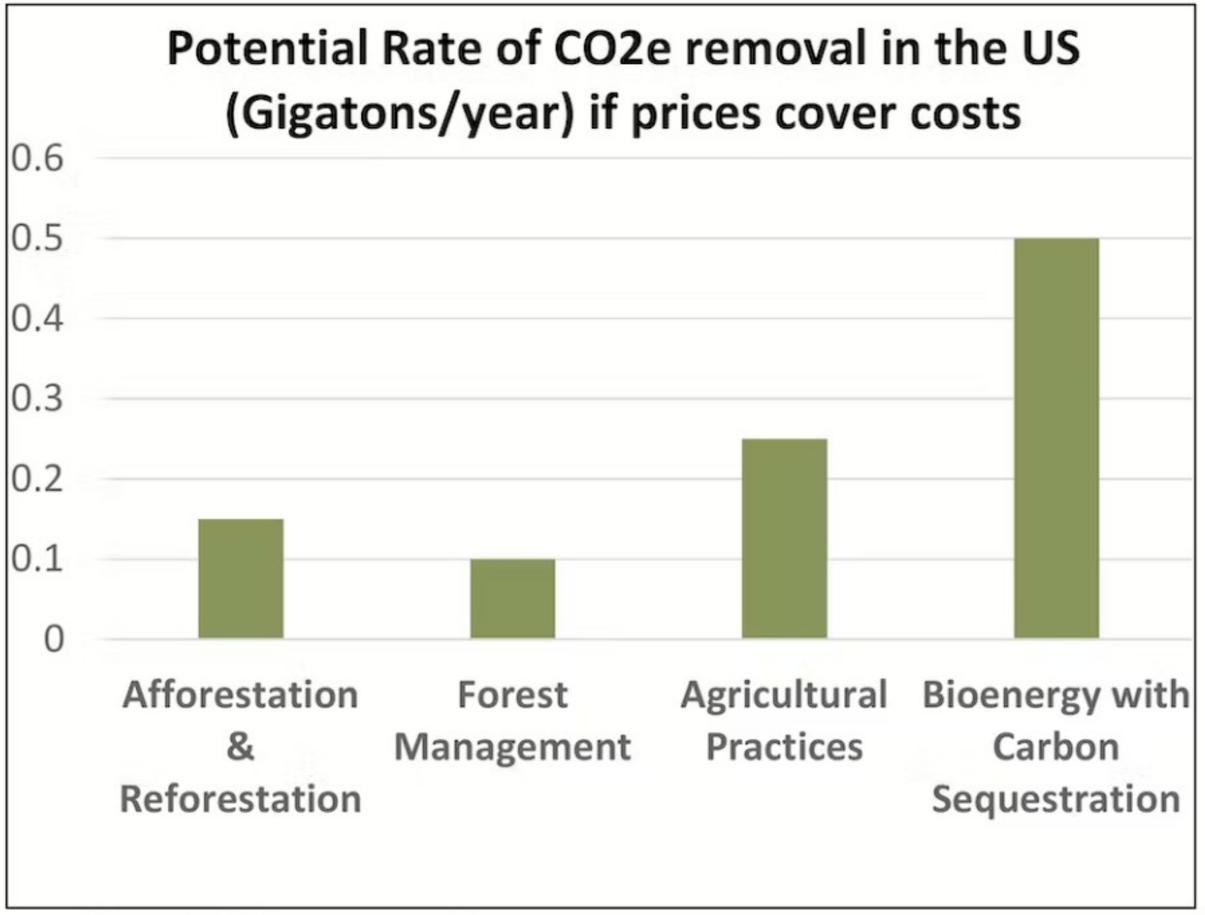
- Competition in supply of carbon credits from forestry and industrial carbon sequestration





National Academy of Sciences, Engineering, and Medicine (2019)

Challenge 6: Greenwashing & fraud

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The Guardian (https://tinyurl.com/ymnun7uh)

Australia's carbon credit scheme 'largely a sham', says whistleblower who tried to rein it in

Prof Andrew Macintosh says the system, which gives credits for projects such as regrowing native forests after clearing, is 'a fraud' on the environment, taxpayers and consumers

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EUROPE

Europe's Energy Crisis Threatens to Slow Green Transition

Continent might not be moving as fast as promised to shift away from fossil fuels

WSJ

MARKETS | FINANCE

Booming Carbon-Credits Market Took Hit as Stocks Sold Off

Rising interest rates upended bets that soaring demand would push prices higher

Bloomberg Green (https://tinyurl.com/262924xd)

This Timber Company Sold Millions of Dollars of Useless Carbon Offsets

Now Lyme Timber CEO Jim Hourdequin wants to fix a broken system to create a market that actually helps slow climate change.

Hourdequin near the Lyme Timber office in L'Anse, Mich.

German police raid DWS and Deutsche Bank over greenwashing allegations

Asset manager accused of misleading investors about ESG factors in its financial products

Approximately 50 officers arrived at the DWS premises and Deutsche Bank's twin towers in downtown Frankfurt mid-morning © Alex Kraus/Bloomberg

FINANCIAL TIMES

https://www.ft.com/content/ff27167d-5339-47b8-a261-6f25e1534942

Federal Support to Carbon Markets

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- Inflation Reduction Act of 2022 (August):
- Invest **$369 billion** in climate solutions, environmental justice, and to help reduce carbon emissions by 40% by 2030
- **$19.5 billion for agricultural conservation** through existing USDA conservation programs on working lands
- **$1 billion in technical assistance** by NRCS
- **$300 million to measure carbon sequestration** and GHG emissions in agricultural lands (starting with CRP lands)
- Other USDA: **$2.8 billion** in Partnership for Climate-Smart Commodities, **$1 billion** to expand market for CS commodities

Possible Scenarios for U.S. Carbon Farming

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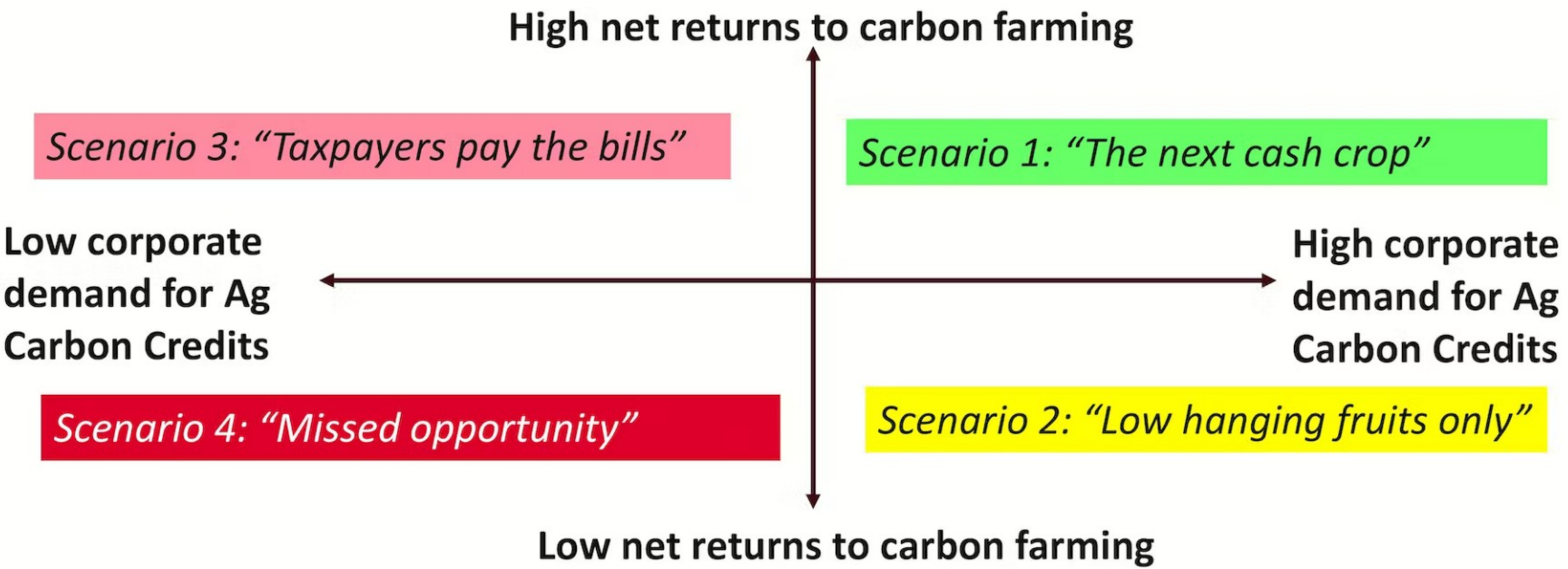

Wongpiyabovorn, Plastina, & Crespi. 2022. *AEPP*
https://doi.org/10.1002/aepp.13254

How to move from S2 to S1?

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- **Address challenges 1-4** to reduce the uncertainty in the production of ag carbon credits, increase the transparency of the system, and improve the credibility of agricultural carbon credits against other carbon credits

- Develop and enforce **minimum standards for carbon credits**, and let the market define premiums and discounts with respect to the standard (example: organic markets before/after certification)

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Concluding Remarks

- Carbon models are central to carbon programs
- Carbon sequestration estimates are highly uncertain
- Standardization of carbon credits should help market development
- Growing number of very different Carbon Programs
- Farmers must do their homework before signing carbon contracts (talk with family, attorney, trusted advisors, understand pros and cons of participation)

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Mentimeter

Thank you for your attention!

Questions?
Comments?

Where to start?

1) **How to Grow and Sell Carbon Credits in US Agriculture**

https://www.extension.iastate.edu/agdm/crops/pdf/a1-76.pdf

2) **How Do Data and Payments Flow Through Ag Carbon Programs?**

https://www.extension.iastate.edu/agdm/crops/pdf/a1-77.pdf

3) **What's in Store for Voluntary Agricultural Carbon Markets?**

https://www.card.iastate.edu/ag_policy_review/article/?a=136

Carbon Credit Generation through Agoro

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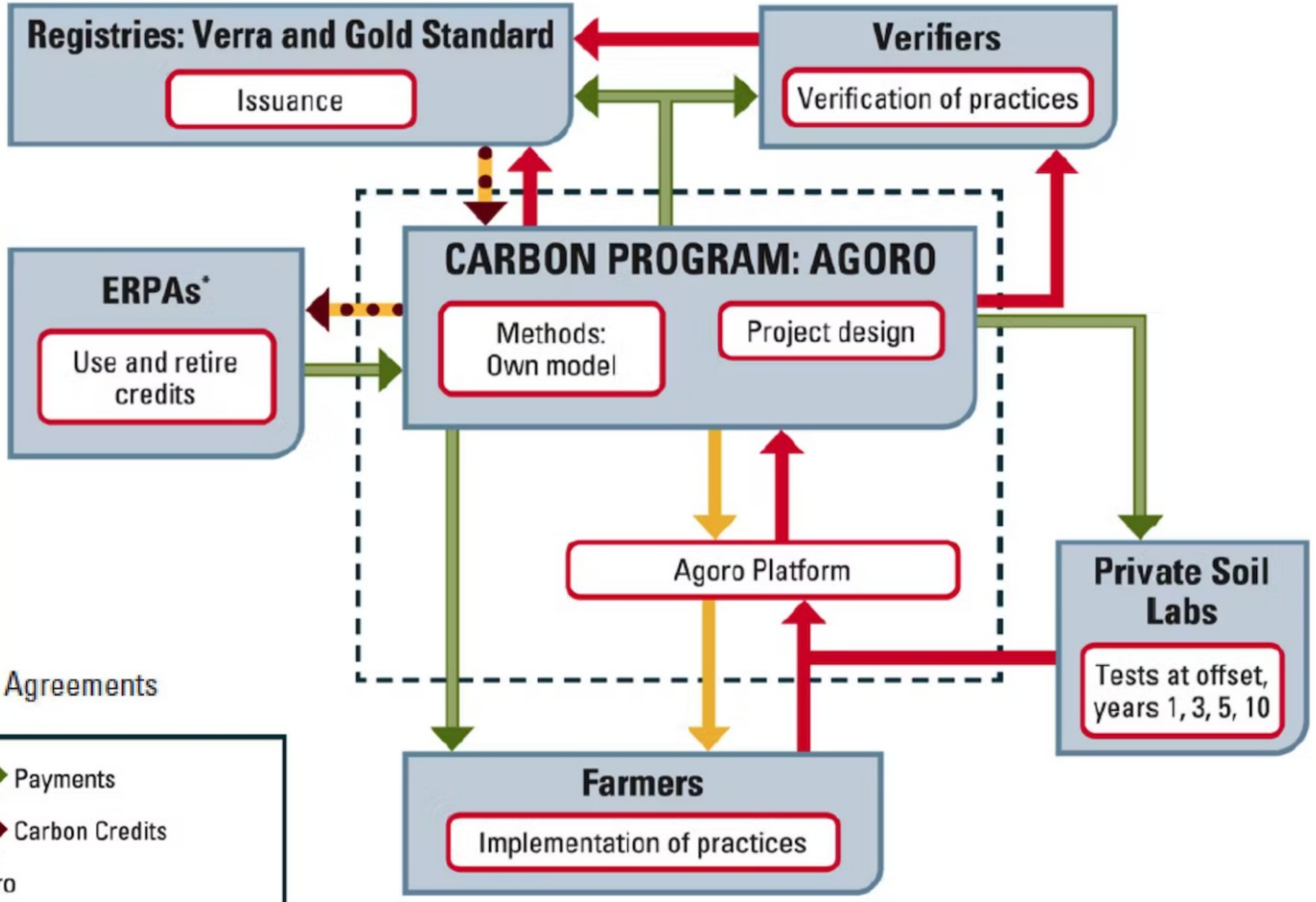
- ✓ Contract length: 10 years
- ✓ Min area: 500 acres
- ✓ Payments: annual



Looking to the Future

Conclusions

2022 Carbon in Agriculture

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Final Comments

Caro Cordova

Assistant Professor

Agronomy & Horticulture

Andy Suyker

Associate Professor

School of Natural Resources

Chuck Rice

Professor

Agronomy, KSU

What surprised you in what you heard today?

What is one thing you will do to follow up today?

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Possibility to analyze SOC, soil health and carbon stock in perennial crops outside Nebraska. Especially in my country, Indonesia.

Organize my notes to incorporate all information.

Be careful with any contracts offered for selling any carbon credits.

3

Meeting materials will be posted at: https://ianr.unl.edu/carbon-agriculture-summit

- Recording of Live Stream Event
- Menti.com Results
- Summary

Thank you for attending the 2022 Carbon in Agriculture Summit!

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