Climate solutions, justice, and the rise of a trillion dollar industry

Penn Regenerative Ag Alliance Workshop
March 24, 2023

Dr. Jane Zelikova
Director
Soil Carbon Solutions Center
Colorado State University

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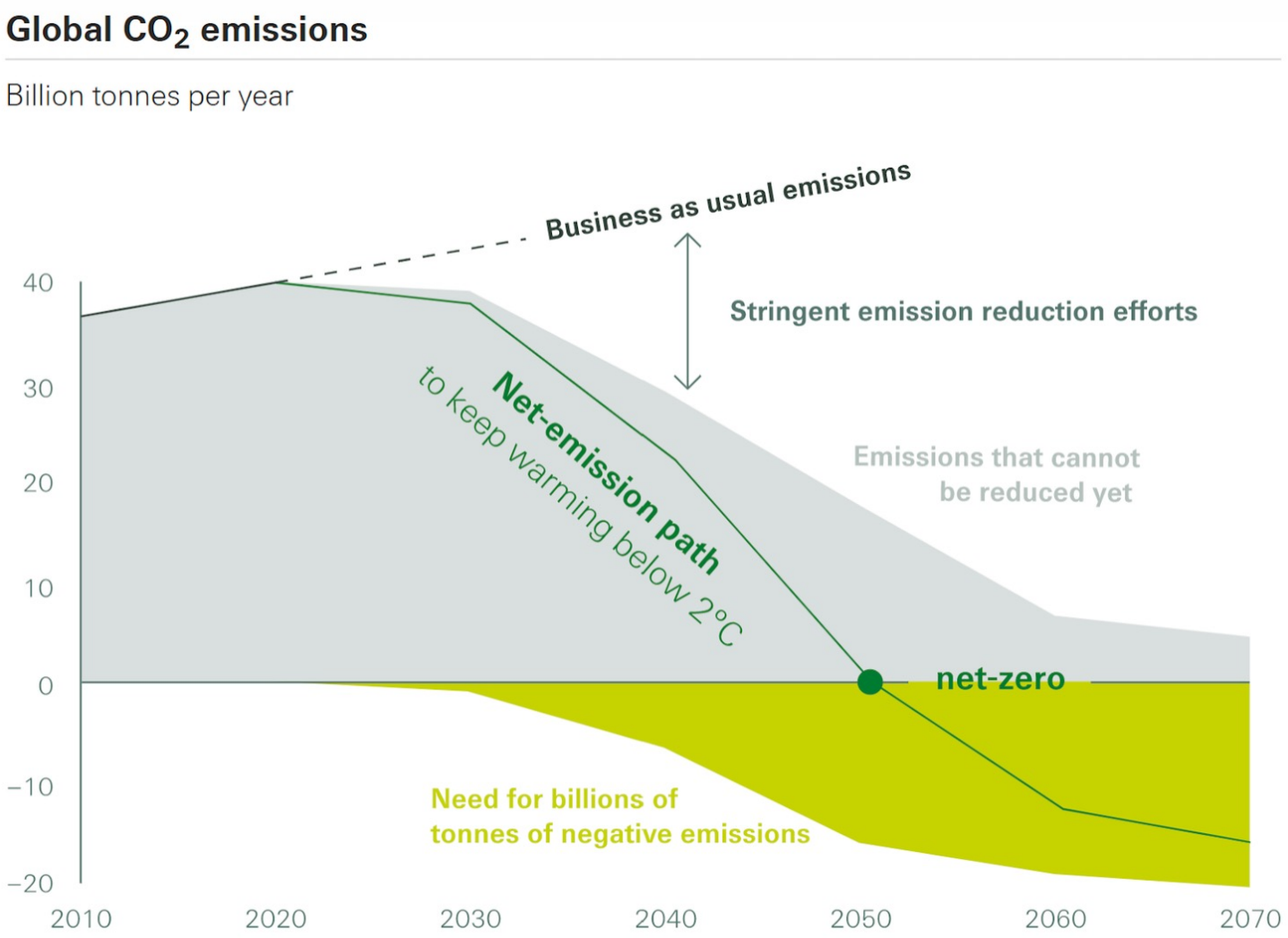
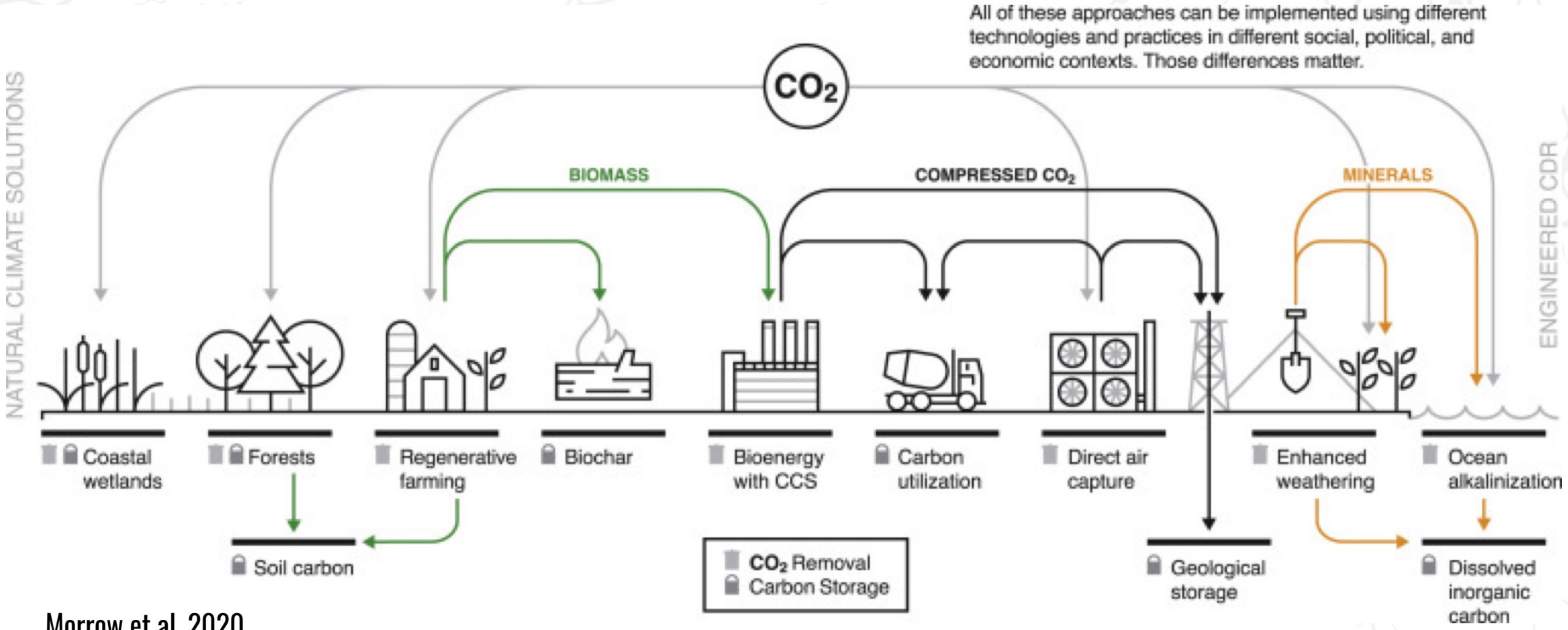
Carbon removal is now “essential"



Source: Swiss Re, based on IPCC data

Carbon removal is now “essential"



Morrow et al. 2020

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This is soil's moment

Interest in agricultural soil carbon and soil health more broadly is rapidly gaining traction with producers, companies, policy makers, C markets, and civil society.

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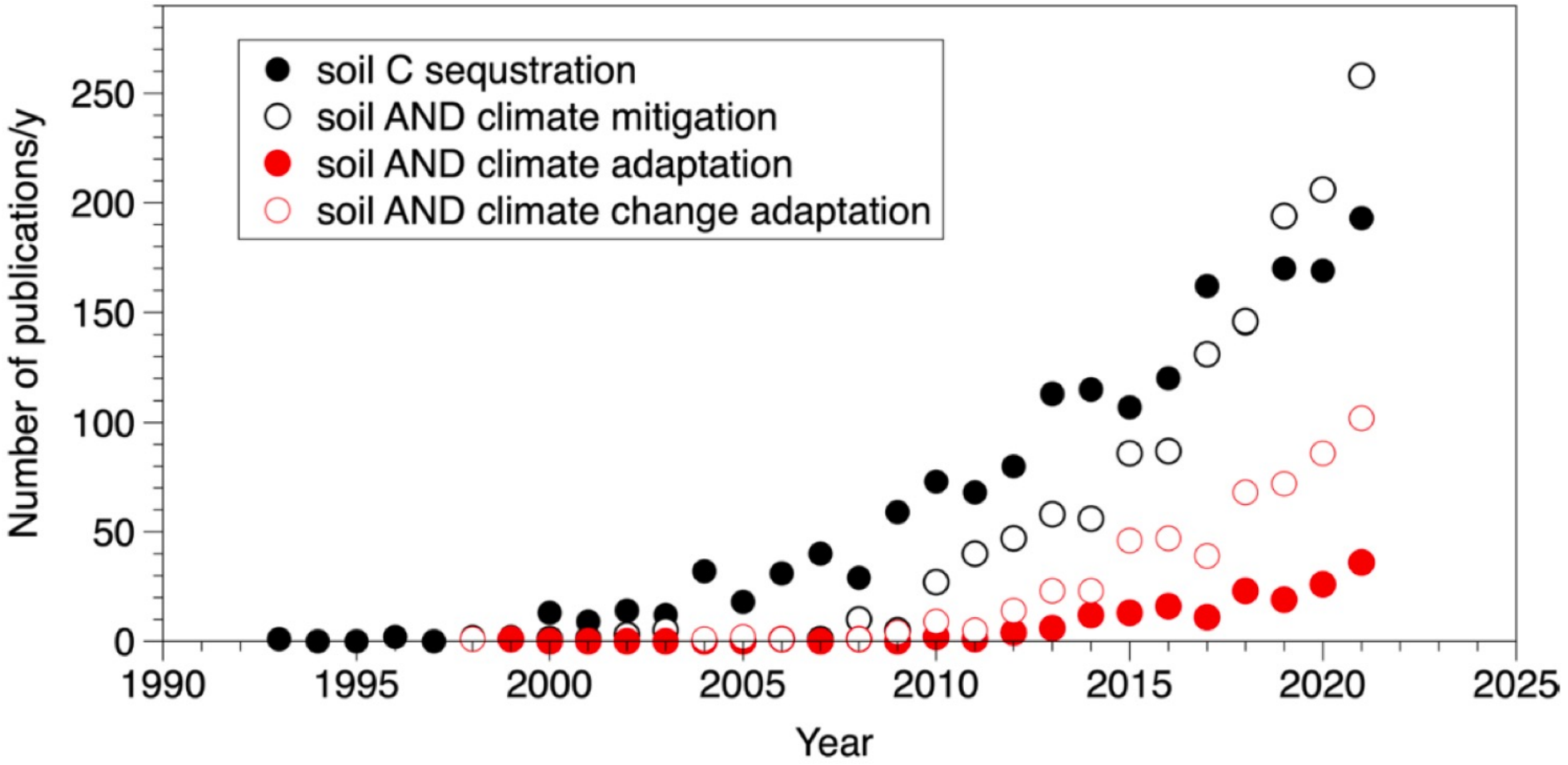
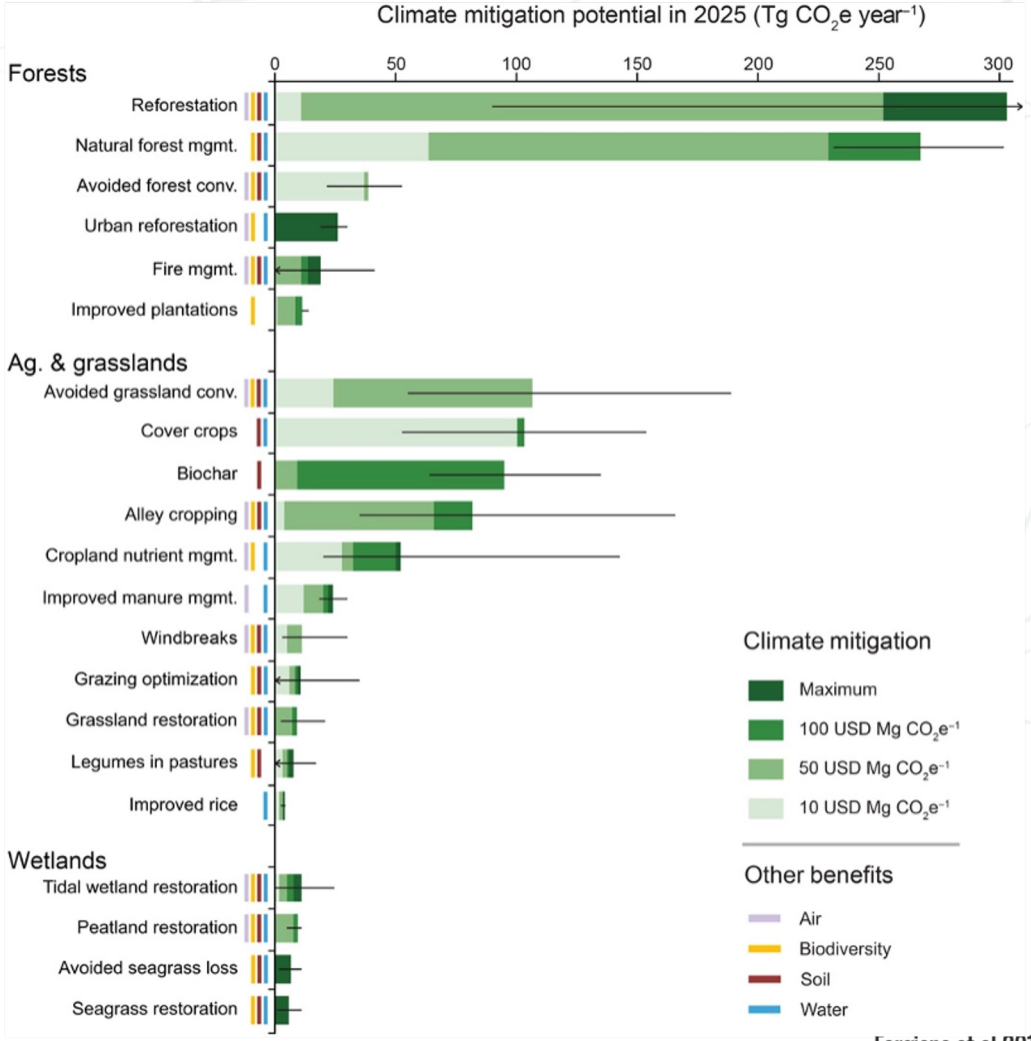
Interest in soil carbon is growing



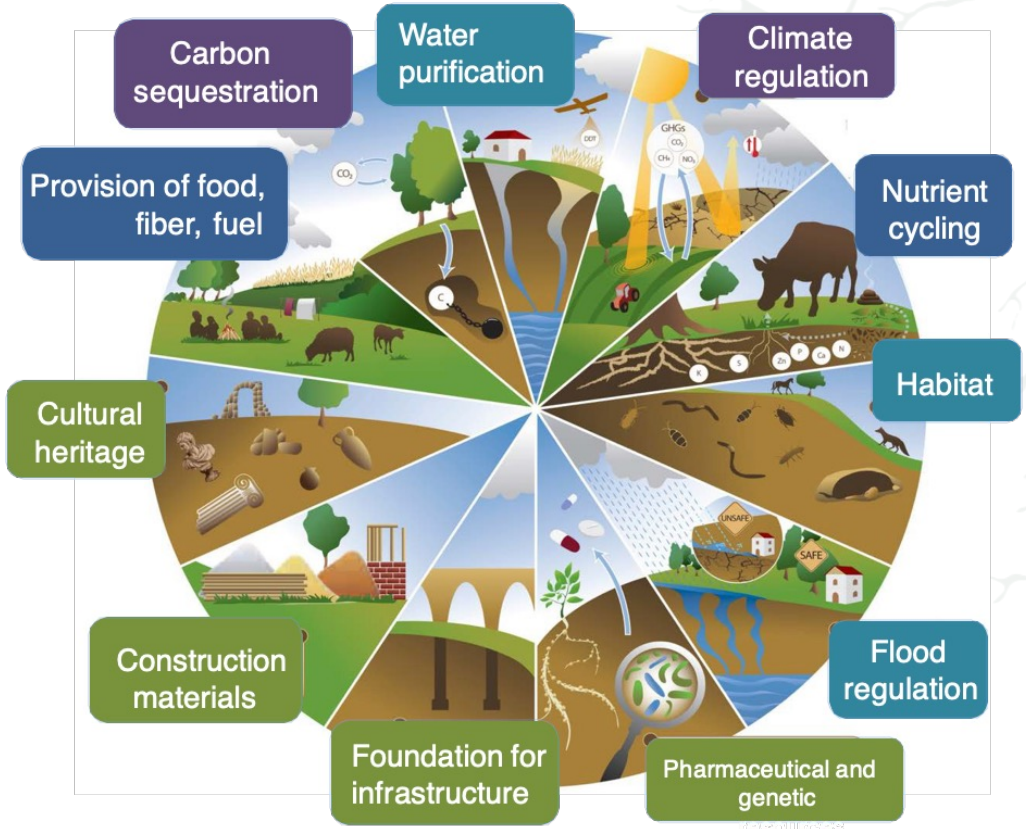
Amundson et al. 2022 https://doi.org/10.1007/s10533-022-00952-6

A “win win” solution under our feet

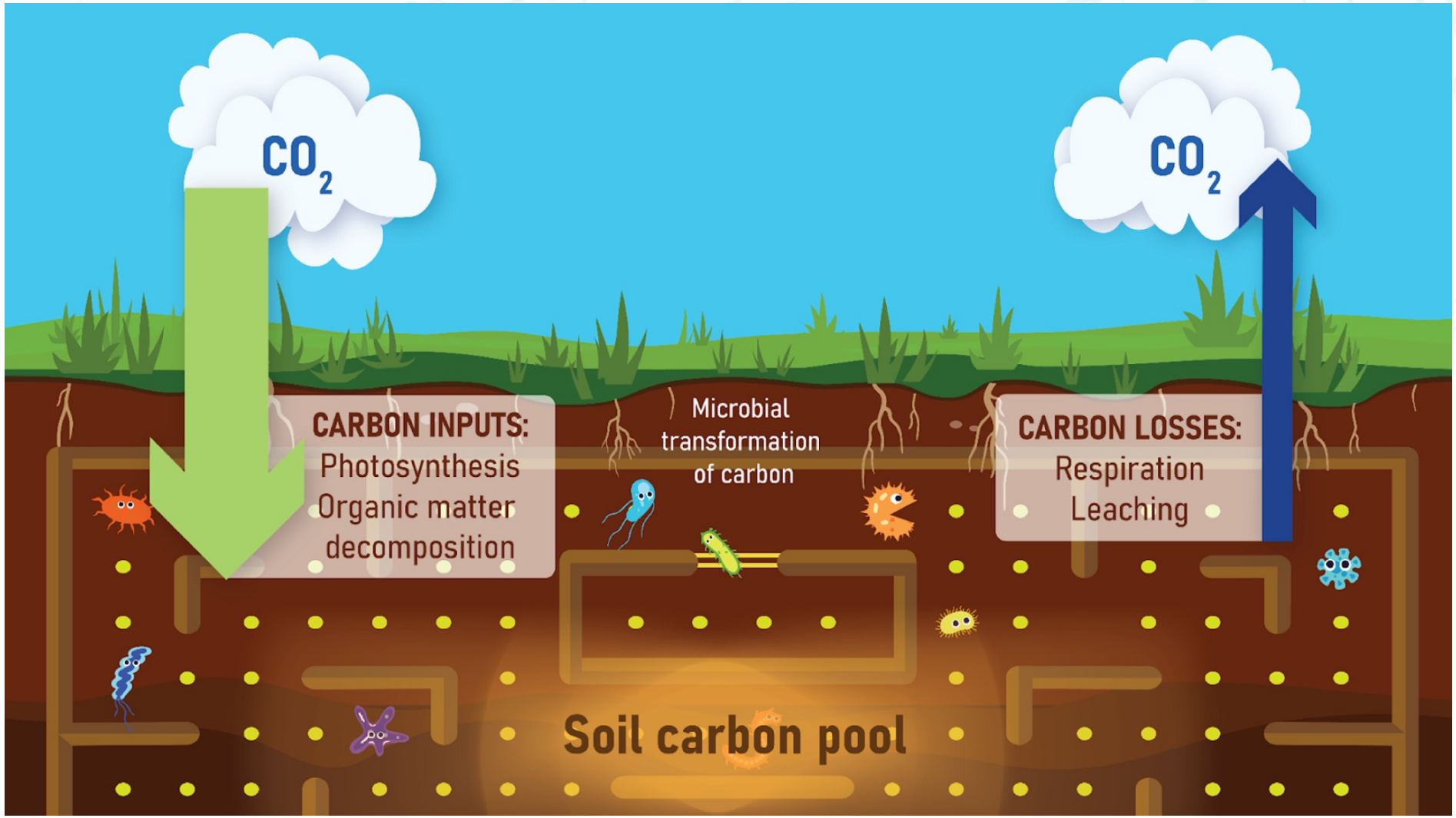


Fargione et al 2018

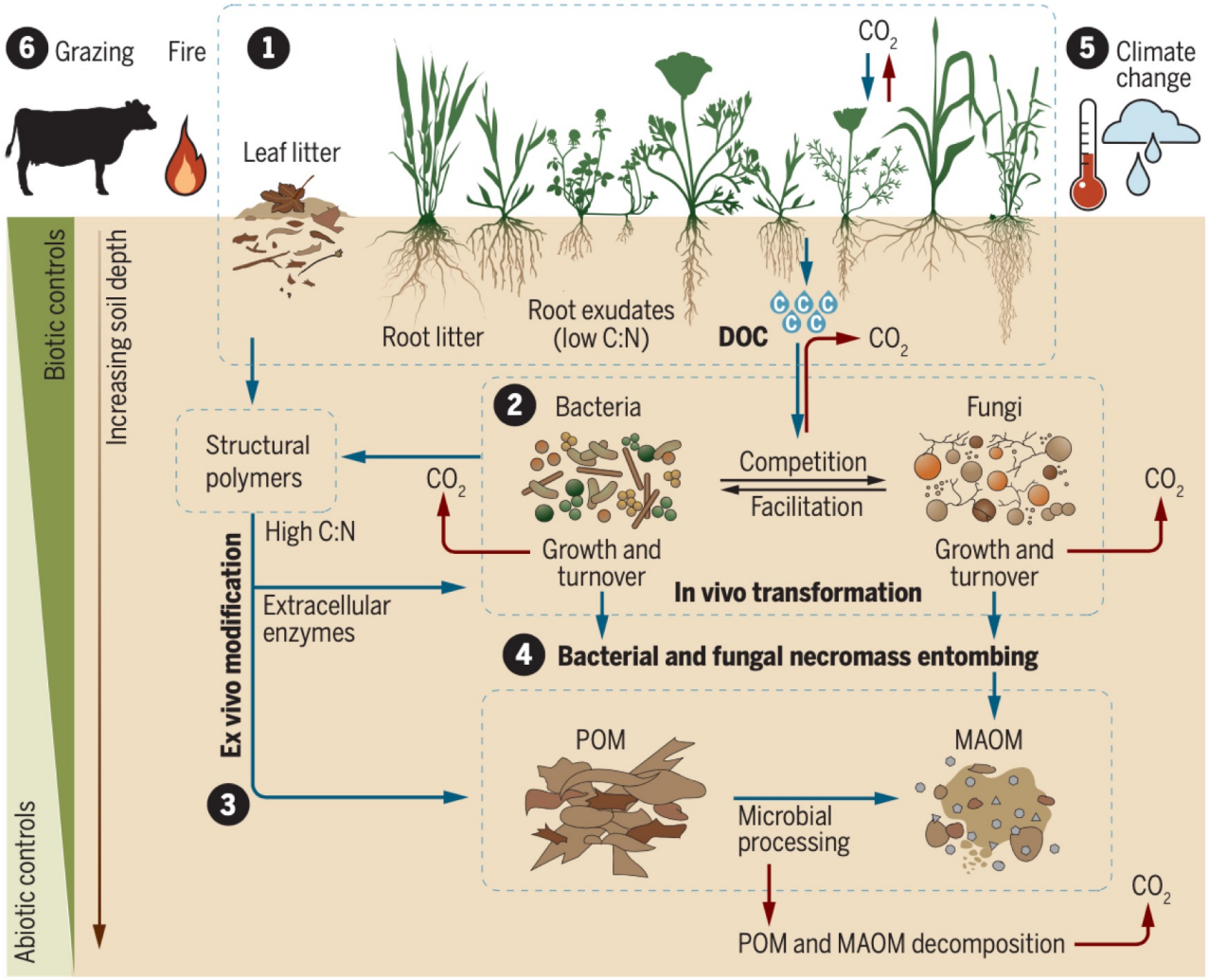
Soils are at the nexus of many concurring and reinforcing challenges



How do soils sequester carbon?



How do soils sequester carbon?



Bai and Cotrufo 2022

Sampling + lab analyses

To Stratify or not to stratify

Fluxes

Towers towers everywhere

Spectra and satellites

Can we measure soil carbon from space?

Models

Daycent, DNDC, SNAP, RothC, MEMS, MIMICS, the list goes on and on and on

You can't value what you can't measure

All the ways we measure soil carbon

A key barrier to implementing programs that incentivize increases in soil C at large scales is the need for credible and reliable MRV (for NDCs, emissions trading, supply chain, etc)

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We can't value what we can't measure

Measuring soil C

We need to take a LOT of samples

There are no one-size-fits-all sampling strategies

We can't "measure" soil carbon from space

We don't have rapidly deployable field instruments *yet*

Valid inferences about soil carbon in heterogeneous landscapes

Paige Stanley [a,*], Jacob Spertus [b], Jessica Chiartas [c], Philip B. Stark [b], Timothy Bowles [a]

[a] Department of Environmental Science, Policy, and Management, University of California, Berkeley, Berkeley, CA, USA
[b] Department of Statistics, University of California, Berkeley, Berkeley, CA, USA
[c] Department of Land, Air, and Water Resources, University of California, Davis, Davis, CA, USA

Article

Optimizing Sampling Strategies for Near-Surface Soil Carbon Inventory: One Size Doesn't Fit All

Charles Bettigole [1,*], Juliana Hanle [2], Daniel A. Kane [3], Zoe Pagliaro [1], Shaylan Kolodney [1,4], Sylvana Szuhay [1], Miles Chandler [1], Eli Hersh [1], Stephen A. Wood [3,5], Bruno Basso [2], Douglas Jeffrey Goodwin [6], Shane Hardy [7], Zachary Wolf [4] and Kristofer R. Covey [1]

Research article

Carbon farming: Are soil carbon certificates a suitable tool for climate change mitigation?

Carsten Paul [a], Bartosz Bartkowski [b], Cenk Dönmez [a i], Axel Don [c], Stefanie Mayer [d], Markus Steffens [e], Sebastian Weigl [a], Martin Wiesmeier [d f], André Wolf [g], Katharina Helming [a h]

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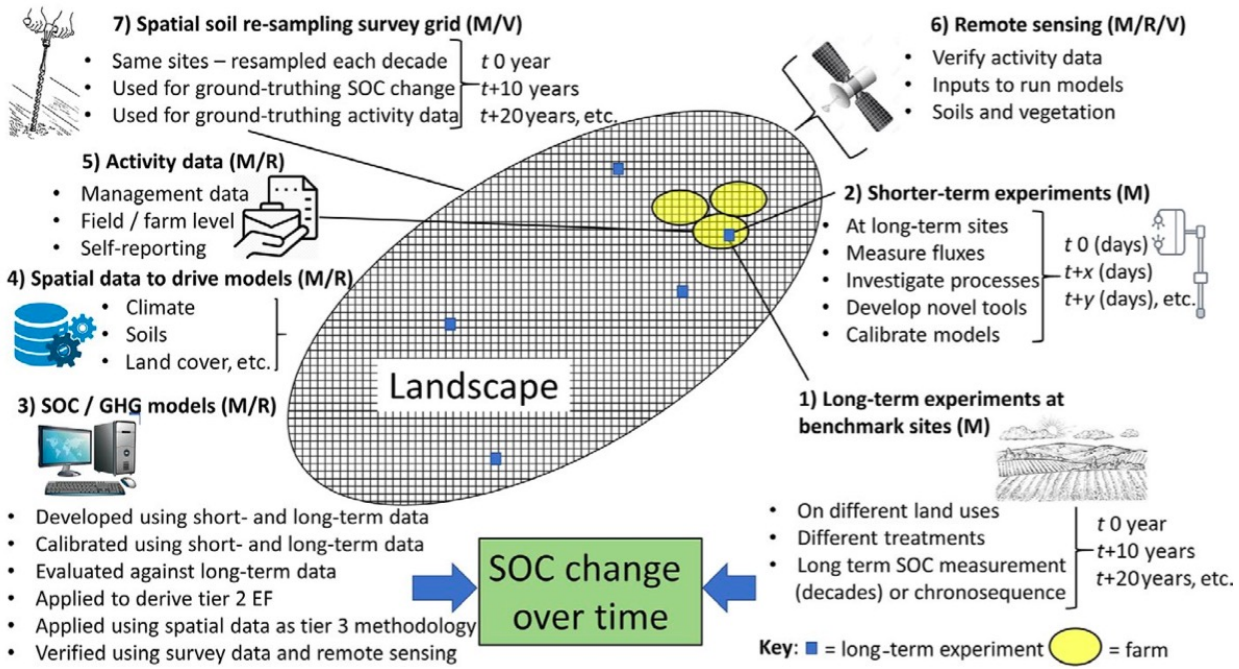

Smith et al. 2019

We can't value what we can't measure

Integration across scales of measurement

No one method is perfect

Integration across scales (space and time) is a promising and much needed next step

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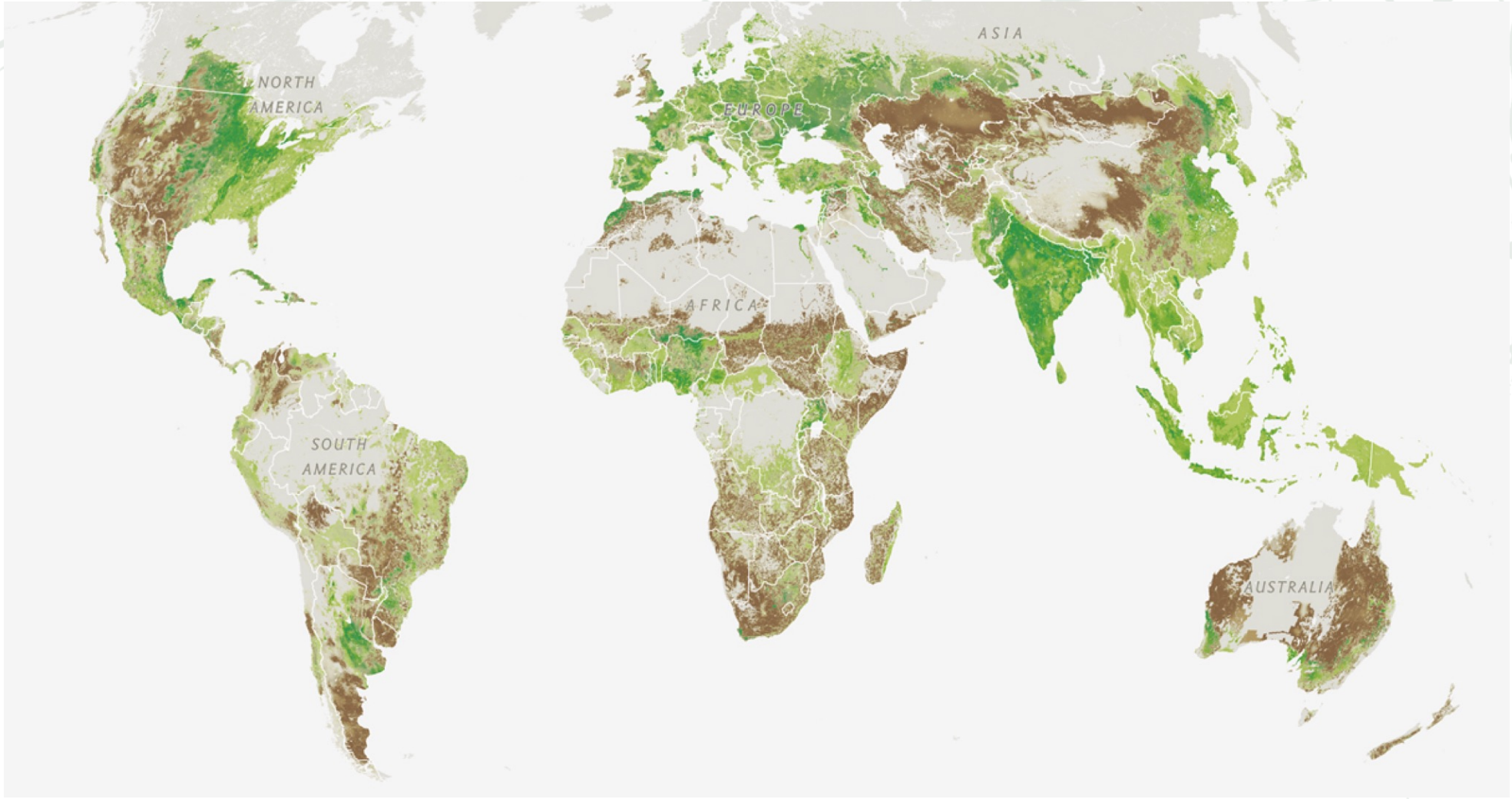
Where is the potential?



Where we grow food, fiber, fuel

Where there is high technical sequestration potential

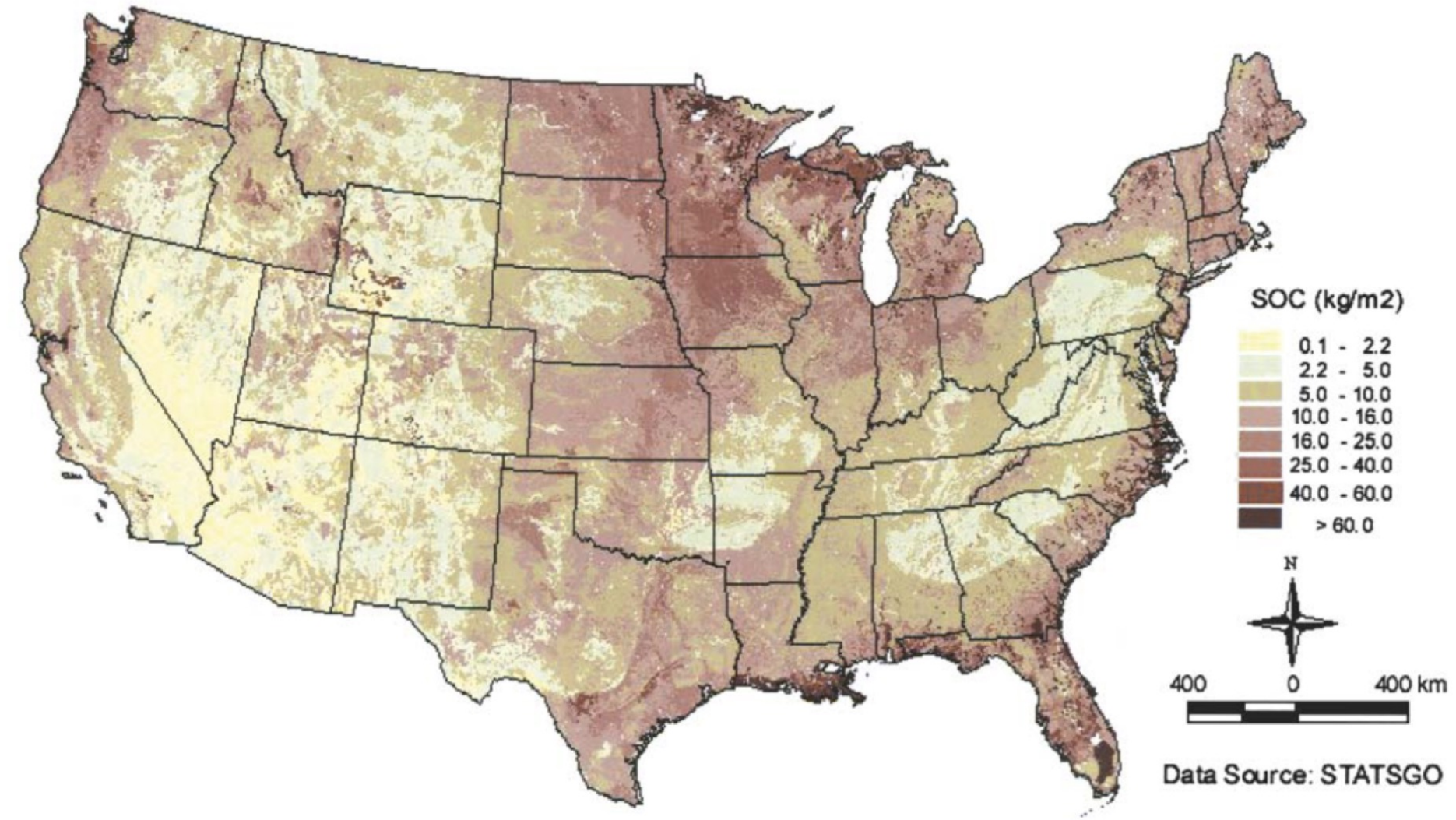
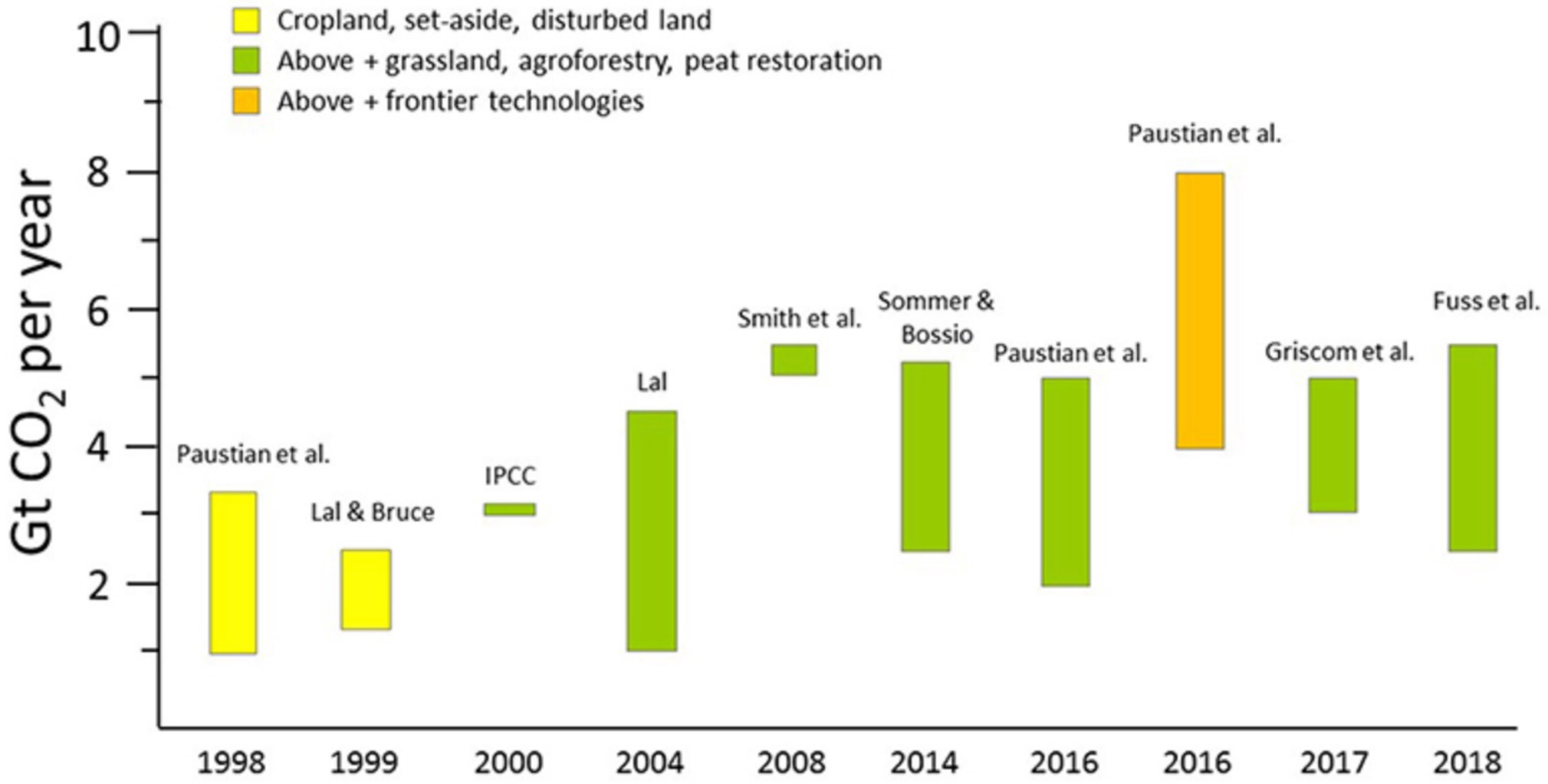


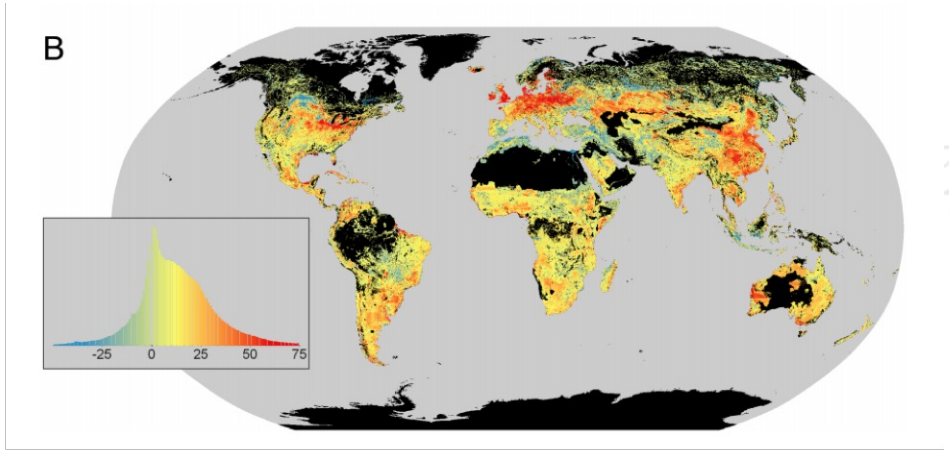
Fig. 1. Spatial distribution of soil organic C (SOC) content to 2-m soil depths in the conterminous USA (midpoint method).

What is the potential?



~ 10% of annual emissions

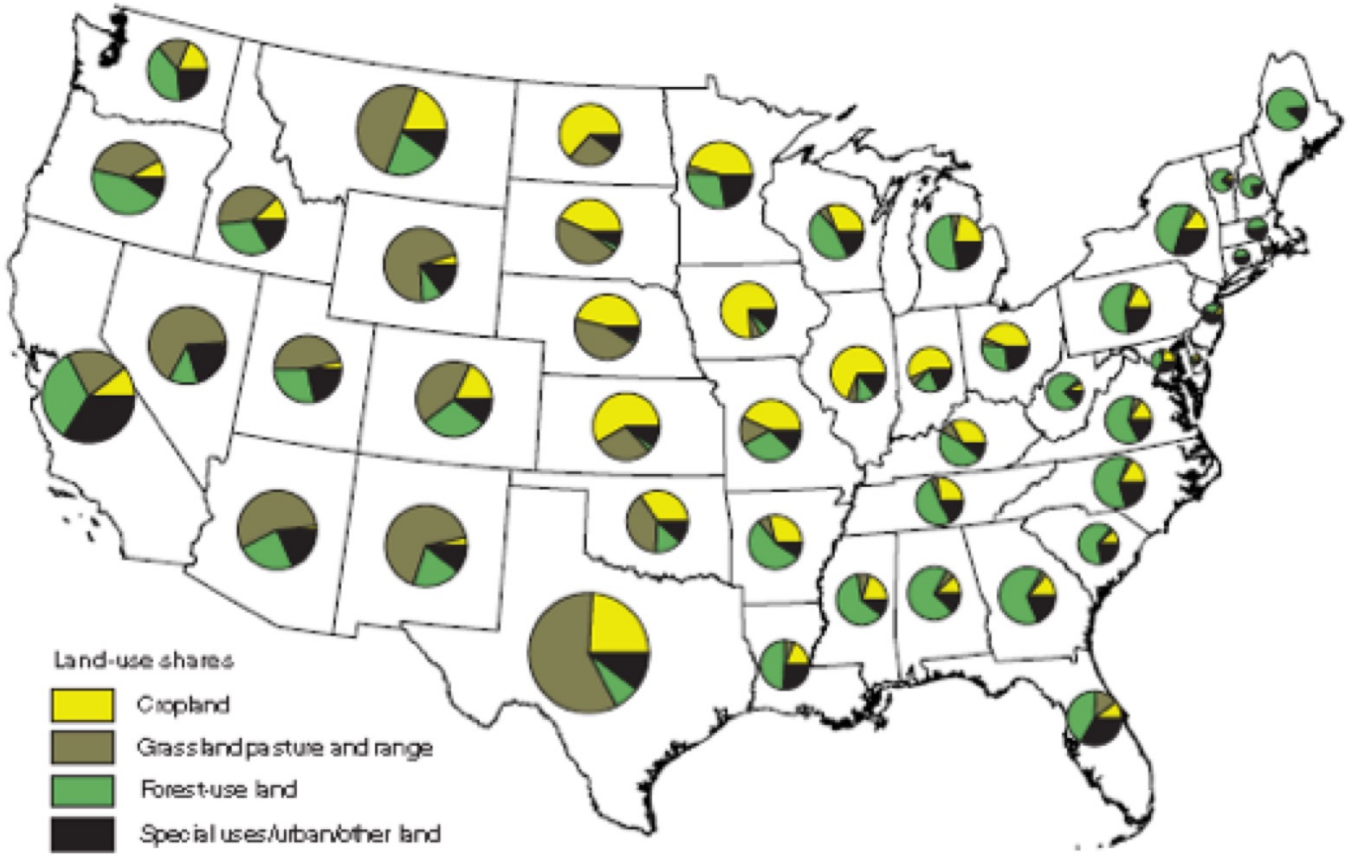
Where we have lost a lot of carbon



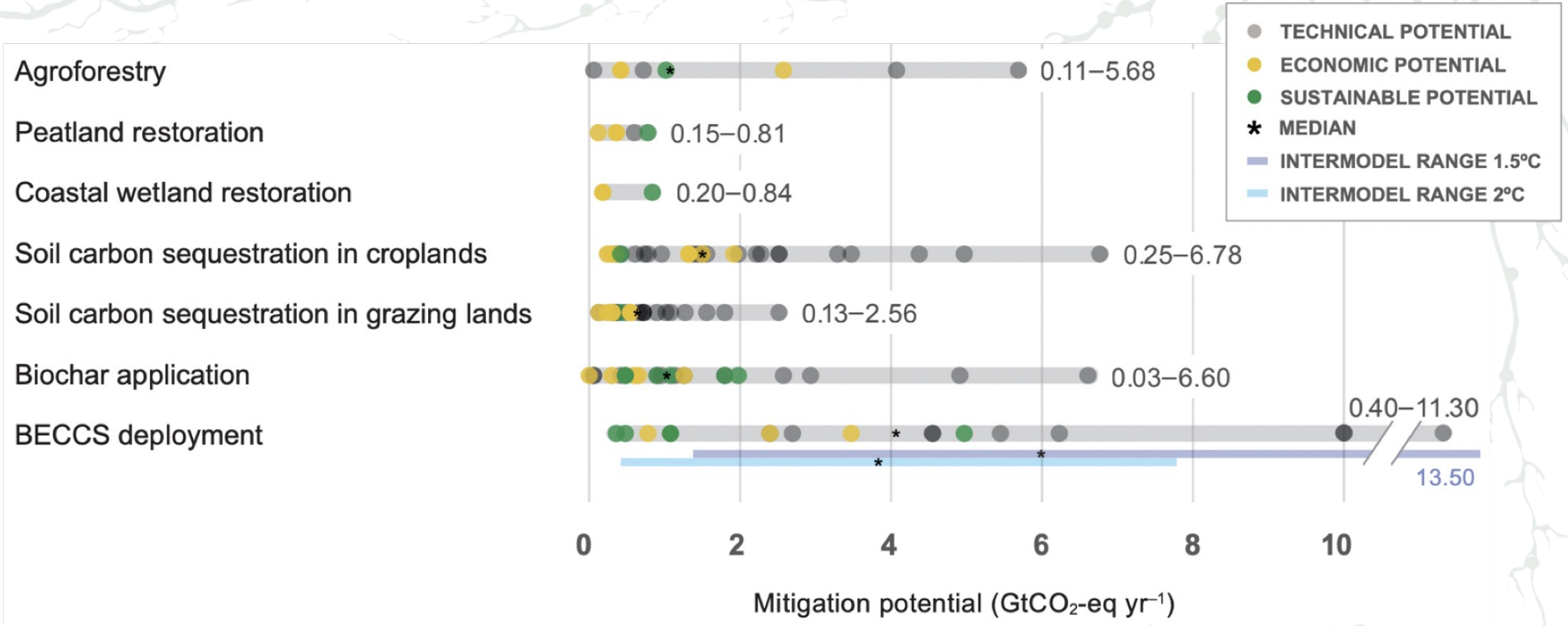
Sanderman et al. 2017

Agricultural land uses have resulted in the loss of **133 Pg C** from the soil. Maps indicate hotspots of soil carbon loss, often associated with major cropping regions and degraded grazing lands, suggesting that there are identifiable regions that should be targets for soil carbon restoration efforts.

Where we can shift management practices



Just < Economic < Technical sequestration potential



https://link.springer.com/journal/10533/volumes-and-issues/161-1

Shifting to regenerative agriculture is hard

Soil carbon is only one dimension of the transition to regenerative agriculture

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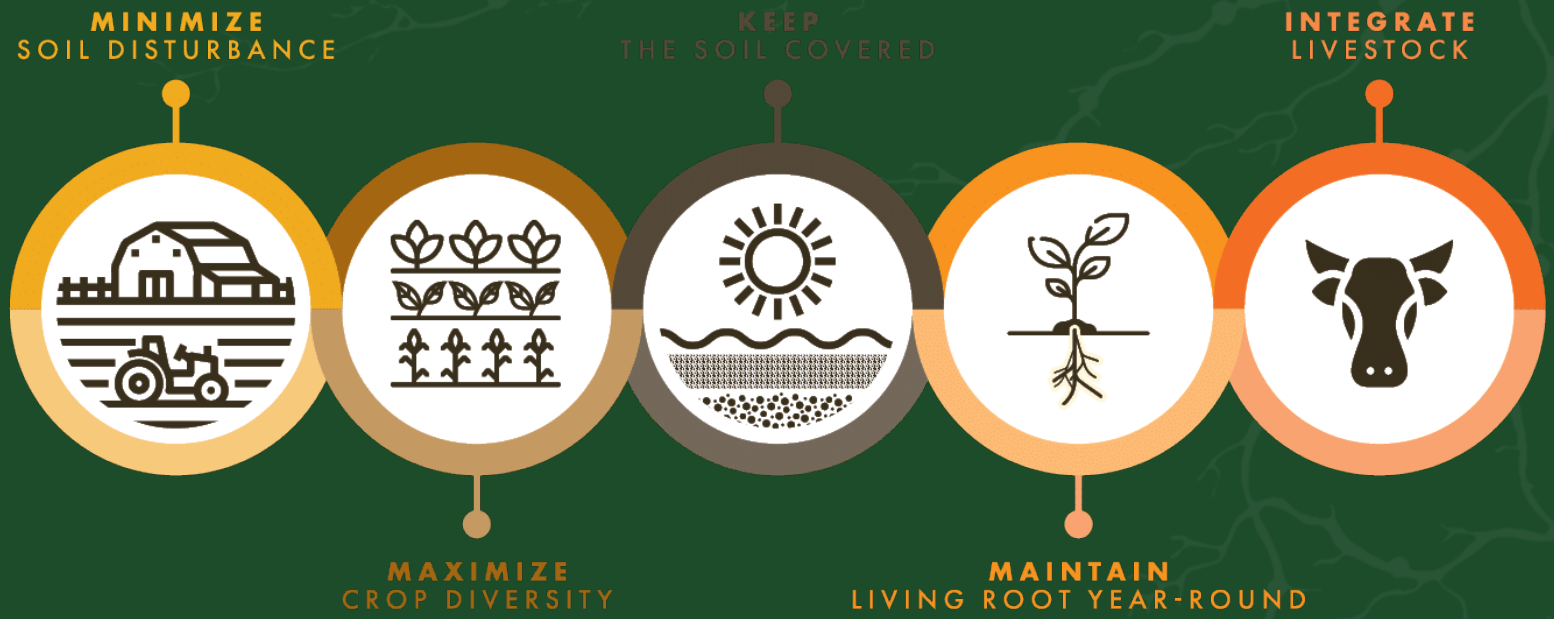
Soil and Climate

Enabling a shift toward regenerative ag



Markets

Carbon markets, price premiums

Policy

Federal, state, local
Corporate, procurement, climate commitments

Vision

Internal transformation

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Soil carbon markets

2023 market map of the „new" voluntary carbon market

puro·earth

Buy-side → Sales-side ← Supply-side

Corporates:
Buy and retire credits to achieve climate commitments, e.g., net-zero pledges

Governmental Institutions and NGOs:

Decarbonization Platforms:
Offer offsetting in addition to their core business, e.g., carbon accounting or green fintech

Individuals and Subscription-Based Mobile Offsetting:

Brokers:
Procure and transfer or retire credits from a trader on behalf of a client. Charge a commission and do not necessarily take credit ownership

Exchanges:
Provide trading infrastructure

Traders:
Buy large credit batches from suppliers and sell them in bundled portfolios, usually for a commission

Direct Sales:
Host and sell credits without an intermediary

Project Proponents:
Own and operate an emissions avoidance, reduction, or removal project

Marketplaces and API Providers:
Enable credit transactions by hosting a marketplace and/or API services to directly bridge end-buyers to registered credits

Meta-Registries:
Integrate multiple registry systems and display credits through a decentralized and shared metadata layer

Standards and Registries:
Provide a set of independent methodologies to certify projects and issue credits, which are hosted and/or displayed in a registry

Project Developers and Aggregators:
Have the legal right to carry out an owner's project and claim carbon credits

Advance Market Commitments:
Enter or offer pre-purchase/ offtake agreements to mobilize capital toward projects at pre-credit stage

Tokenized Credits:
An entire ecosystem for credits moved onto the blockchain has arised

Governance and Accreditation:
Provide guidance through principle frameworks and endorse compliant Standards or corporates with quality labels

Third-Party Auditors (also known as VVBs):
Independently verify a project's climate impact against a Standard's methodology

Financing and Advisory:
Deploy resources to projects; at times with brokering and development arms

Insurance:
Insure projects, credits, or buyers against key risks, either as a broker or insurer

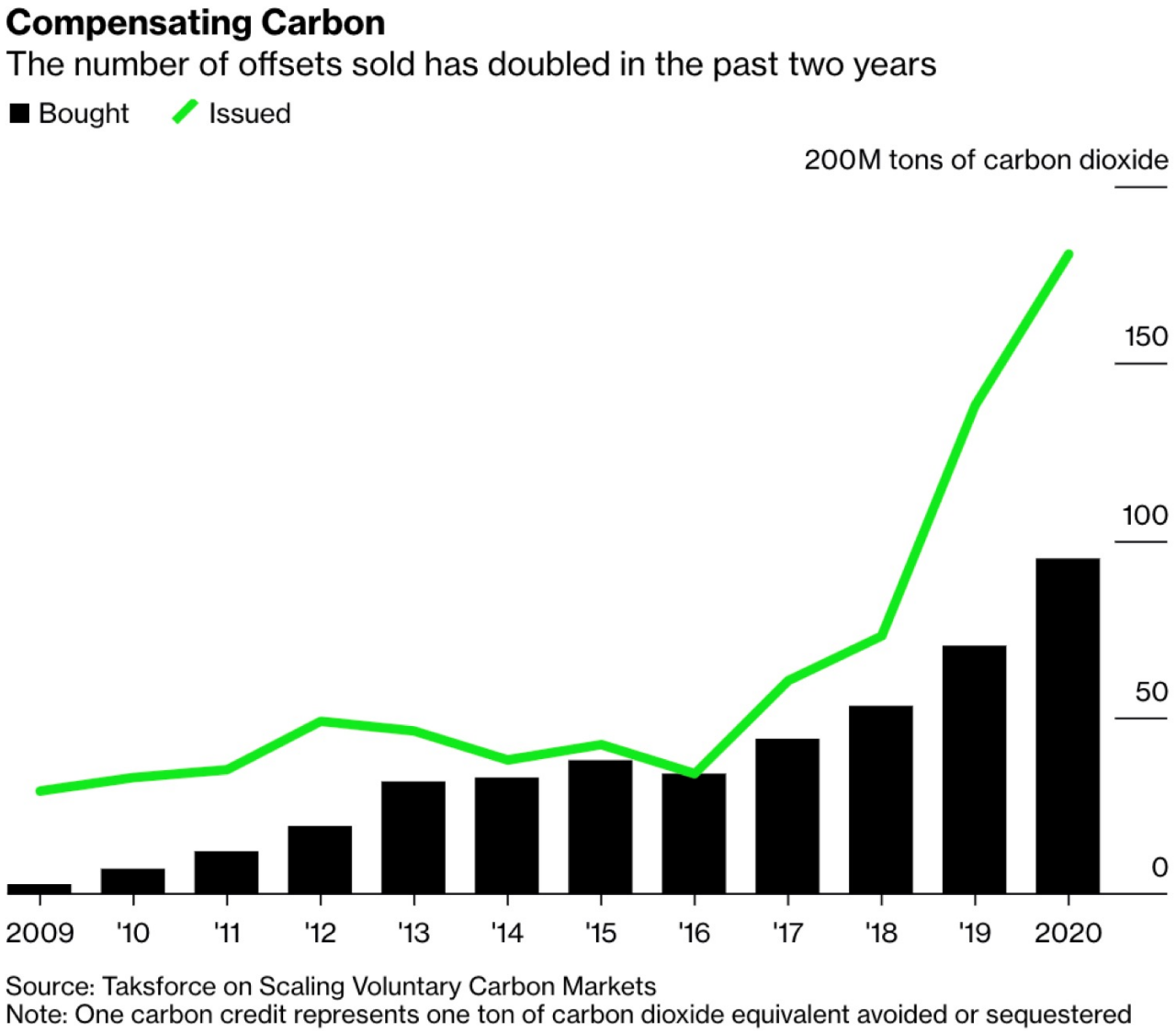
Market Research and Data Platforms:
Gather, analyze, interpret, and publish data on the VCM

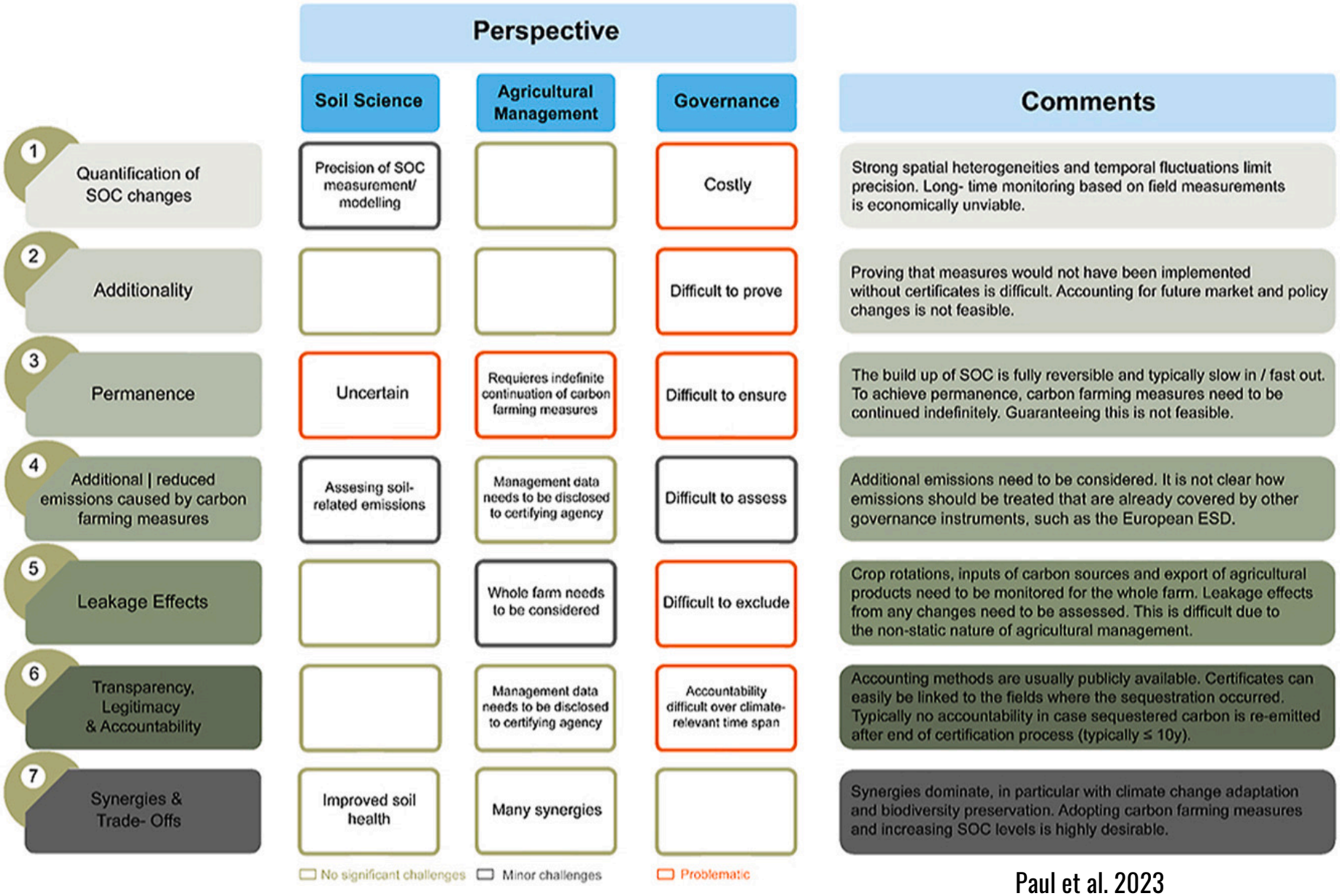
Credit Ratings:
Provide carbon credit ratings based on project data

Measurement, Reporting, and Verification (MRV):
Collect emissions monitoring data for project developers such as through remote sensing, sattelite imagery, and machine learning

Markets

Soil carbon markets





Paul et al. 2023

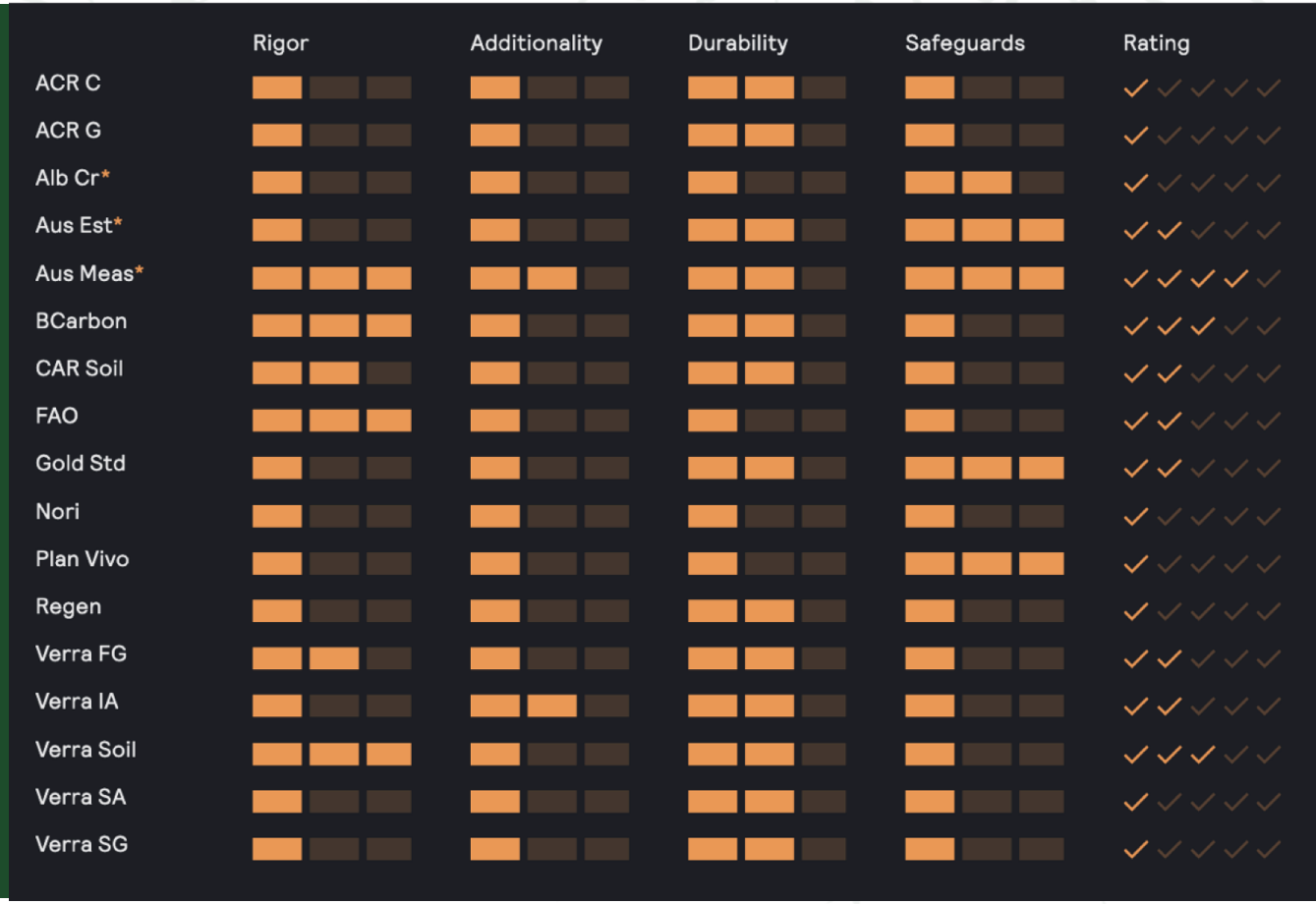
We can’t value what we can’t measure

Criticisms

Crediting protocols lack rigor across all measures (Carbon Plan 2021)

Soil carbon projects deepening existing inequities

- Unequal distribution of benefits
- Non-additionality, leakage
- Another dimension of commoditization



Carbon Plan, Zelikova et al. 2021

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Scaling soil carbon

What do farmers think?

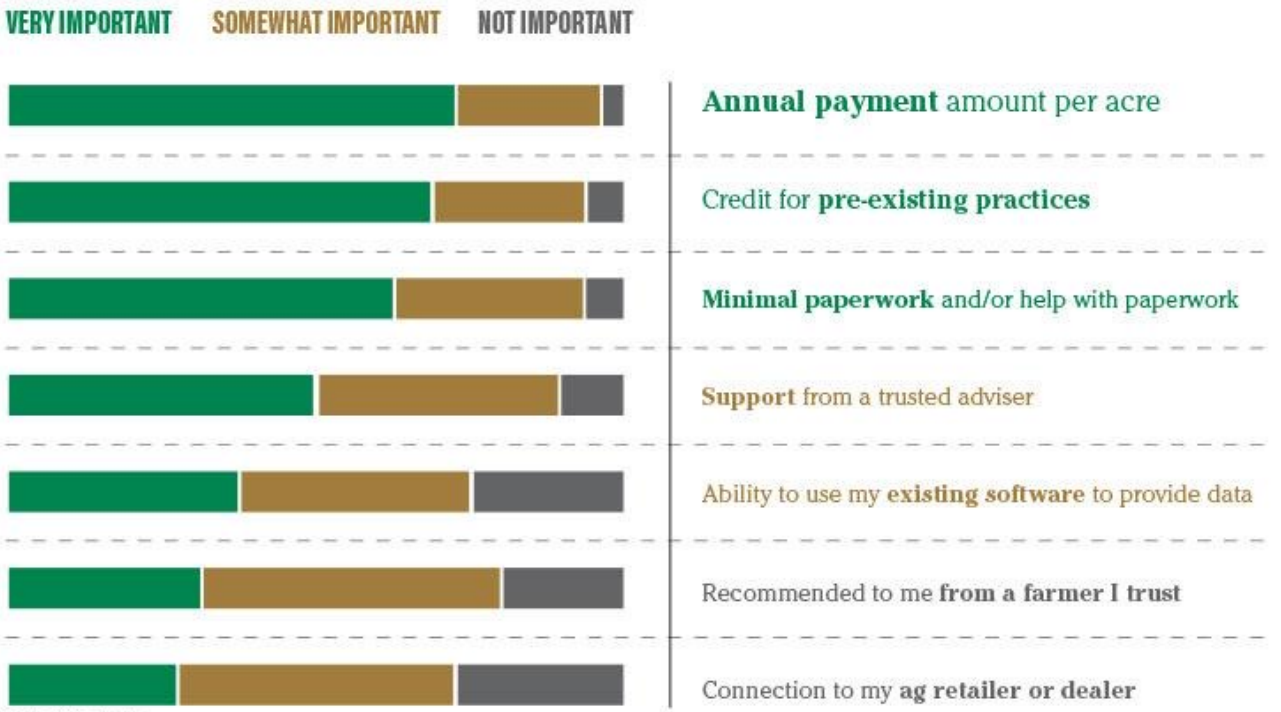
90% are aware of C markets

3% currently participating

59% won't participate without changes

500 FARMER INSIGHTS

How important are the following criteria to you in evaluating what carbon market you might choose to participate in?



SOURCE: TRUST IN FOOD

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“The trouble the enthusiasm about high technical potentials of soils to remove carbon is that these potentials are going to be constrained by social factors, including whether farmers want to change what they do day-to-day to offer a sink for the world’s emissions.”

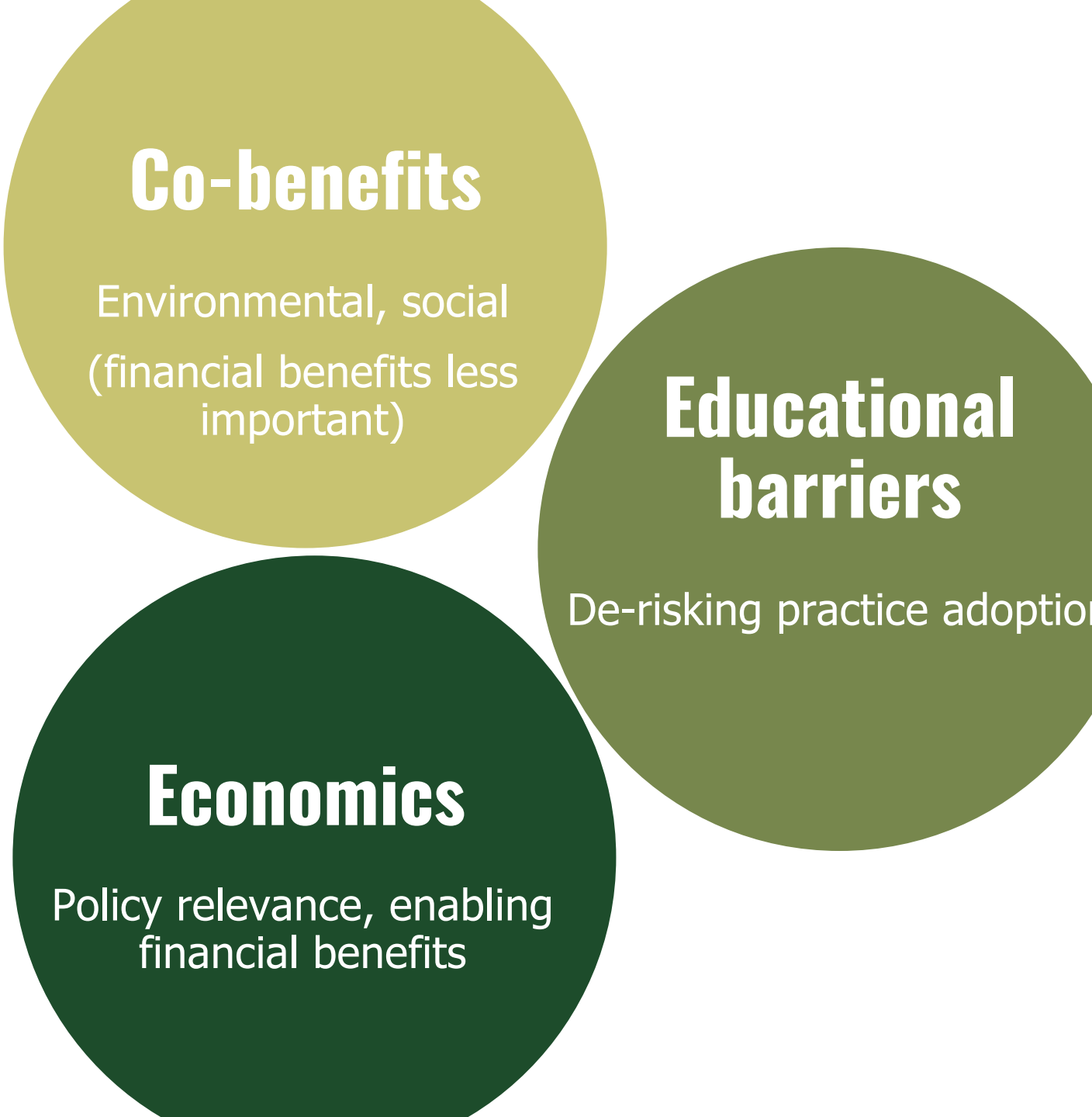
Buck and Palumbo-Compton 2022

Here is a subtitle

Producer considerations

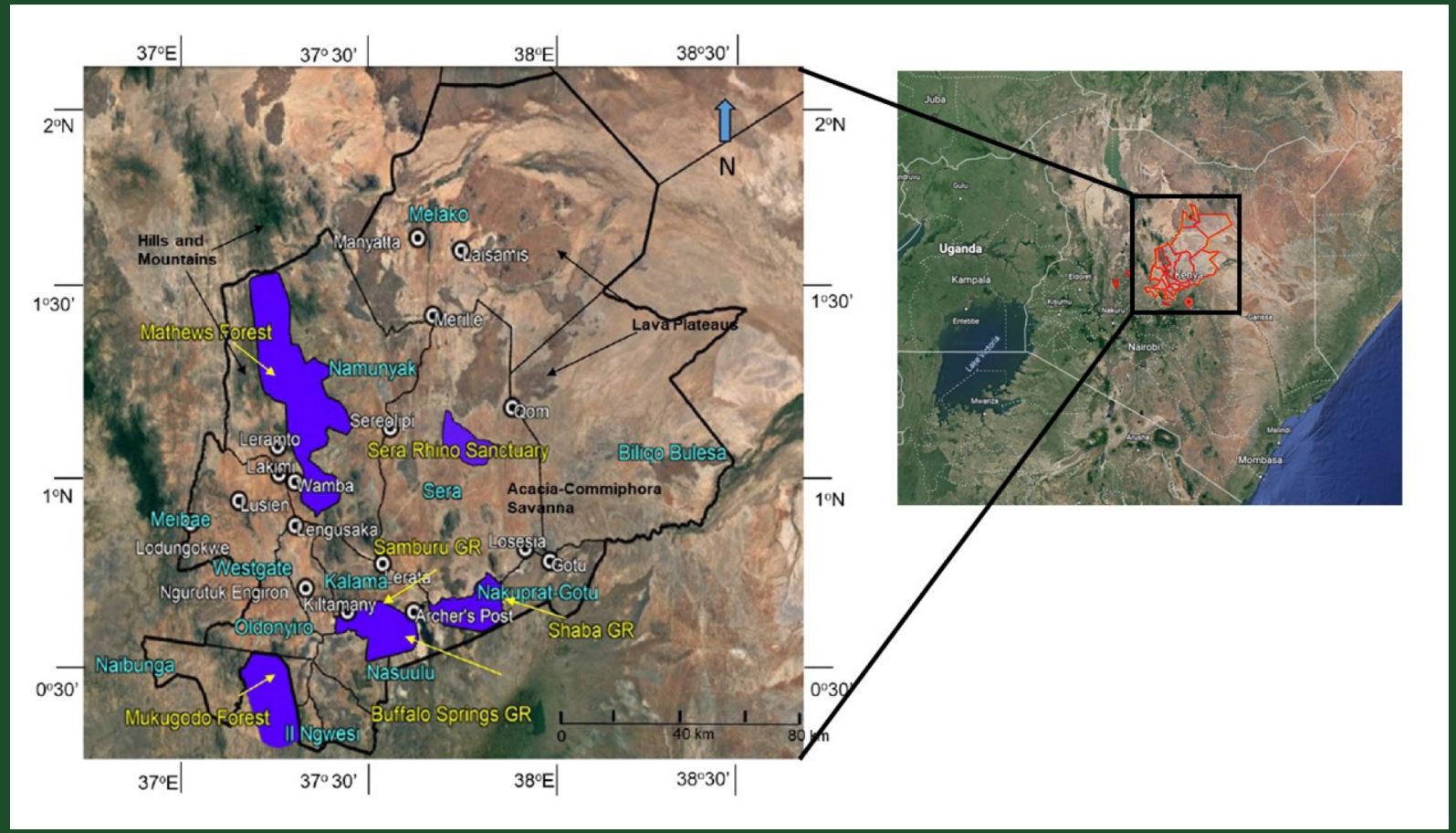
Transitioning to regenerative agriculture isn't just about climate-smart practices that are adopted via education, innovation, and policy support. Rather, "it involves subjective, nonmaterial factors associated with culture, values, ethics, identity, and emotion that operate at individual, household, and community scales and interact with regional, national, and global processes."

Gosnell et al. 2019



What if we do this poorly?

Northern Kenya Grassland Carbon Project



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Blood Carbon: how a carbon offset scheme makes millions from Indigenous land in Northern Kenya
https://assets.survivalinternational.org/documents/2466/Blood_Carbon_Report.pdf

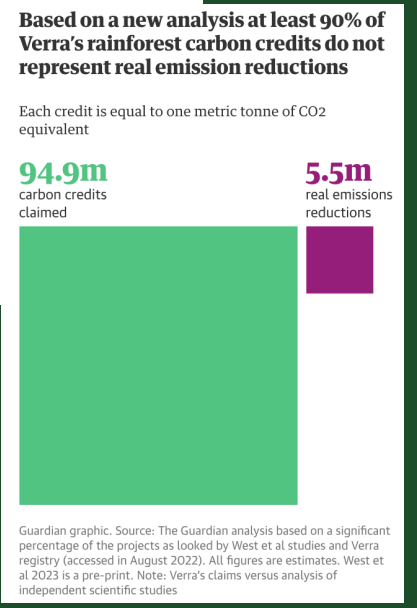
What if we do this poorly?

Lessons from forestry

Revealed: more than 90% of rainforest carbon offsets by biggest certifier are worthless, analysis shows

Investigation into Verra carbon standard finds most are 'phantom credits' and may worsen global heating

Guardian reporting



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What if we do this poorly?

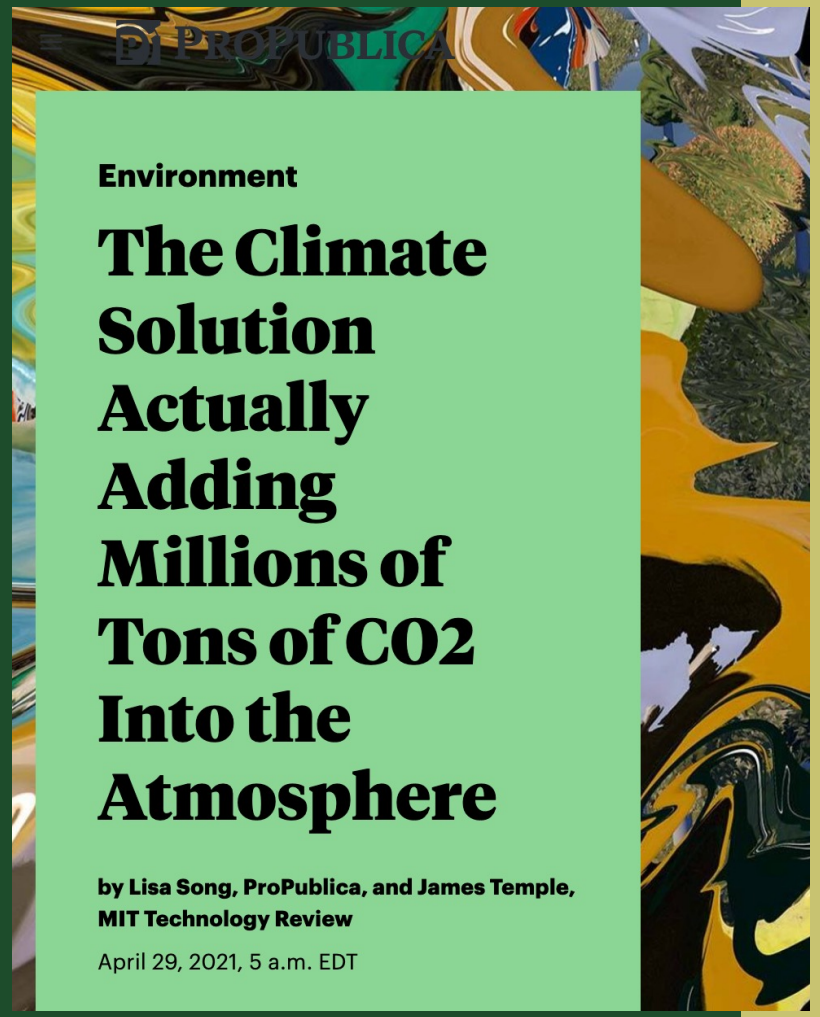
Lessons from forestry

OVER-CREDITING PERCENT	OVER-CREDITING VALUE
29.4% (20.1-37.8%)	$410M ($280-528M)

ANALYZED CREDITS	OVER-CREDITING	CREDIT VALUE
102M	30M (20-39M)	$13.67

FIGURE 1 / Summary of results from our analysis of crediting error, in terms of net over-crediting, percentage relative to the projects we analyzed, and value in dollars assuming a credit value of $13.67. Each credit represents 1 tCO_2e. Ranges report 5th and 95th percentiles of a bootstrapped distribution forming a 90% confidence interval.

Carbon Plan
Badgley et al. 2021



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Are Carbon Offsets the Labradoodle of Climate Solutions?

“It’s too easy to do it wrong,” says Mark Trexler, who helped create the first carbon offset project, on the latest episode of *Zero*.

https://www.bloomberg.com/news/articles/2022-12-01/are-carbon-offsets-the-labradoodle-of-climate-solutions#xj4y7vzkg

What if we get this right?

Vision for regeneration and a just ag system

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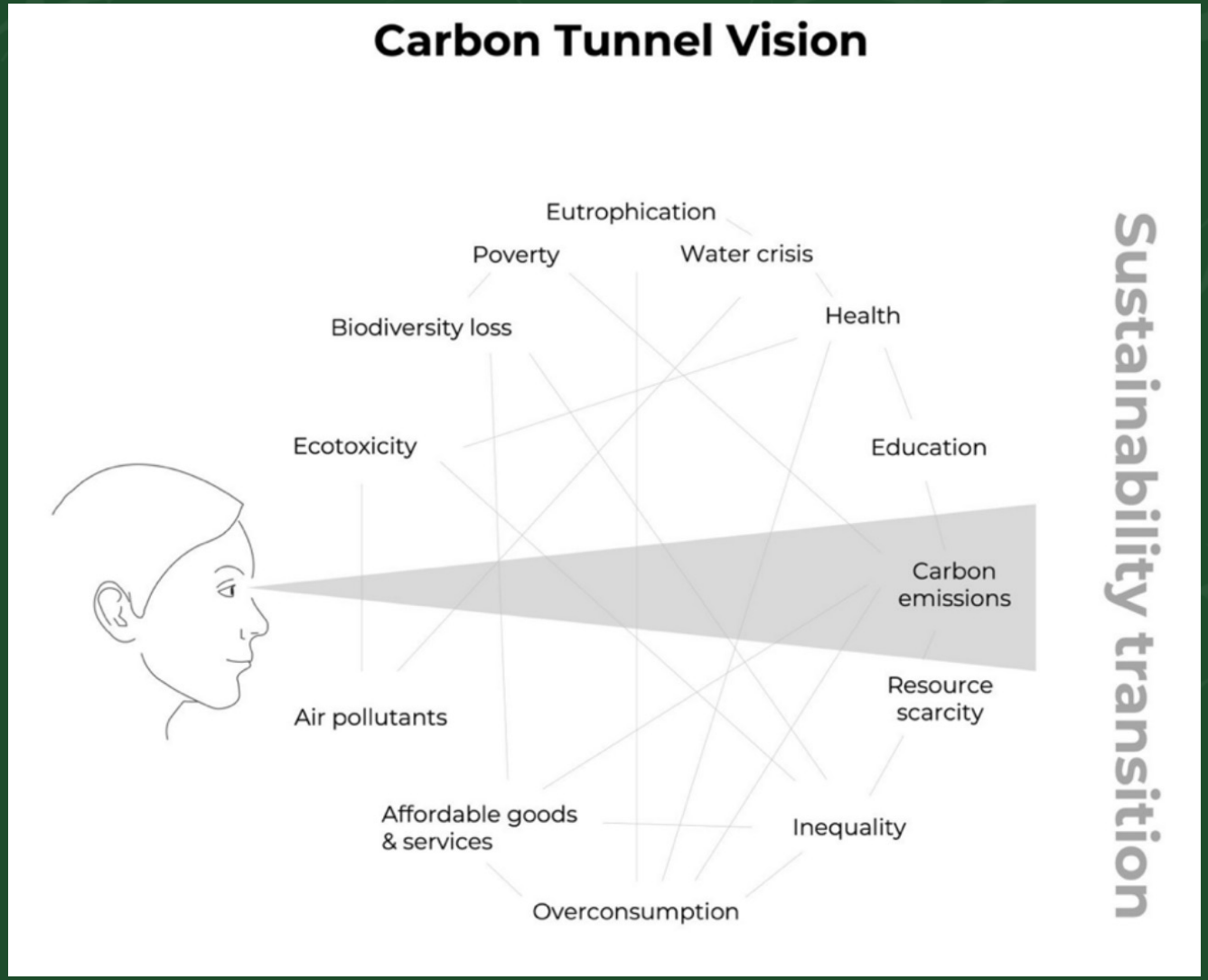
Its not just about the carbon



https://www.sei.org/perspectives/move-beyond-carbon-tunnel-vision/

A justice framework

What would embedding justice principles entail?

Procedural justice = fairness in decision making

Distributive Justice = equitable allocation of risks, benefits, and impacts

Reparative Justice = regressing past harms

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Here is a subtitle

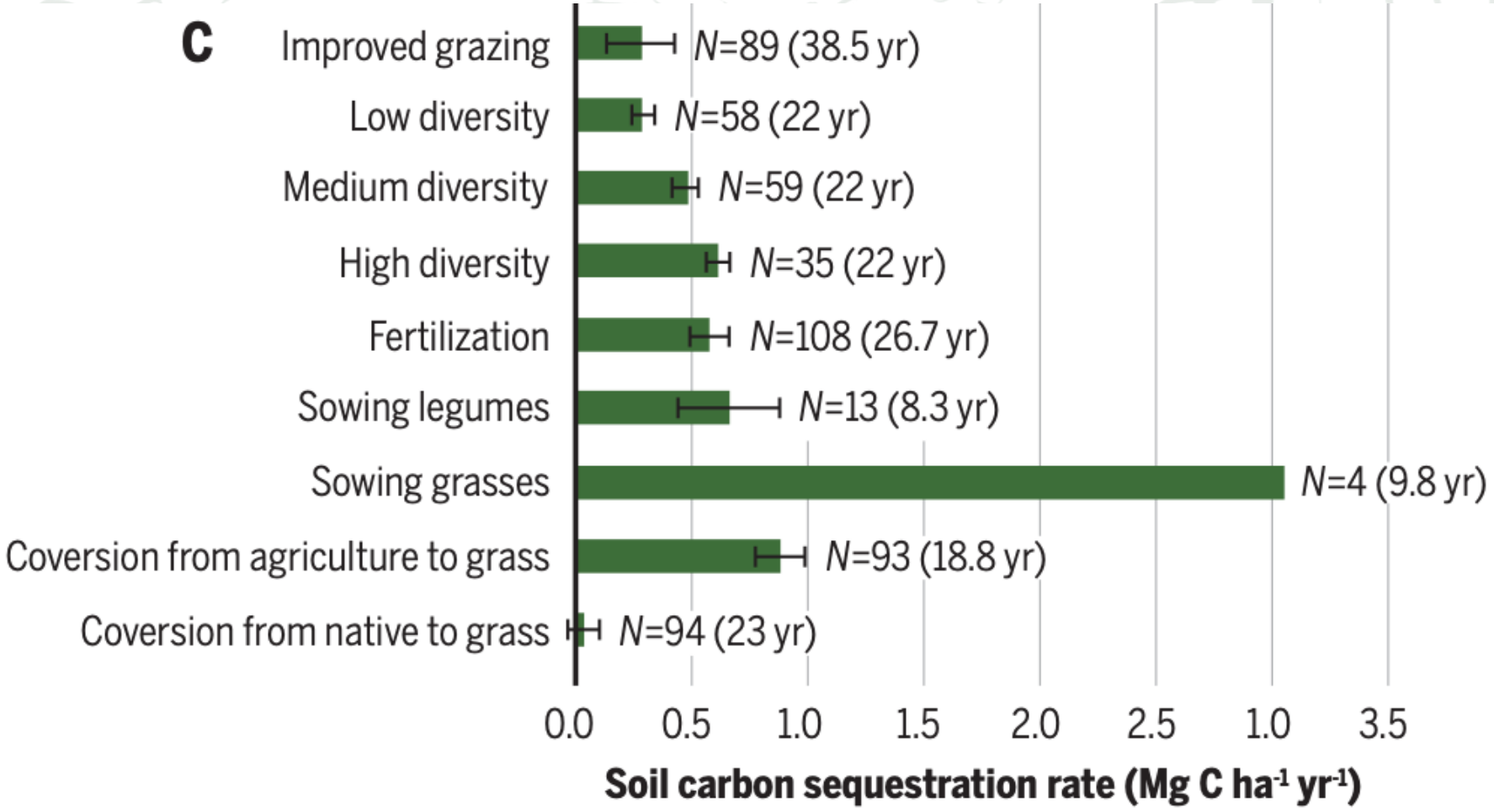
Scaling soil carbon justly

"*When we talk about environmentally just CDR technologies, we have to make sure that we are thinking about everything and everyone that goes into the project. This includes, but is not limited to: the people, policies, processes, communication, transparency, impacts (environmental, health, economic, and more), and decision-making.*"

--- Jasmine Davenport

From the Ground Up: Recommendations for Building an Environmentally Just Carbon Removal Industry

Where we can shift management practices



Bai and Cotrufo 2022

Soil solutions with impact

How to make this moment count

01.

A focus on producers and regenerative production systems

02.

Create incentives that are fostering just outcomes and solving actual problems

03.

Scientific rigor to ensure climate benefits are real

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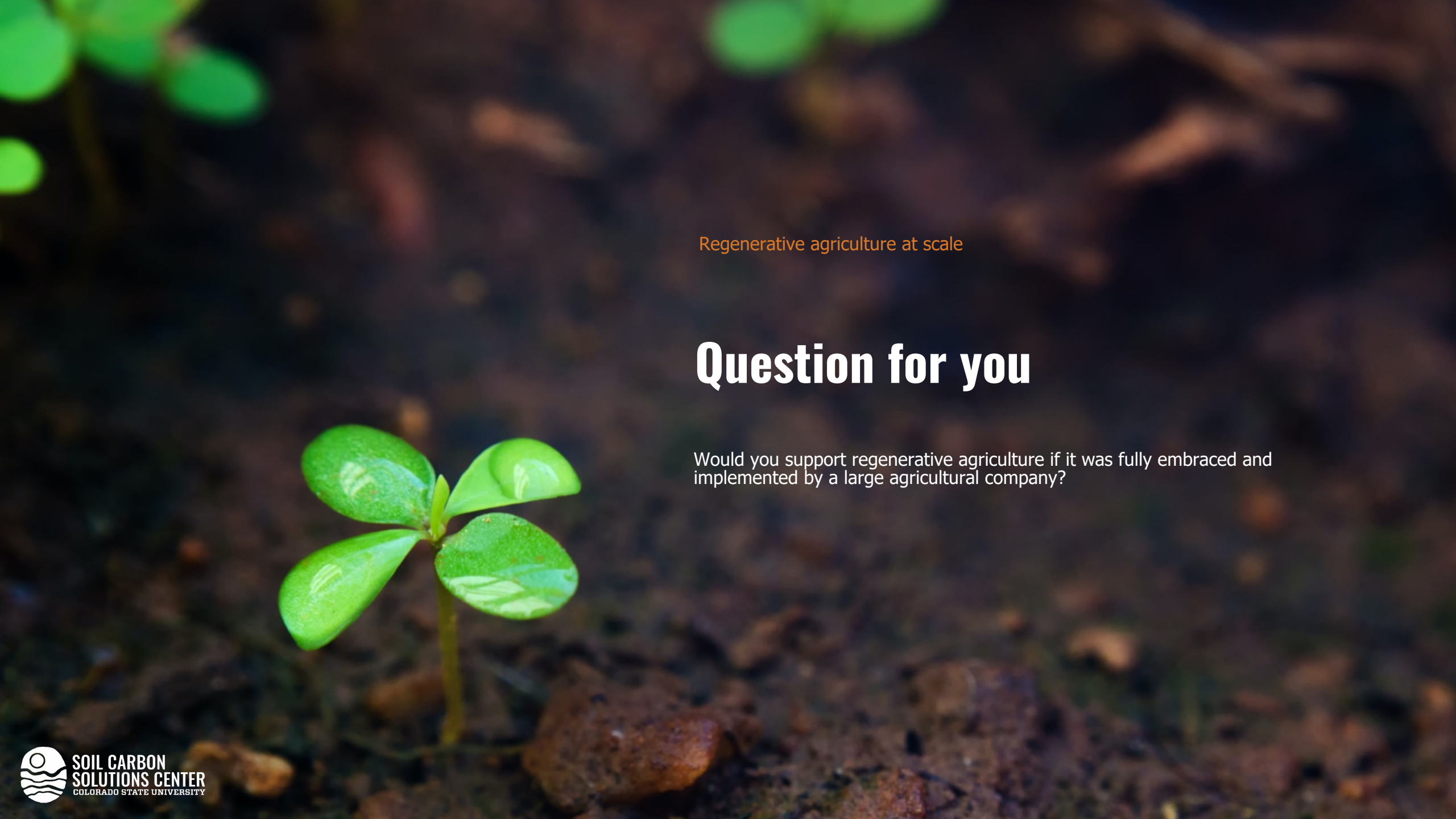
Anything that makes regenerative practices more profitable, easier, and socially acceptable will lead to climate positive outcomes.



Regenerative agriculture at scale

Question for you

Would you support regenerative agriculture if it was fully embraced and implemented by a large agricultural company?

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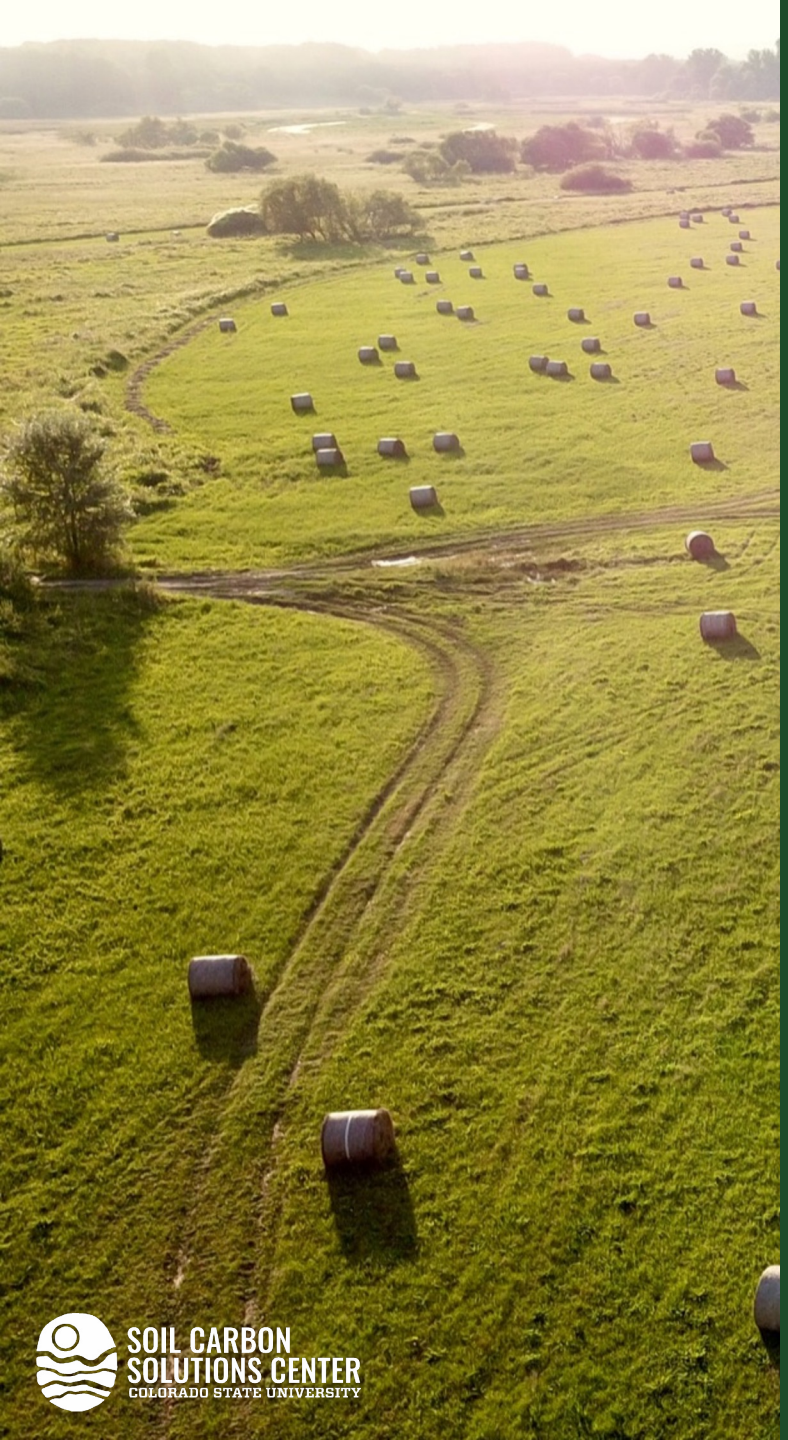

Let's keep the conversation going...

Thank you

jane.zelikova@colostate.edu

https://www.soilcarbonsolutionscenter.com

Instagram @soilcarbon_csu

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CSU's Soil Carbon Solutions Center leverages world-class expertise to **build** the tools needed to **accelerate** the deployment of credible soil-based climate solutions, **measure** their impact, and bring them to **scale**.

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Soil Carbon Solutions Center

Interdisciplinary research

Soil Ecology
Biogeochemistry
Energy Sector
Engineering
Crop genetics
Climate Science

Economics
Extension and outreach
Business development
Humanities
Policy
IT/Tech development

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Unlocking the potential of soil for a more sustainable planet

Our work

Research

Tools

Implementation

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