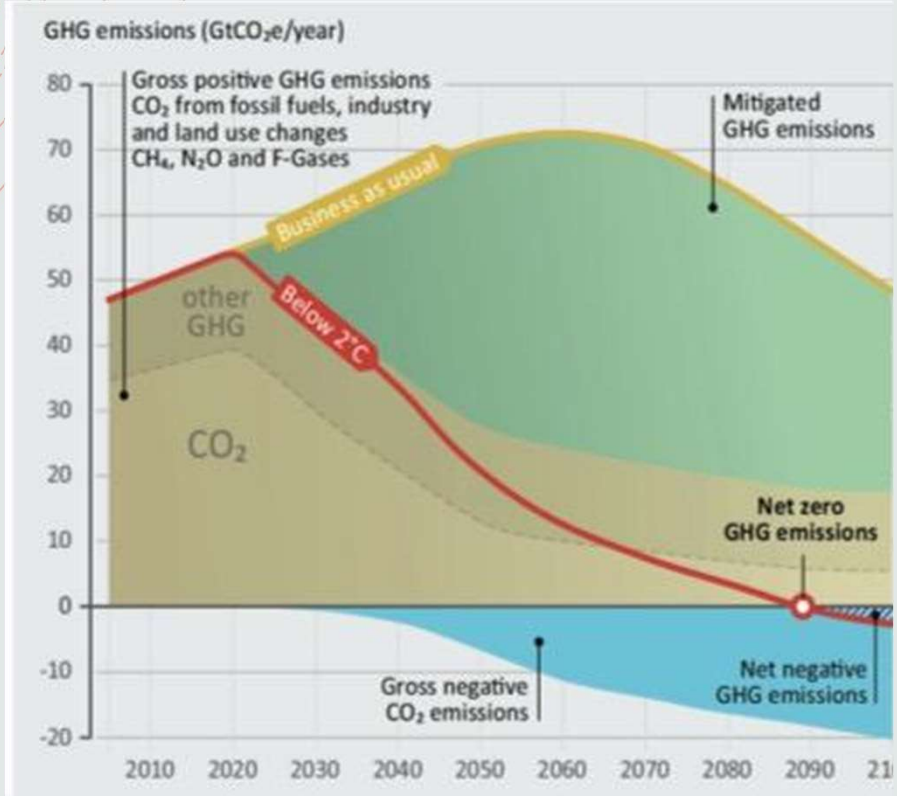
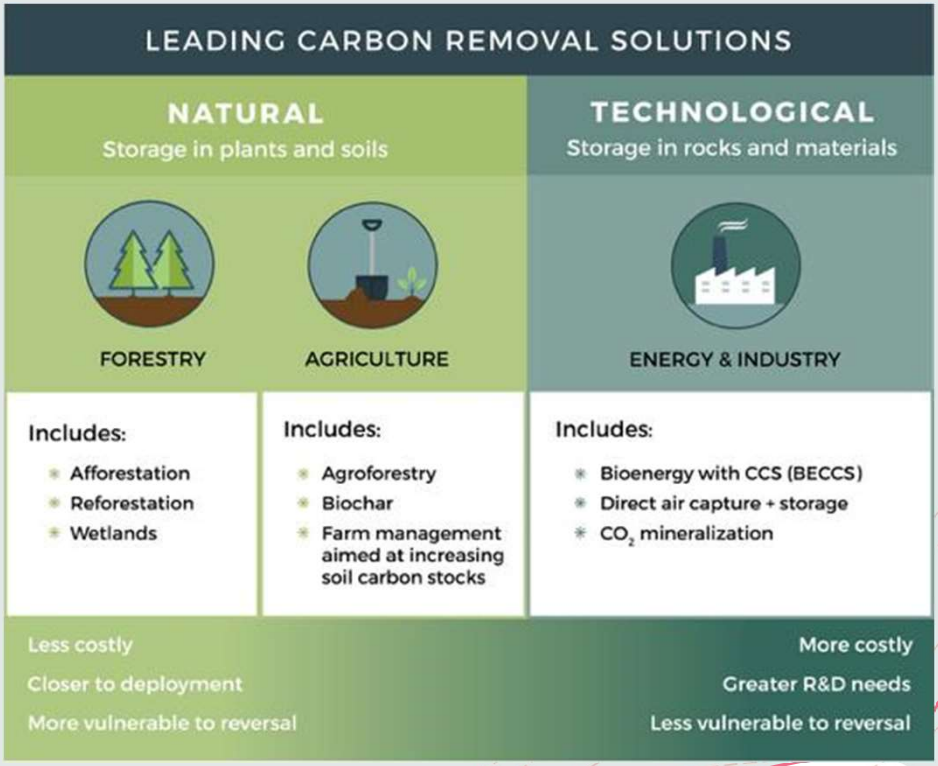
Regenerative Agriculture

Soil Health in Colorado

Max Neumeyer and Helen D. Silver
Colorado Collaborative for Healthy Soils

Regenerative Agriculture as Carbon Removal





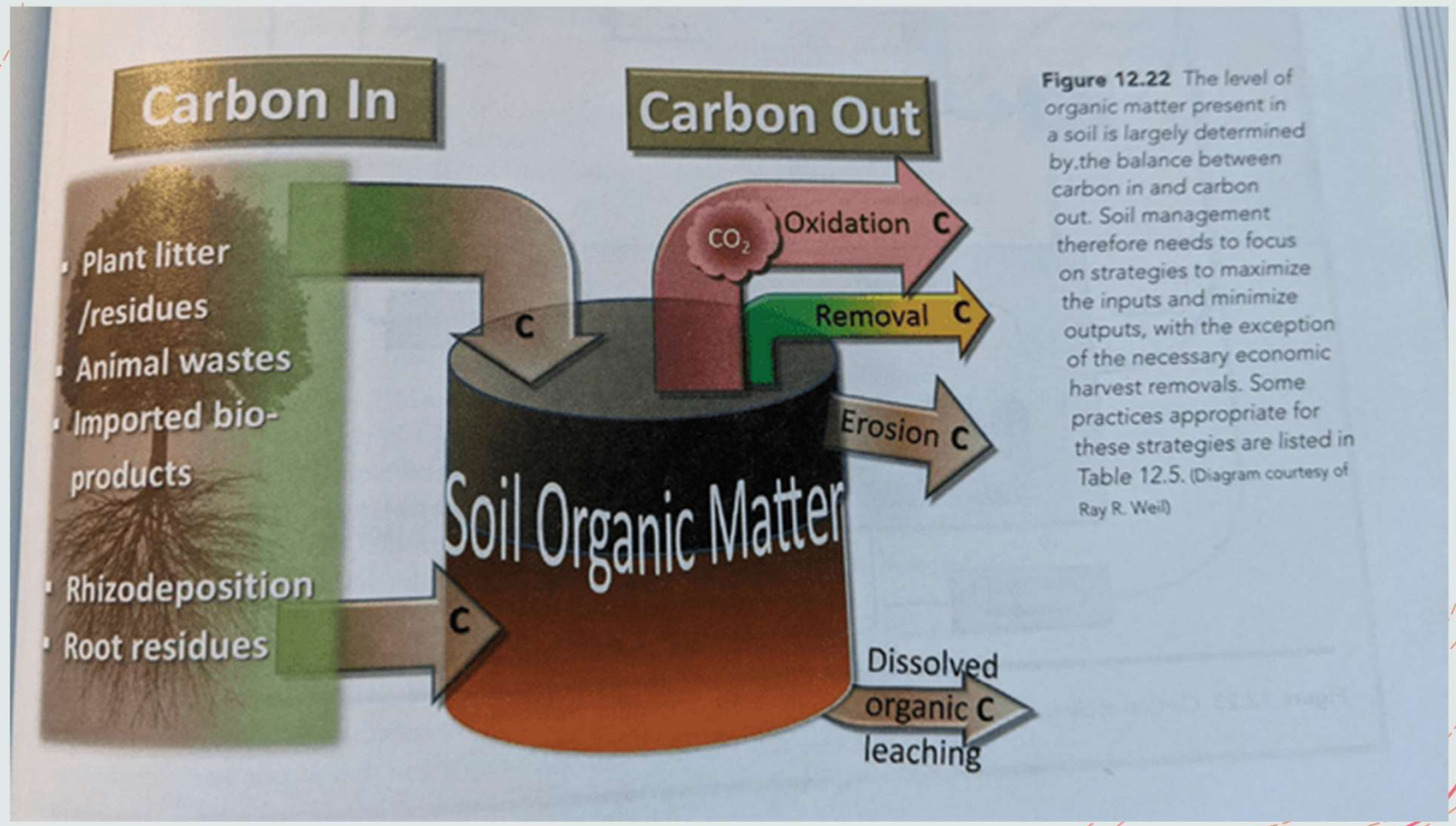
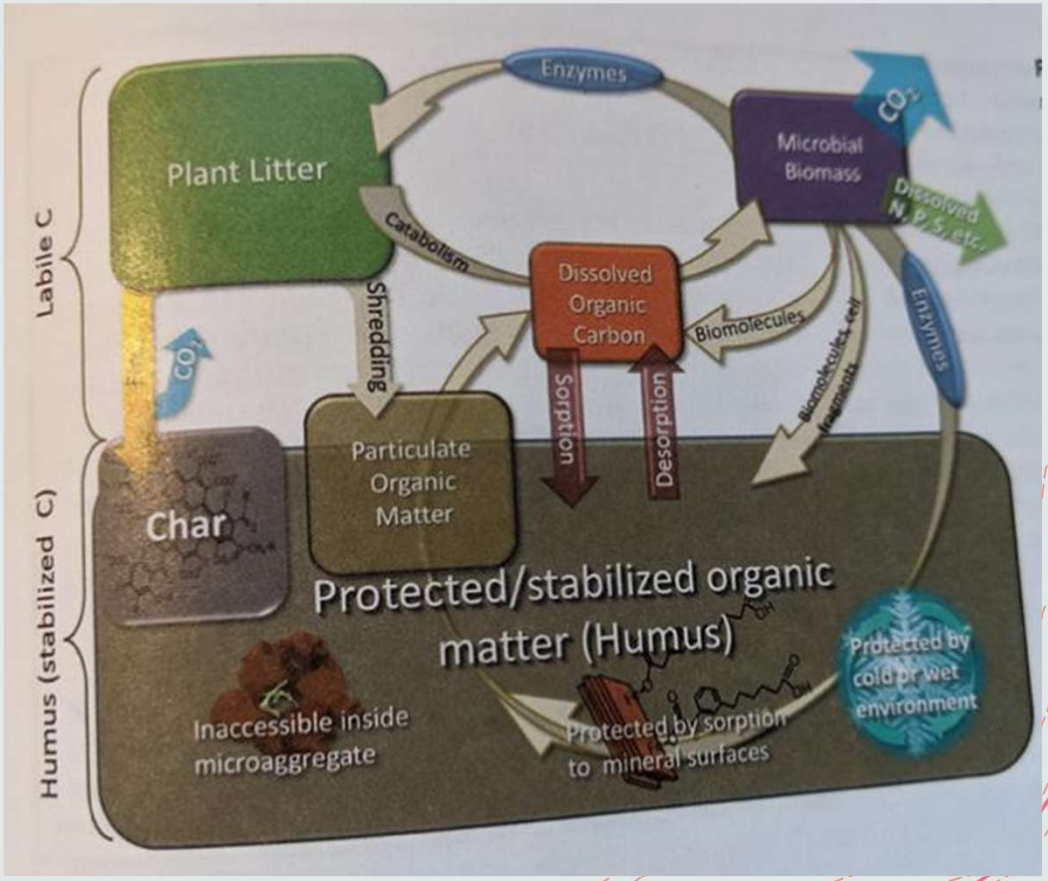


Figure 12.22 The level of organic matter present in a soil is largely determined by the balance between carbon in and carbon out. Soil management therefore needs to focus on strategies to maximize the inputs and minimize outputs, with the exception of the necessary economic harvest removals. Some practices appropriate for these strategies are listed in Table 12.5. (Diagram courtesy of Ray R. Weil)

C-Sequestration

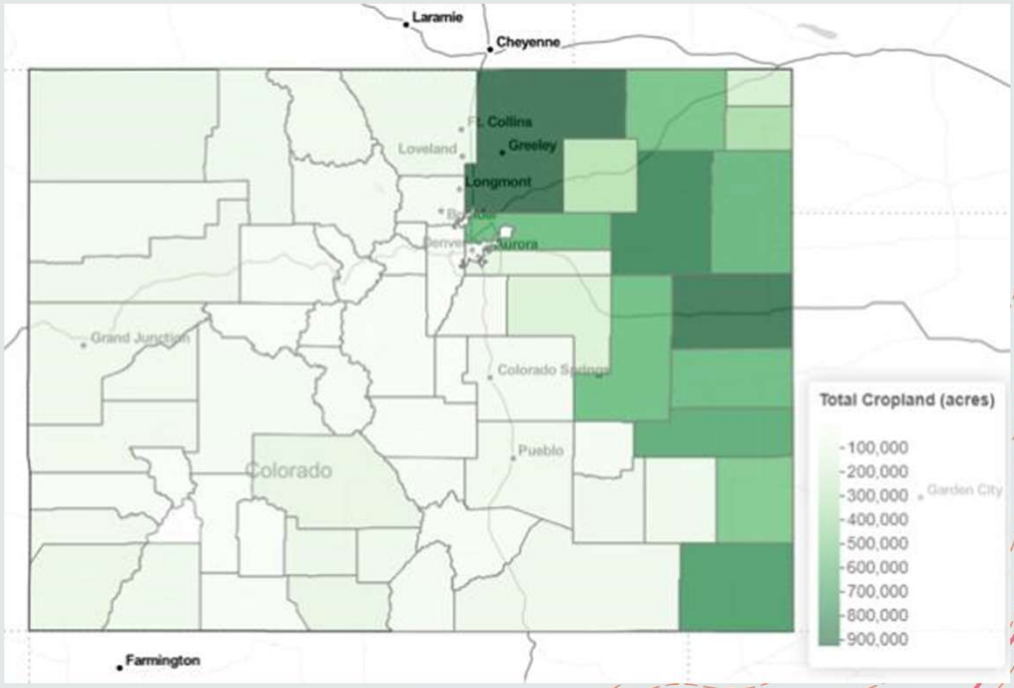
+ Water, time, and soil texture are dominant factors

+ Depending on system, C-seq can be very low:
  + Maybe only between 10 and 30% of the inputs
  + Why it can take years for detectable C level changes



CaRPE Tool

- Created by American Farmland Trust in partnership with USDA
- Estimates C-seq potential by combining data from COMET and USDA Ag Census 2017
- If one practice adopted by all cropland across state = 2.9M metric tons

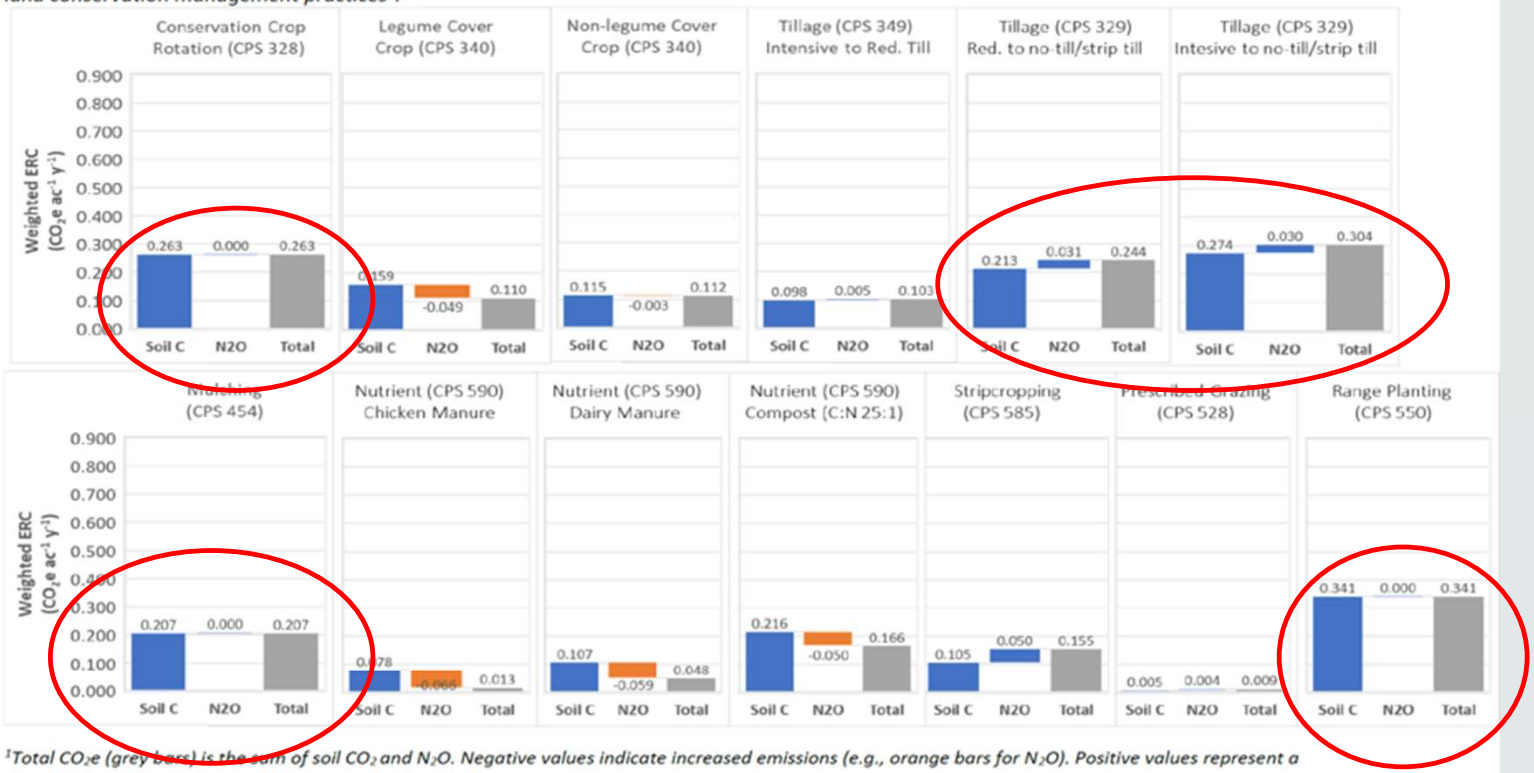


Cropland acres for each county across Colorado created using the Carbon Reduction Potential Evaluation Tool (CaRPE Tool™) with 2017 AgCensus data.

Table 2. Soil CO_2, soil N_2O, and total CO_2e reduction potential (tonnes CO_2e y^{-1}) for Colorado based on all cropland or grazing land implementing example conservation practices (i.e., 100% adoption with assumptions for current adoption levels noted where appropriate)[1].

Conservation Practice Implementation	Soil C	Soil N_2O	Total
	(tonnes CO_2e yr^{-1})		
Mulching (CPS 484)			
Add mulch to cropland	2,289,657	0	2,289,657
Conservation Crop Rotation (CPS 328)			
Decrease fallow frequency or add perennial crops to rotations	2,911,331	1,628	2,912,959
Cover Crop (CPS 340)[2]			
Add legume cover crop with 50% N fertilizer reduction (assumes acres currently in cover crop were planted to a legume cover crop)	1,518,525	-466,562	1,051,963
Add non-legume cover crop with 25% N fertilizer reduction (assumes acres currently in cover crop were planted to a non-legume cover crop)	1,098,024	-32,051	1,065,974
Nutrient Management (CPS 590)			
Replace 20% synthetic N over a 5-yr period with compost (C:N = 25)	2,387,432	-554,873	1,832,559
Replace 20% synthetic N over a 5-yr period with beef feedlot manure	1,188,085	-658,211	529,874
Replace 20% synthetic N over a 5-yr period with dairy manure	1,187,112	-657,656	529,456
Replace 20% synthetic N over a 5-yr period with chicken broiler manure	871,692	-729,825	141,867
Residue & Tillage (CPS 329 and 345)[3]			
Intensive or reduced tillage (CPS 329) to no-tillage (assumes acres currently in no-till started in intensive till, converts current acres in reduced or intensive till to no-till)	1,187,425	129,247	2,223,146
Intensive tillage to reduced tillage (CPS 345) (assumes acres currently in no-till started in intensive till, converts current acres in intensive till to reduced till; current reduced till acres remain as is and are included)	141,372	6,672	1,297,366
Stripcropping (CPS 585)			
Add perennial cover grown in strips to annual crops	1,163,817	548,543	1,712,360
Prescribed Grazing (CPS 528)			
Replace extensive pasture management with intensively managed grazing	93,482	81,818	175,301
Range Planting (CPS 550)			
Seeding forages to improve rangeland condition	6,412,274	0	6,412,274

Figure 3. State-weighted emission reduction coefficients (ERC) for soil CO_2, soil N_2O, and total CO_2e (tonnes CO_2e ac^{-1} y^{-1}) for cropland and grazing land conservation management practices[1].



[1]*Total CO_2e (grey bars) is the sum of soil CO_2 and N_2O. Negative values indicate increased emissions (e.g., orange bars for N_2O). Positive values represent a decrease in GHG emissions and/or increased soil carbon sequestration.*

Scenario Example

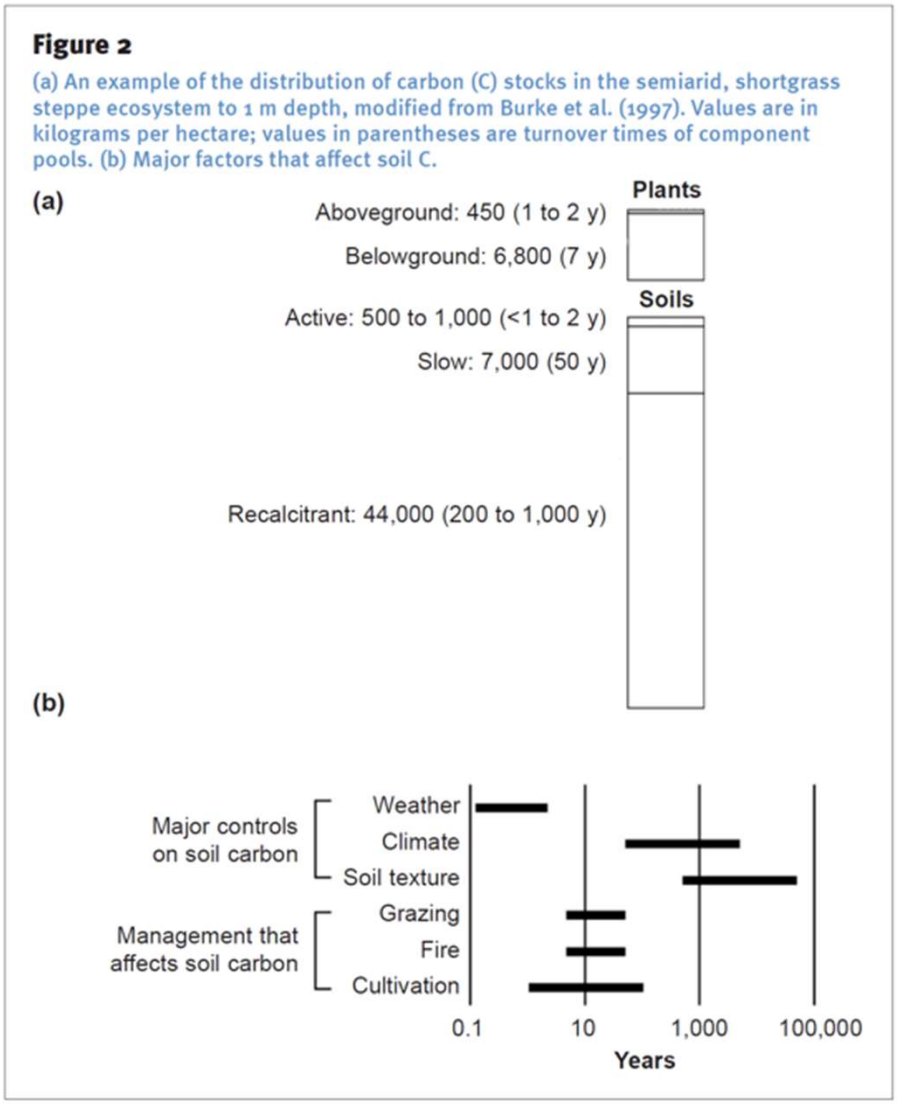
Colorado grazing land acres and percent adoption of 2 conservation practices with estimated CO_2e reduction potential resulting from state-wide implementation.

Practice	Scenario acres	% of Selected Acres	CO_2e (tonnes y^{-1})
Prescribed grazing	9,395,624	50	75,745
Range planting (low)	2,818,687	15	968,824
Range planting (high)	5,637,374	30	1,937,647
Total Low Scenario	**12,214,311**	**N/A**	**1,044,569**
Total High Scenario	**15,032,998**	**N/A**	**2,013,392**

Low to high-levels of adoption represent 1.0 to 2.0 M CO2e tonnes y^{-1}

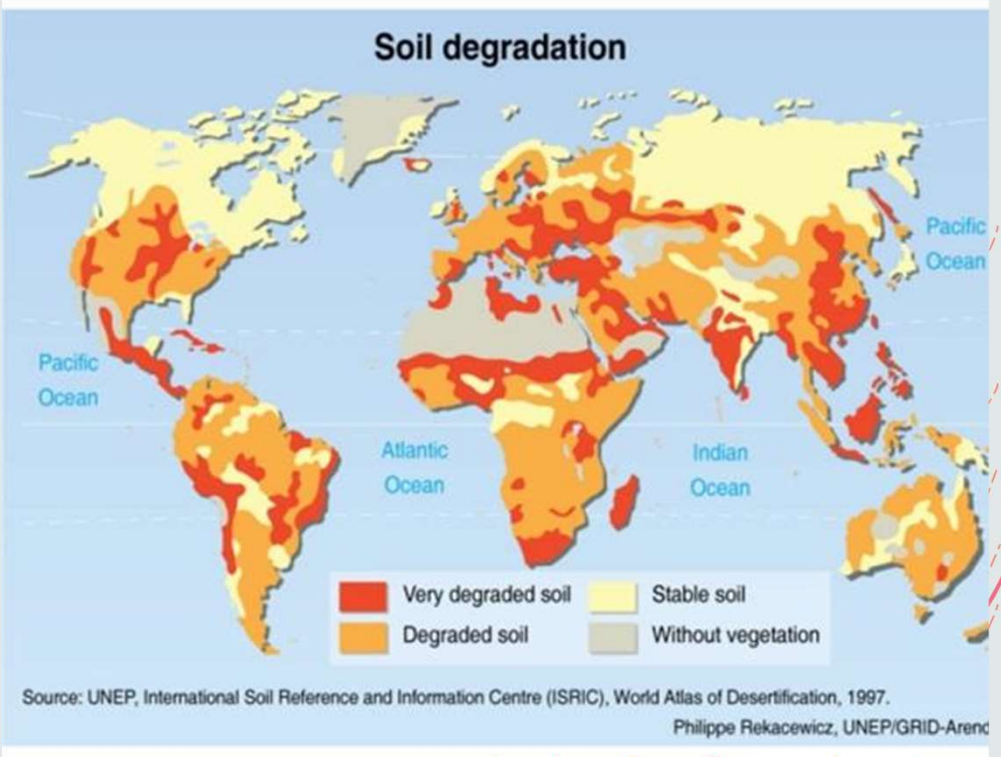
Prairies

- E. CO & Midwest
- Short-term dominant factors: Weather and cultivation; grazing has some impact
- Long-term dominant factors: Soil texture and climate
- Best ways to sequester C: 1) conserve land; 2) revegetate; and 3) adaptive management grazing



Global Soil Degradation

- >75% of Earth's land is degraded and potential for 90% by 2050
- Soils have lost 50-70% of original carbon stock
- Plowed agricultural lands lose 6 tons/acre/year
  - >5x the natural regeneration rate (in some areas)
- CO: Significant improvement ~7.75 t/acre/year compared to about 13 in 1982



Regenerative Ag and UN Sustainability Goals

Goal 1: No poverty
Goal 2: Zero hunger
Goal 3: Good health and wellbeing
Goal 4: Quality education
Goal 5: Gender equality
Goal 6: Clean water and sanitation
Goal 7: Affordable and clean energy
Goal 8: Decent work and economic growth
Goal 9: Industry, innovation, and infrastructure
Goal 10: Reduced inequalities
Goal 11: Sustainable cities and communities
Goal 12: Responsible consumption and production
Goal 13: Climate action
Goal 14: Life below water
Goal 15: Life on land
Goal 16: Peace, justice, and strong institutions
Goal 17: Partnerships for the goals

Benefits of regenerative agriculture

Builds soil fertility

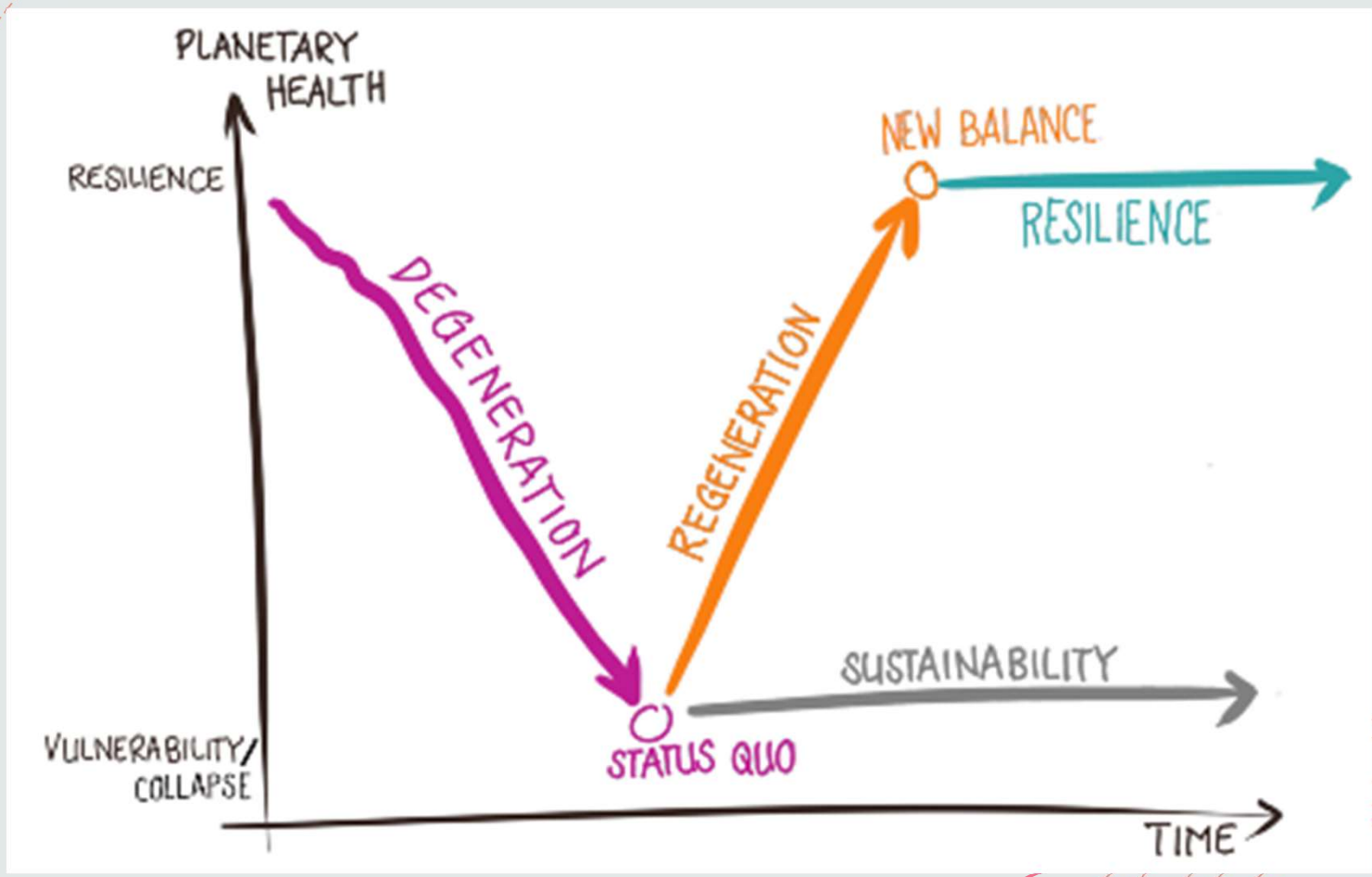
Enhances farmer profitability

Improves the water cycle

Carbon sequestration

Increases biodiversity and resilience

Regenerative?



Soil health principles

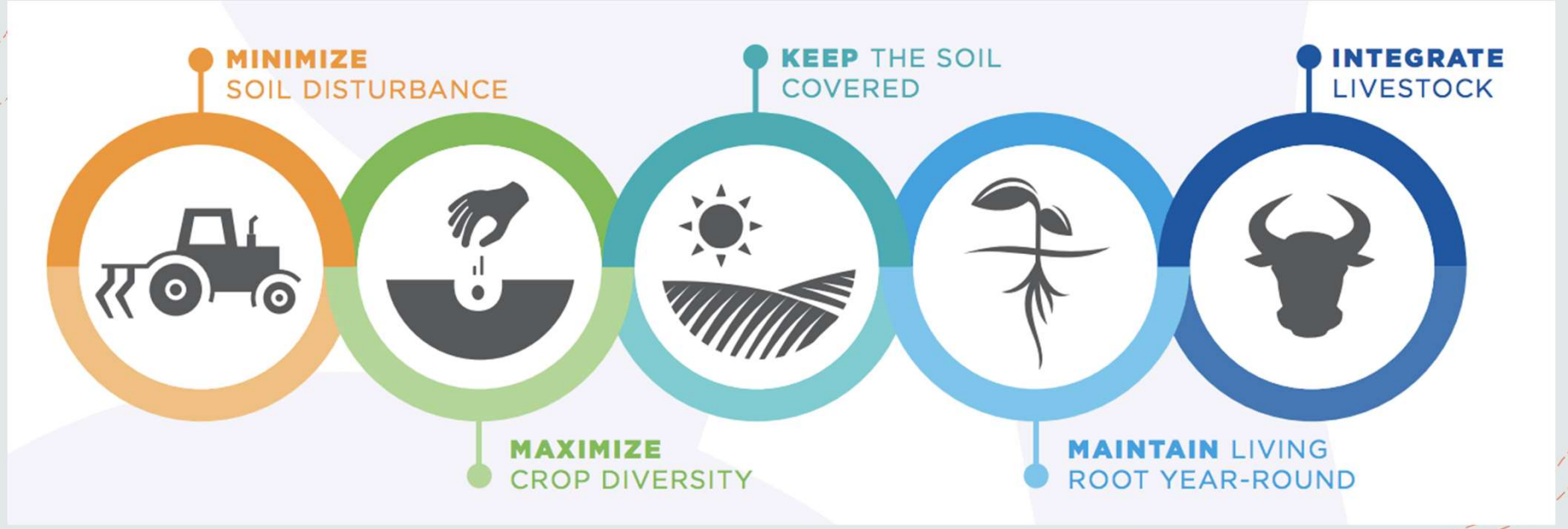
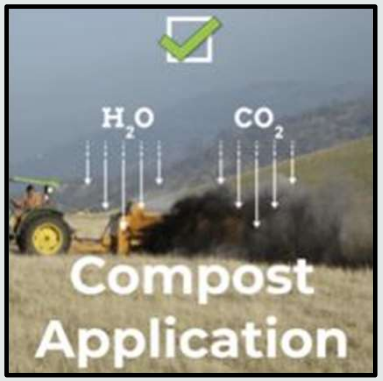
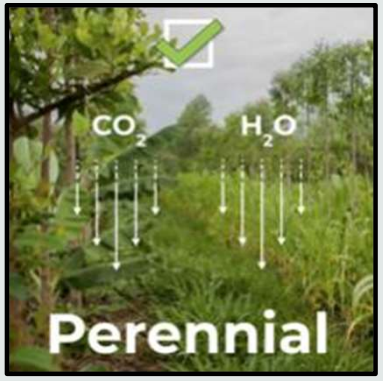
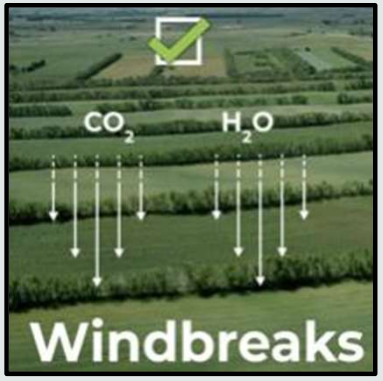


Image Credit: *General Mills Regenerative Agriculture Self Assessment*

Soil health practices







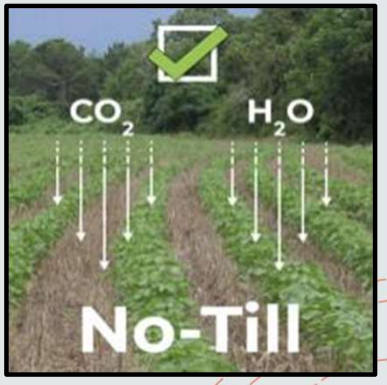


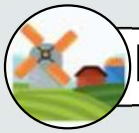
Image Credit: Kiss The Ground

What does a regenerative farm look like?

Obstacles to implementation

Upfront costs, long-term benefits

Lack of a revenue premium for regenerative goods



Farmers that rent land don't benefit from investments in soil

Increased profits, but reduced yields (?)

Access to financing, tools and equipment

Awareness and difficulty of change

COLORADO COLLABORATIVE FOR HEALTHY SOILS

"If you want to go fast, go alone. If you want to go far, go together."

CCHS: A Bottom up, Big Tent Community Effort

STORMING

- "Make sure to get all the right people in the room"
- No mandates or new regulations
- Producer-centered not producer-led

NORMING

- Decided on core principles to guide work
- Launched working groups and coordination team
- Held listening sessions across the state

FORMING

- Created a proposal for a soil health initiative that was approved by the group
- Draft bill language for introduction in January 2021
- Submitted grant applications to fund a pilot program

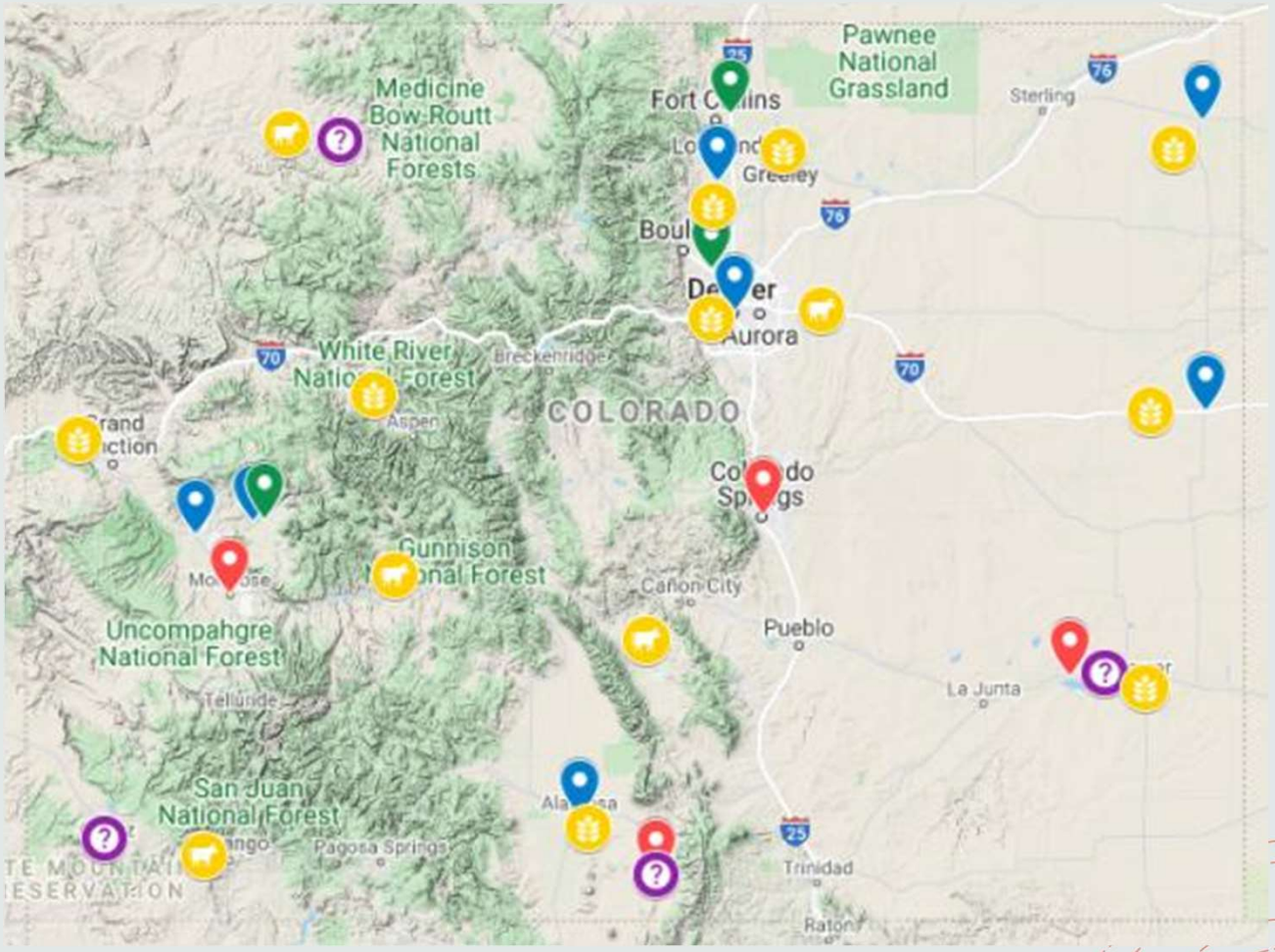
CCHS Core Principles

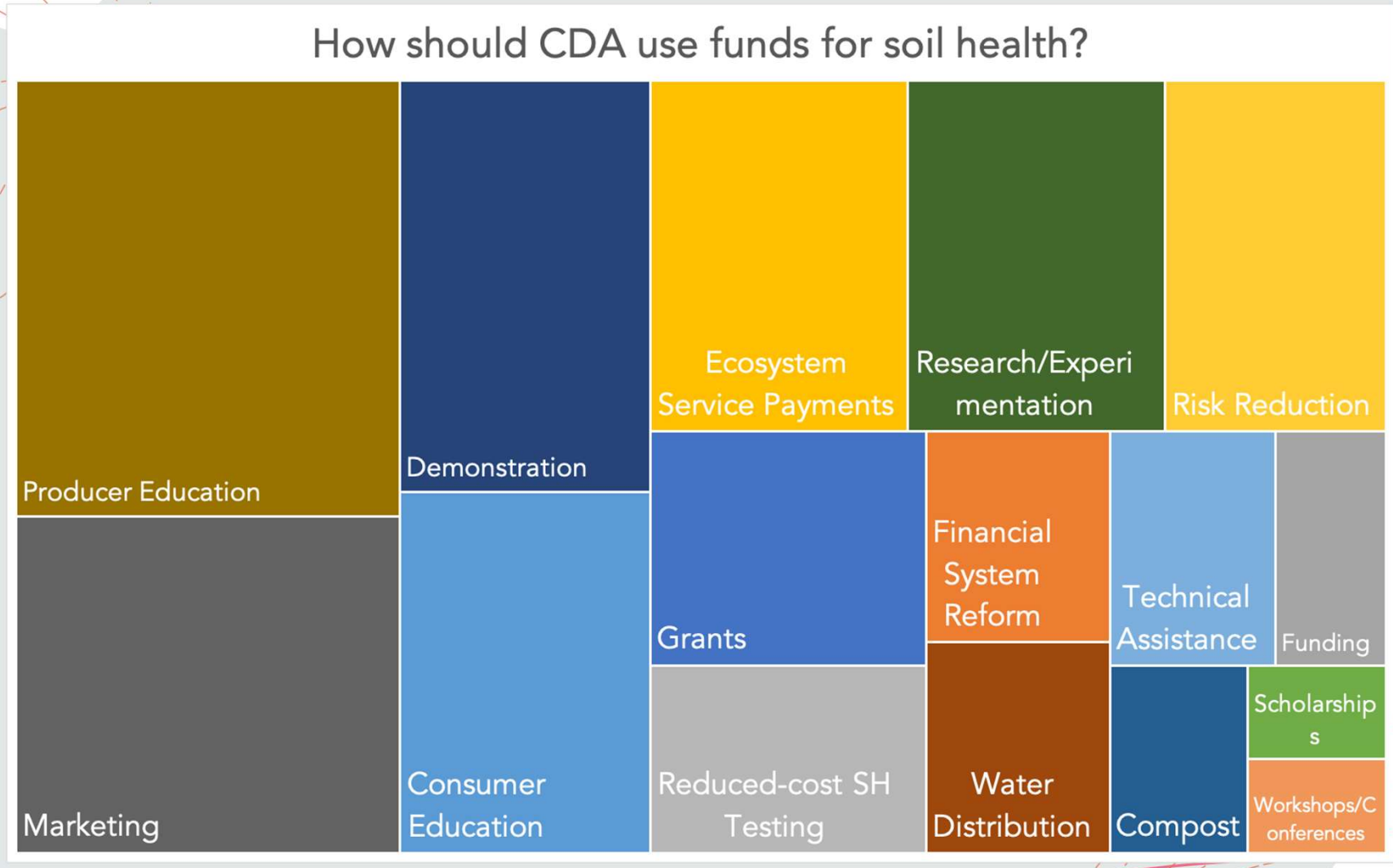
- Producer-centered
- Science-based
- Participatory
- Action-oriented
- Will only pursue policies and programs that are voluntary and incentive-based

PHOTO CREDIT: Jane Cavagnero | Mad Agriculture

CCHS: A Bottom up, Big Tent Community Effort

Stakeholder Engagement




How should CDA use funds for soil health?
Producer Education
Demonstration
Ecosystem Service Payments
Research/Experimentation
Risk Reduction
Marketing
Consumer Education
Grants
Financial System Reform
Technical Assistance
Funding
Reduced-cost SH Testing
Water Distribution
Compost
Scholarships
Workshops/Conferences

Proposal for a Soil Health Initiative

1. Soil Health Grant Program
2. Increased Capacity for NRCS and CDA
3. Soil Health Partnership and STAR Program
4. Reduced Cost Soil Health Testing
5. Soil Health Inventory

Soil Health Bill

A BILL FOR AN ACT

CONCERNING THE CREATION OF A VOLUNTARY SOIL HEALTH PROGRAM.

Bill Summary

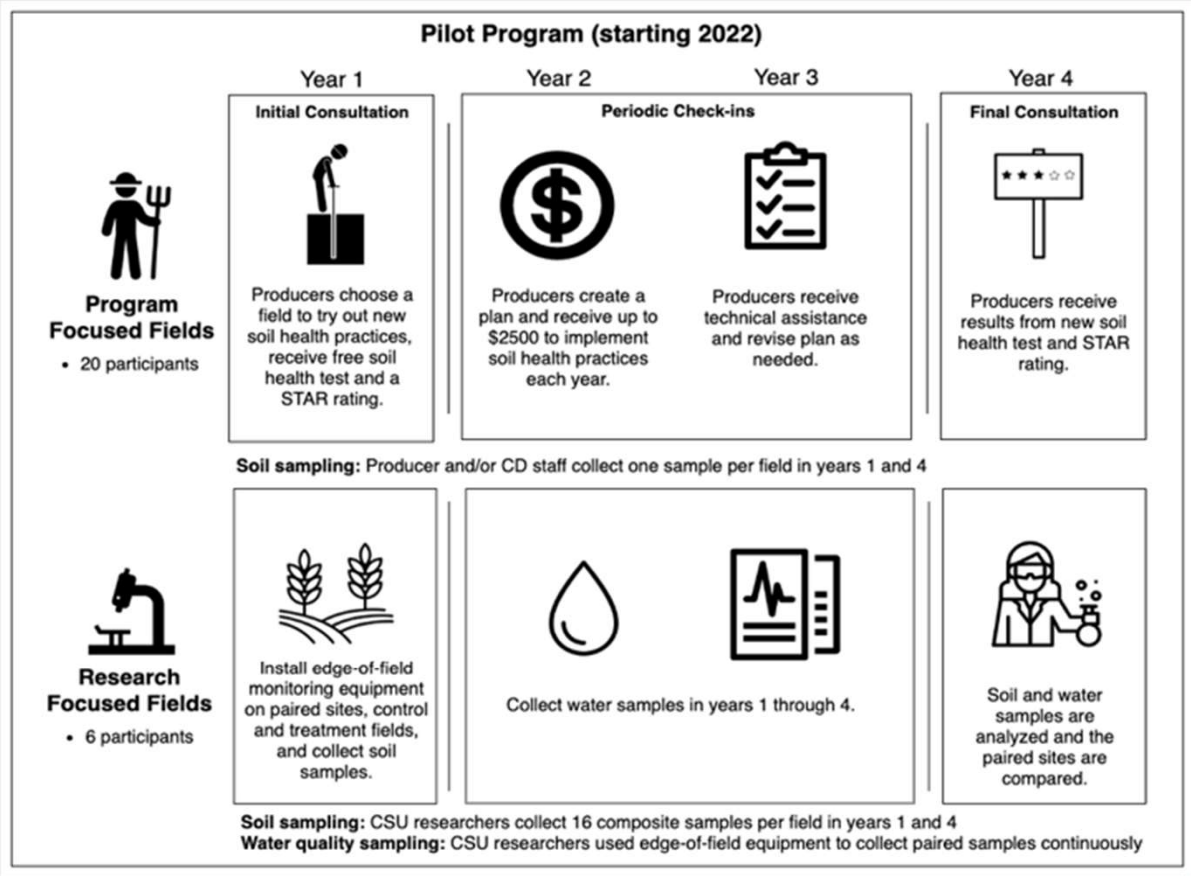
(Note: This summary applies to this bill as introduced and does not reflect any amendments that may be subsequently adopted. If this bill passes third reading in the house of introduction, a bill summary that applies to the reengrossed version of this bill will be available at http://leg.colorado.gov.)

The bill creates the Colorado soil health program in the department of agriculture (department). The soil health program is voluntary. The department, commissioner of agriculture (commissioner), and state agricultural commission will administer the soil health program.

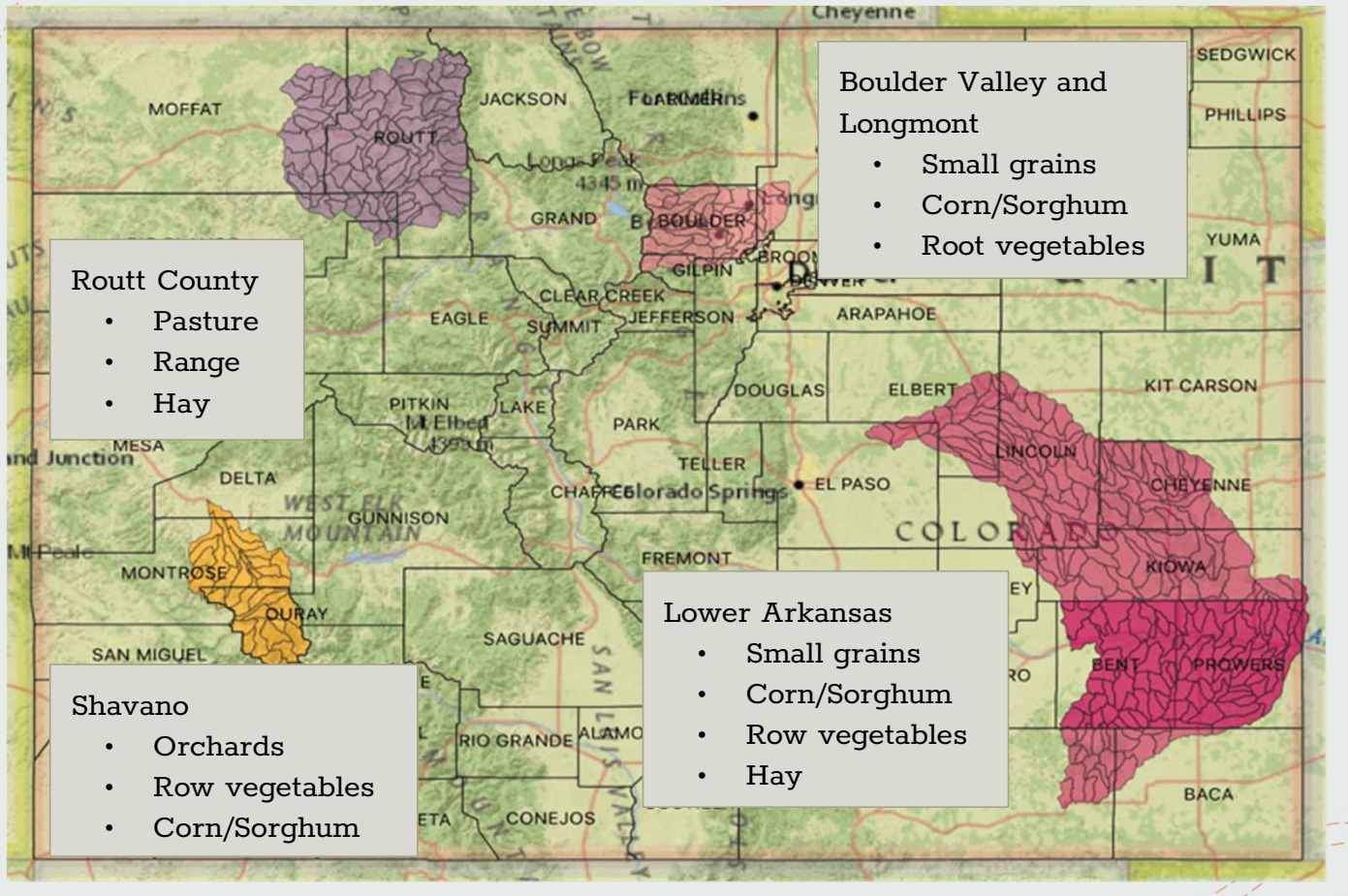
The department may establish the following:

- A system for monitoring the environmental or economic

Pilot Program



Pilot Areas



Routt County
- Pasture
- Range
- Hay

Boulder Valley and Longmont
- Small grains
- Corn/Sorghum
- Root vegetables

Lower Arkansas
- Small grains
- Corn/Sorghum
- Row vegetables
- Hay

Shavano
- Orchards
- Row vegetables
- Corn/Sorghum

Colorado STAR Program

★ **Average** - a field with practices similar to what 80% of fields of that type are doing in that region

★★ **Above average** - a field beginning to implement soil health practices

★★★ **Great** - a field implementing multiple soil health principles

★★★★ **Excellent** - a field implementing several soil health principles

★★★★★ **Ideal** - a field implementing all five soil health principles