CARBON FARMING

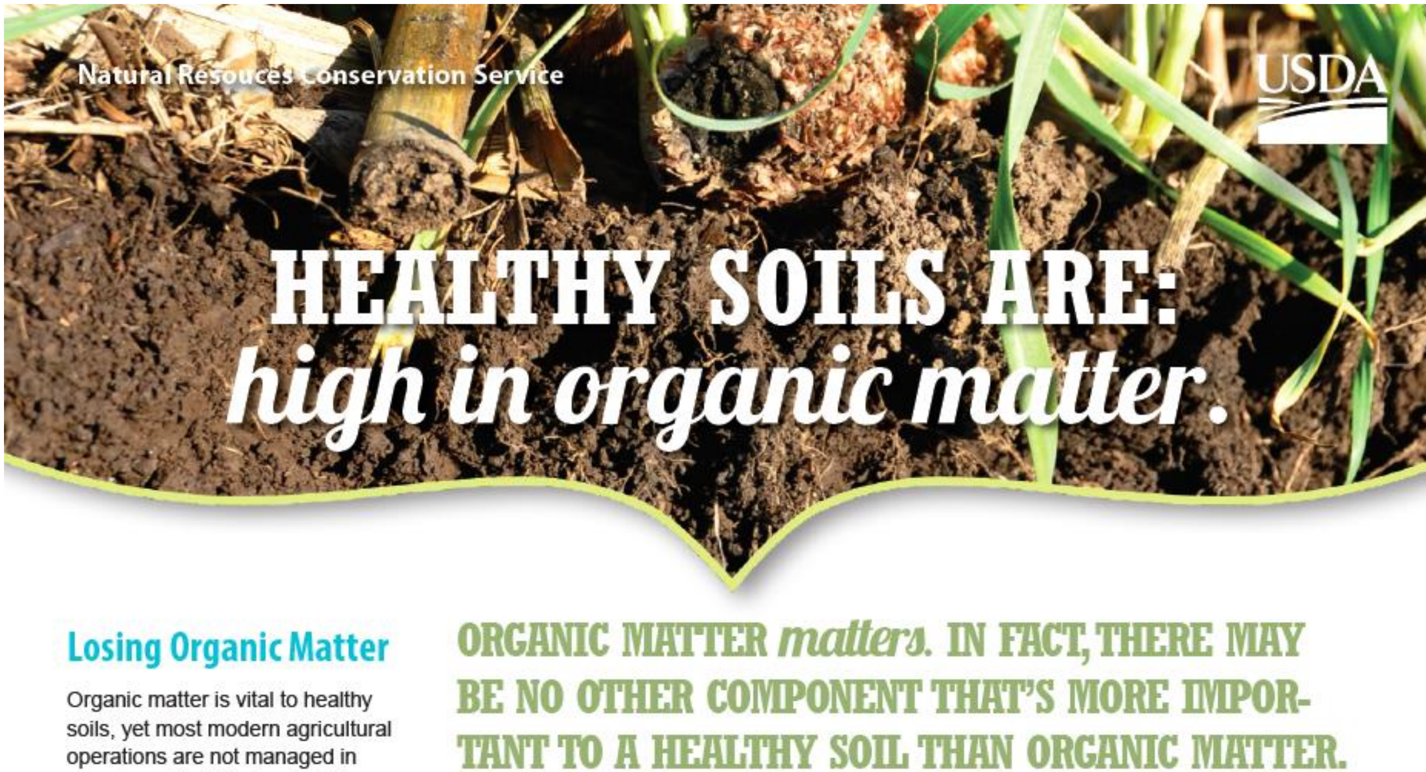
Soil, Water, Carbon, Climate

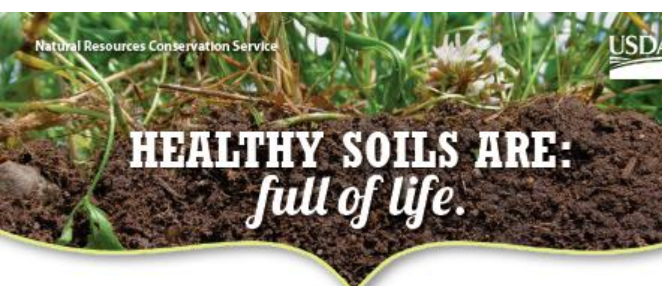
Ag “Waste Disposal”
And Healthy Soils

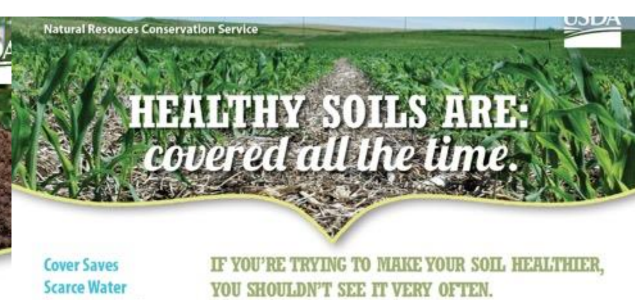
Carbon Cycle Institute

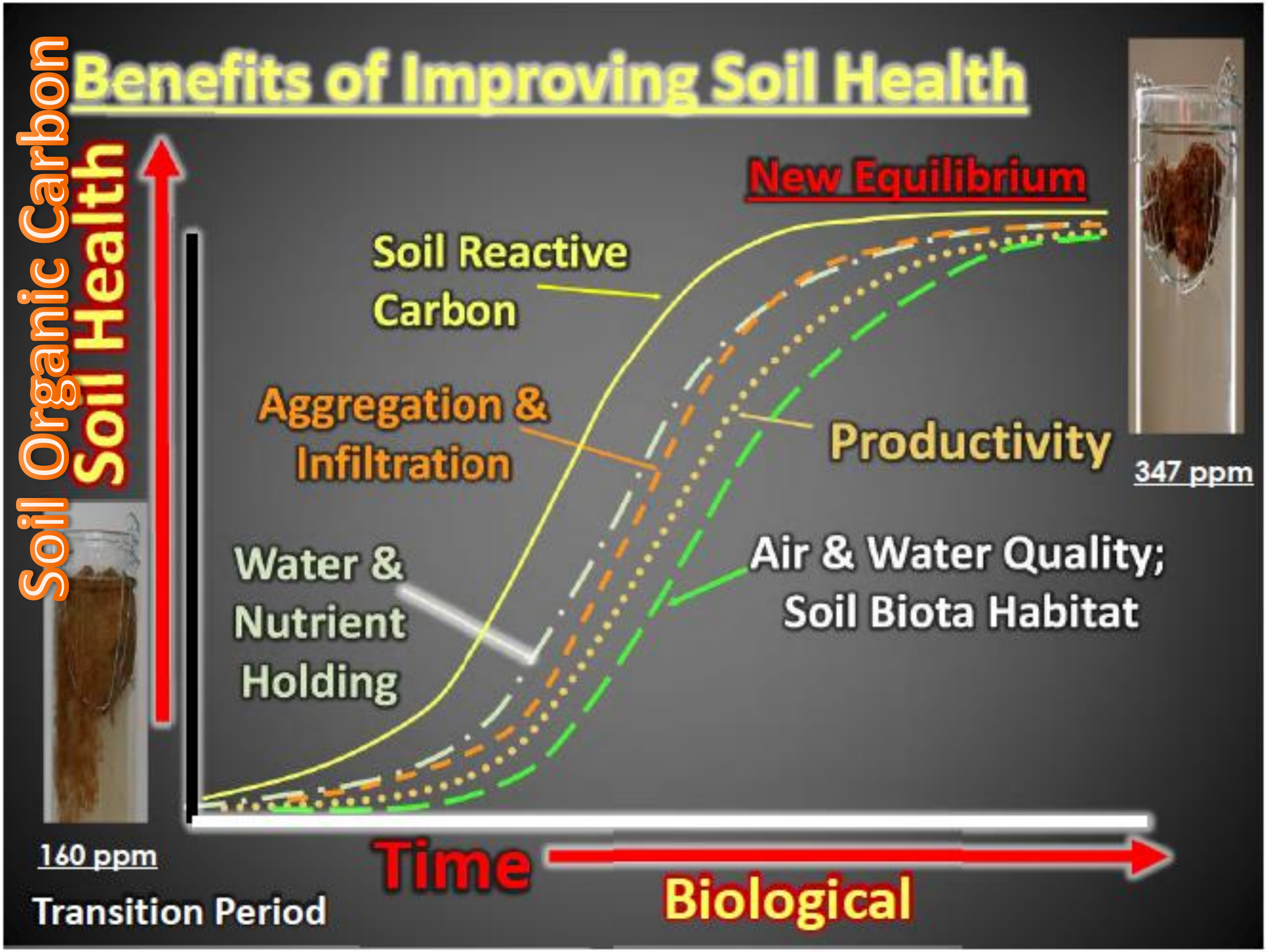
www.carboncycle.org

Soil Health: *The capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans. USDA*-NRCS.









Benefits of Improving Soil Health
Soil Organic Carbon
Soil Health
New Equilibrium
Soil Reactive Carbon
Aggregation & Infiltration
Productivity
347 ppm
Water & Nutrient Holding
Air & Water Quality; Soil Biota Habitat
160 ppm
Time
Transition Period
Biological


Same Soils: Dynamic Soil Properties Changed!
62.8% loss of SOM after 17 yr intensive tillage
Forest
SOM = 4.3 %
17 yr- Soybean monoculture
SOM = 1.6 %


How do we improve soil health?
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Return ALL Agricultural “Wastes” to the Soil

Ag Waste: Problem or Asset?

"Excess materials generated by commercial agricultural and forestry operations, biomass and wood harvested through forest health and restoration treatments, and material that is generated in response to Tree Mortality Emergency activities, should be used in a manner that minimizes GHG and black carbon emissions and promotes public and environmental health."

CARB-2017


Mulch Layer
ARTHROPODS
Decomposition active zone
Compost Layer
Aggregation active zone
Zone of aggregation in layers
This enrichment of the surface layer with SOM maintains soil quality by enhancing aggregation and facilitating aeration (Doran and Parking, 1994; Franzluebbers, 2007).

Marin Carbon Project 2008
H1: Management can increase soil carbon
and: we can measure it

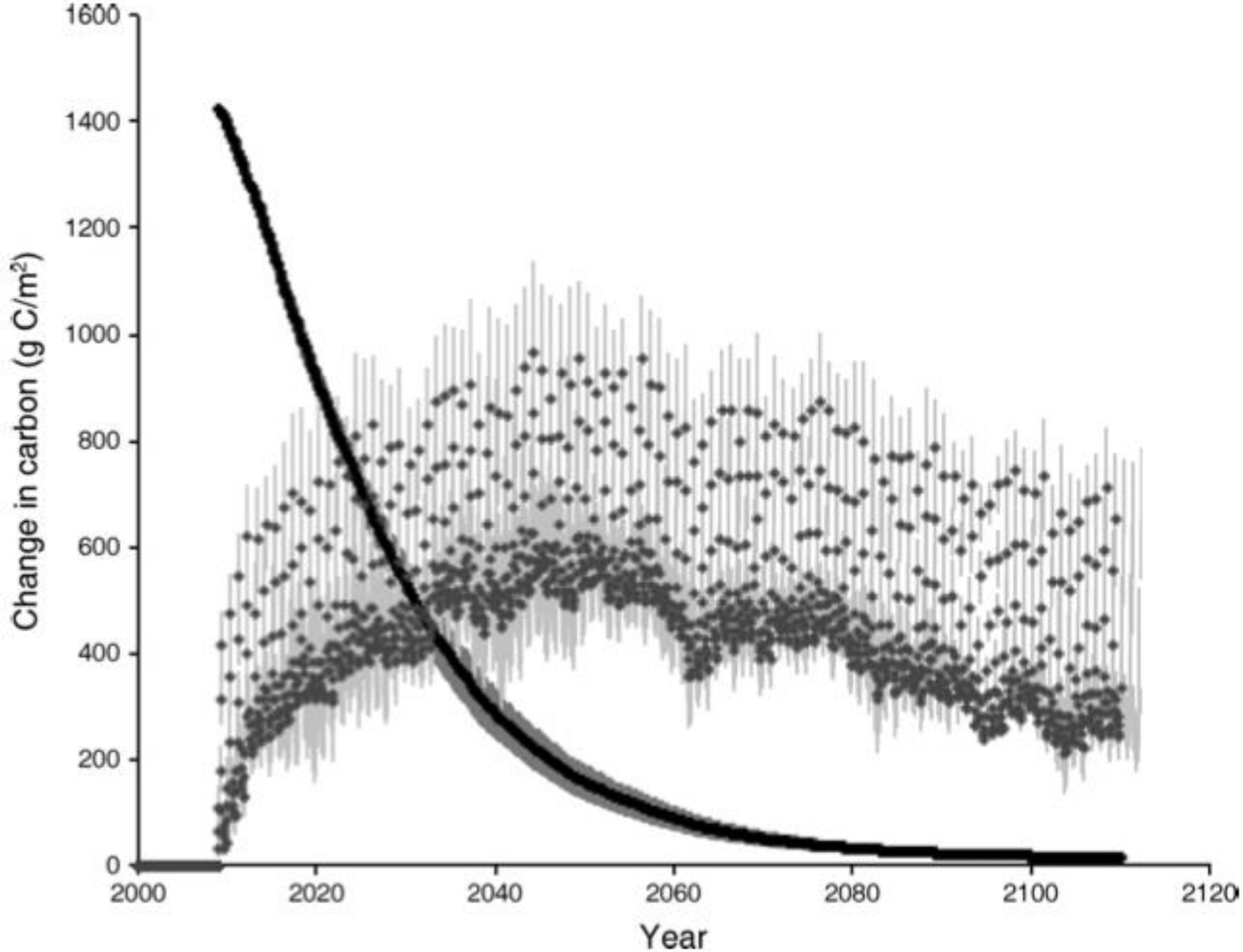
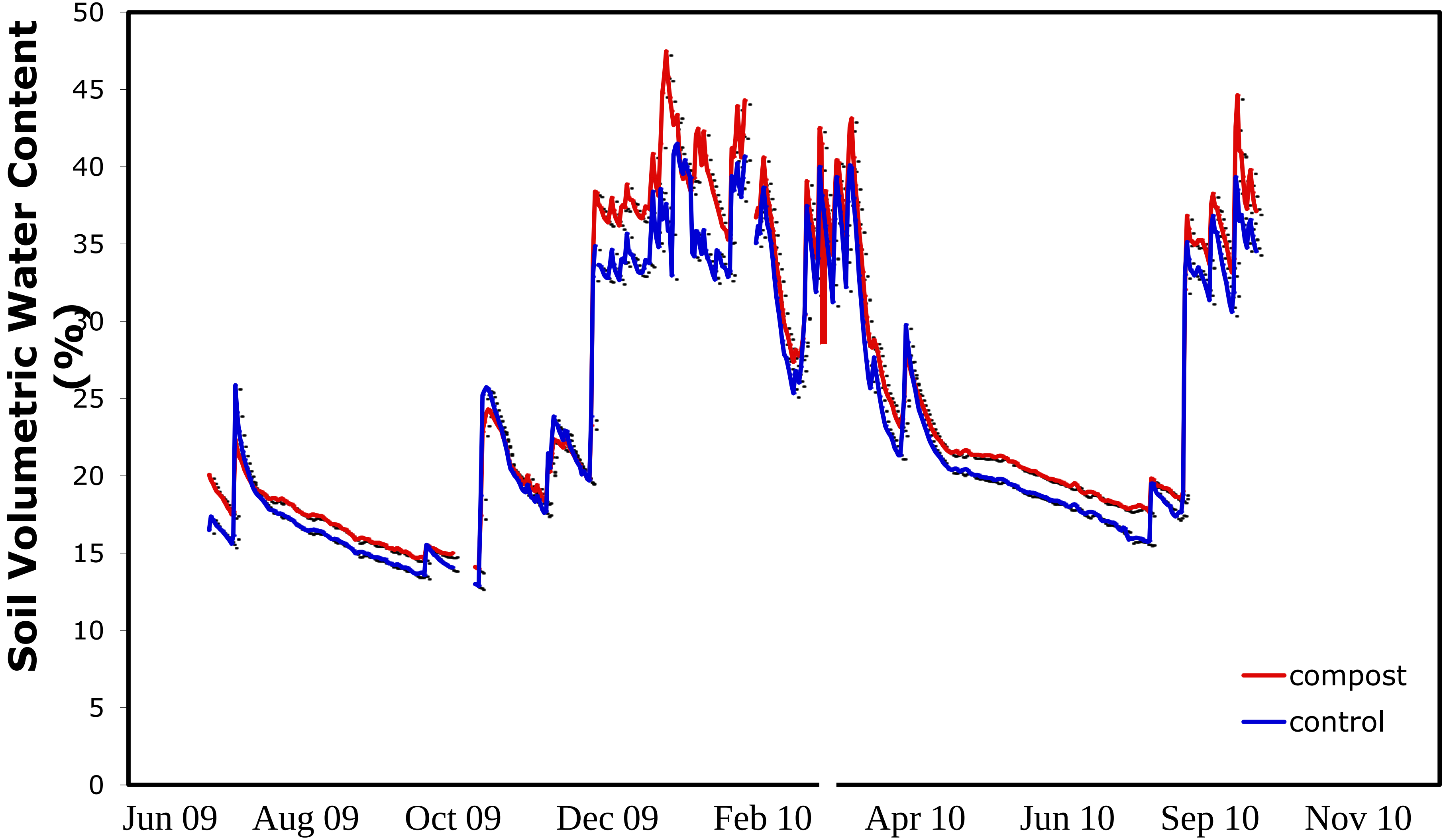


FIG. 3. The black line shows simulated decomposition of the compost following application to grassland soils. Gray circles show the monthly change in total ecosystem carbon, not including compost carbon. Values are averages across site characterizations, with standard error bars in light gray. Ryals et al, 2015. Ecological Applications, 25(2): 531–545.

Increasing soil C increases soil moisture….



UCSFREC, Browns Valley, Ryals and Silver 2013

USDA-NRCS SOIL HEALTH INFOGRAPHIC SERIES #002

unlock the SECRETS IN THE SOIL

what's underneath

healthy soil has amazing water-retention capacity.

Every **1%** increase in organic matter results in as much as **25,000** gal of available soil water per acre.

Source: Kansas State Extension Agronomy e-Updates, Number 357, July 6, 2012

USDA United States Department of Agriculture

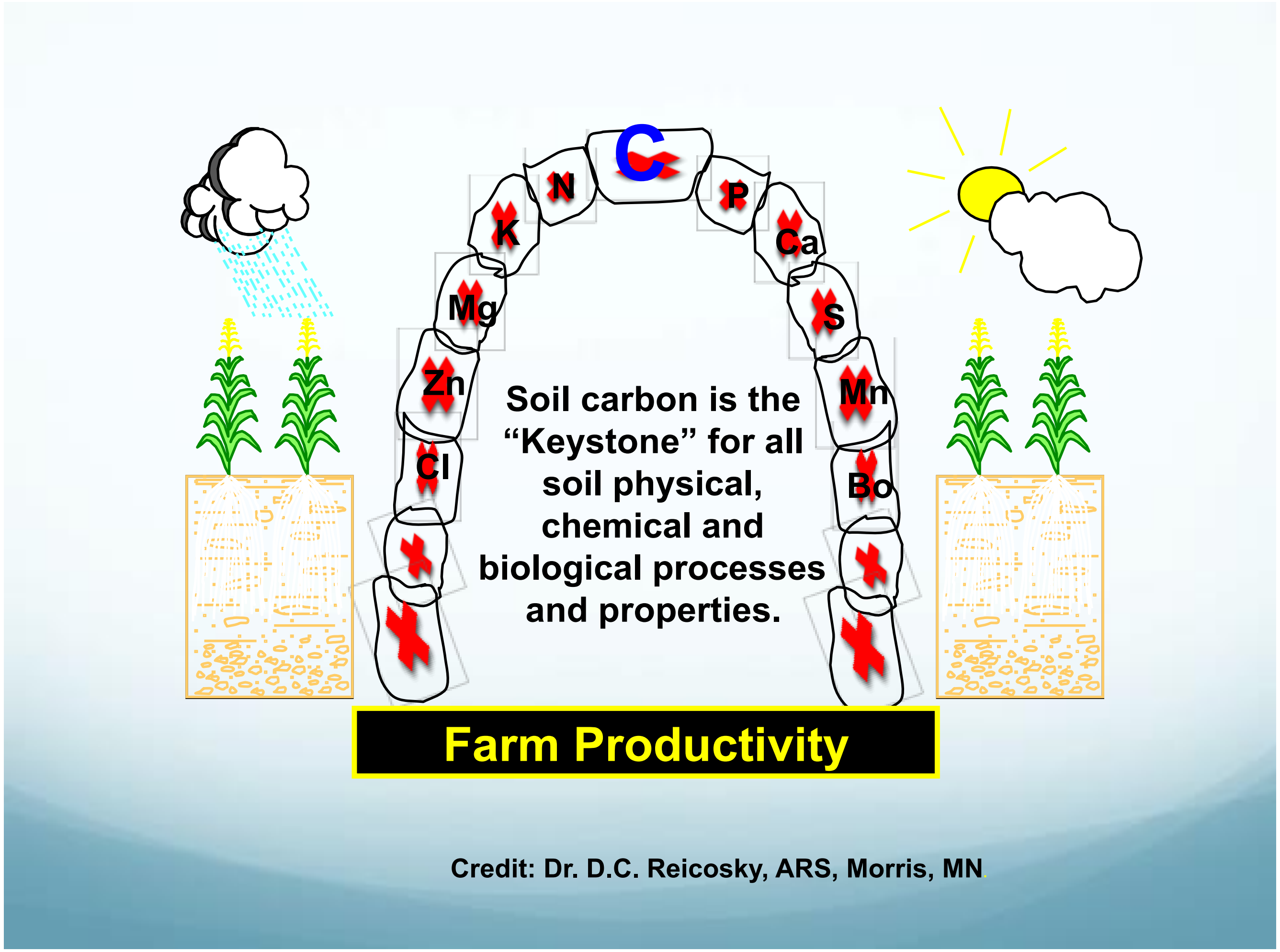
Want more soil secrets?
Check out **www.nrcs.usda.gov**

Farmland after rain (right): waterlogging due to poor structure resulting from cultivation, compaction and lack of soil cover (and roots!). Different management, including denser groundcover, on the adjacent paddock (left) results in higher soil carbon, better structure and improved water absorbing and holding capacity.

Patrick Francis, Australian Farm Journal

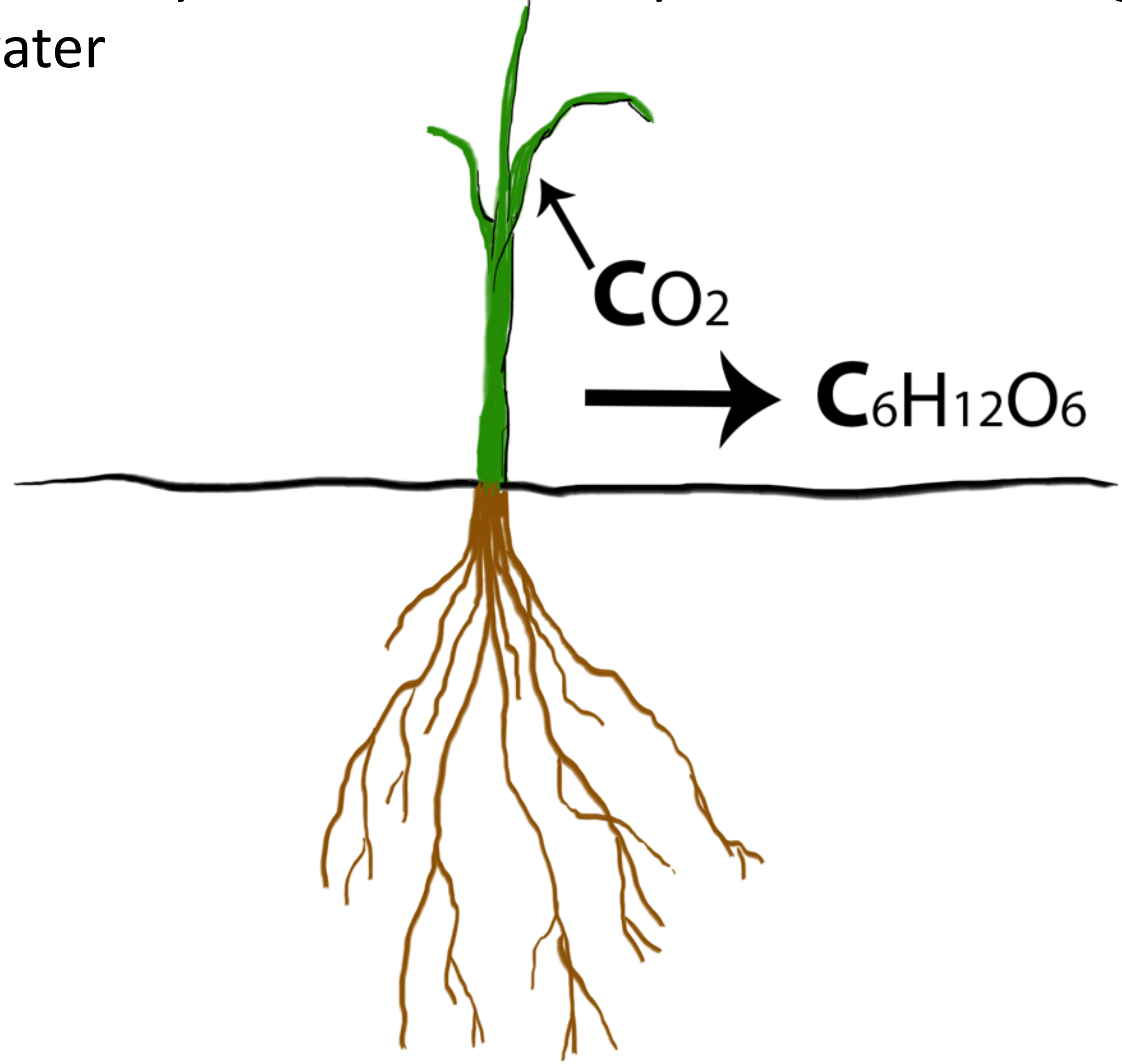
Carbon:

Key to agricultural productivity and resilience



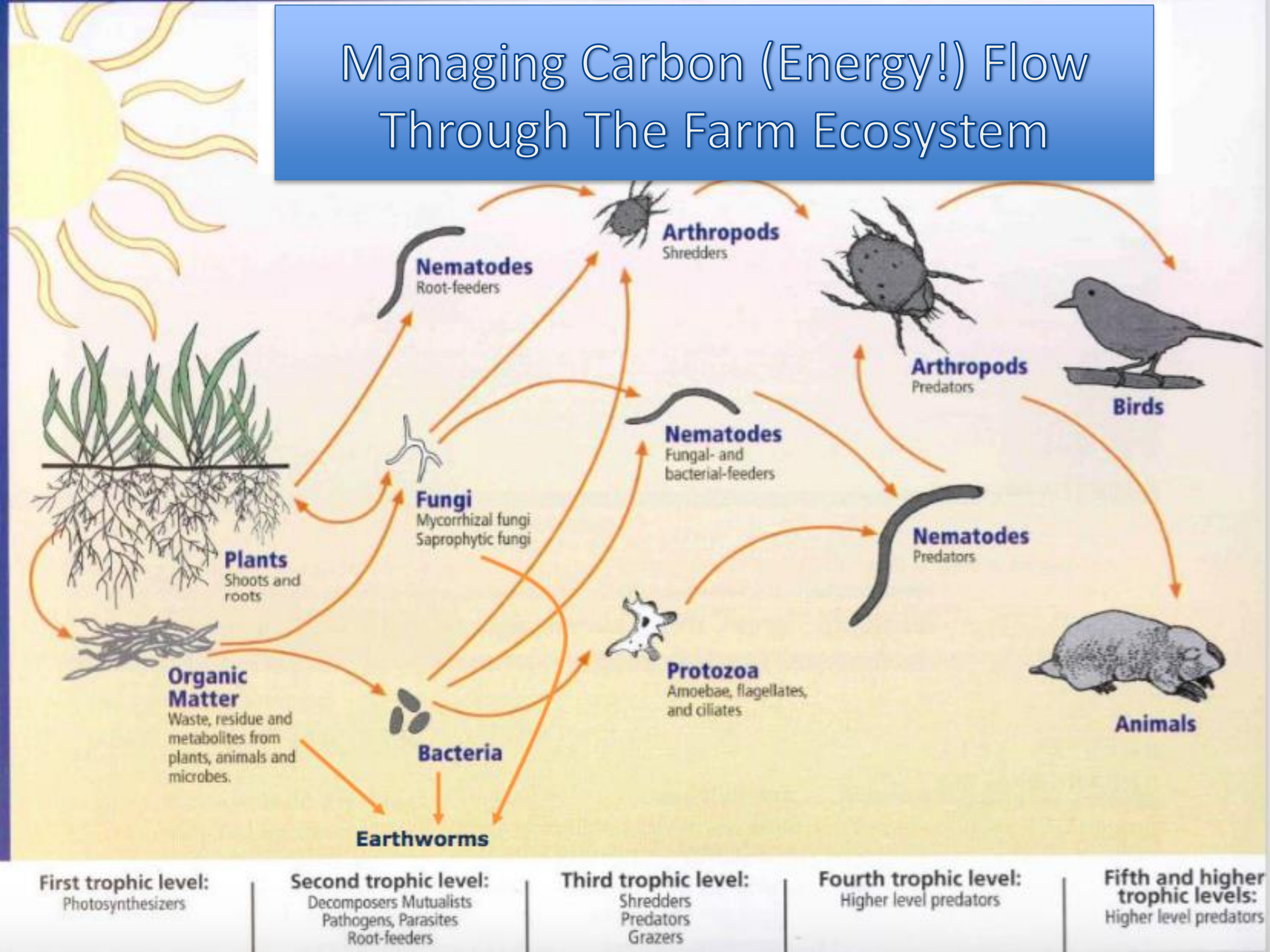
Photosynthesis:

the *synthesis* of carbohydrates from *sunlight,* carbon dioxide & water



ALL OF THE
CARBON
IN
CARBOHYDRATES
COMES FROM
THE **AIR.**

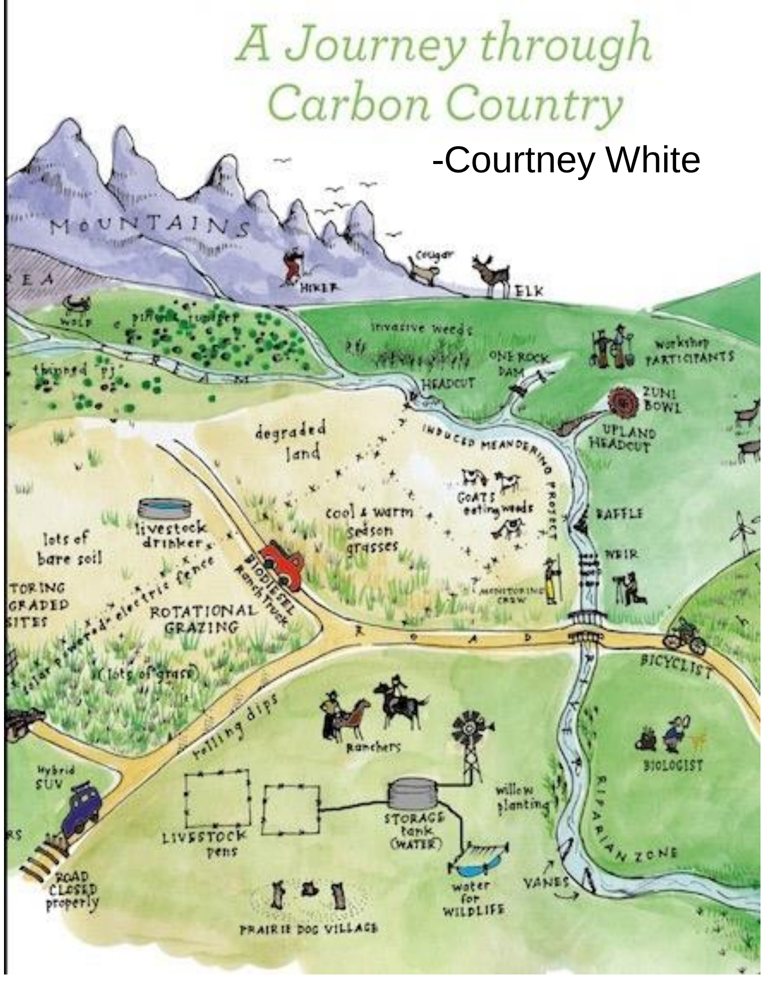
Managing Carbon (Energy!) Flow Through The Farm Ecosystem



Carbon Farm Planning

CONSERVATION PLANNING through a carbon lens:

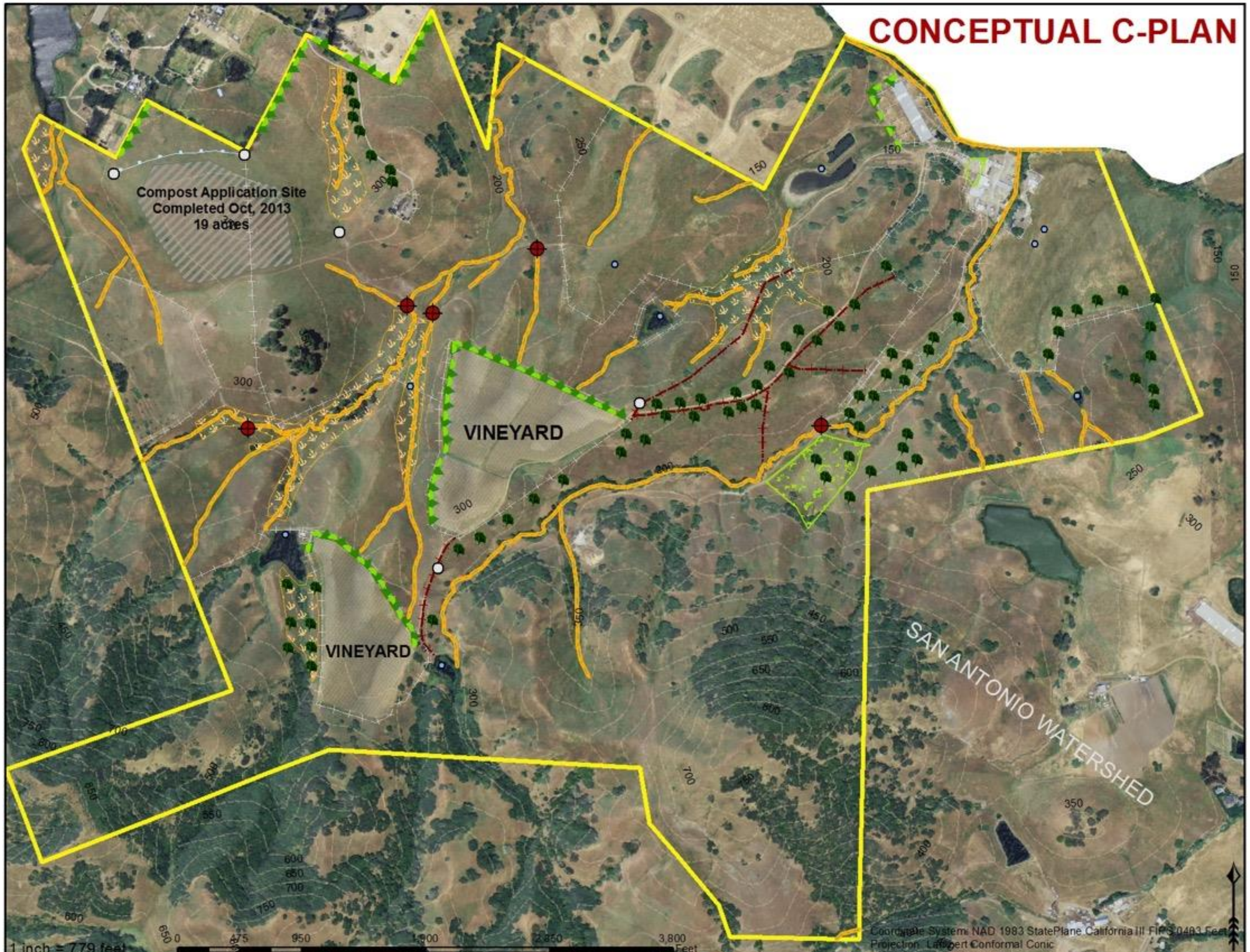
- *Increase terrestrial carbon*
- *Reduce GHG emissions*
- *Quantify carbon benefits of conservation practices*
- *Recognize the co-benefits of increasing on-farm carbon, including the benefits of conserving carbon from ag "waste" as mulches and compost on-farm:*
  - ↑ *Production*
  - ↑ *Soil Health*
  - ↑ *Water Quantity*
  - ↑ *Water Quality*



MARIN AGRICULTURAL LAND TRUST

Marin Carbon Project
DRAFT
Carbon Farm Plan
CORDA RANCH

MARIN RESOURCE CONSERVATION DISTRICT



Legend

Parcel Boundary

Corda Ranch: 856 acres

Ranch Infrastructure

Fencing, Existing

Water Developments, Existing

Completed Practices

Compost Application/ Mulching

Planned Practices

Silvopasture: 6 acres

Field/Riparian Forest Buffer: 20 acres

Stream Crossing Repairs: 4

Stream Restoration and/or Planting: 6.7 miles

Riparian Buffer Planting: 34 acres

Hedgerow/Windbreak: 7205 linear ft

Fencing/Access Control: 6500 linear ft/ 1.2 miles

Water Development

Pipeline: 1730 linear ft

Troughs: 4

Proposed Conservation Practices (NRCS Practice #)

1. Compost Application/ Mulching (484) (initiated, fall 2013)
2. Critical Area Planting/Riparian Herbaceous Cover (342/390)
3. Fencing/Access Control (382/472)
4. Field Border (386)
5. Range Management Plan/ Prescribed Grazing (110/528)
6. Hedgerow Planting/ Windbreak/Shelterbelt (422/380/601)
7. Livestock Pipeline/ Water Facility (516/614)
8. Nutrient Management (590)
9. Pasture Planting (512)
10. Range Planting (550)
11. Riparian Forest Buffer (391)
12. Silvopasture: Establish Trees & Native Grasses (381/612)
13. Structure for Water Control (587)
14. Wetland Restoration (657)

Author:Lynette K Niebrugge

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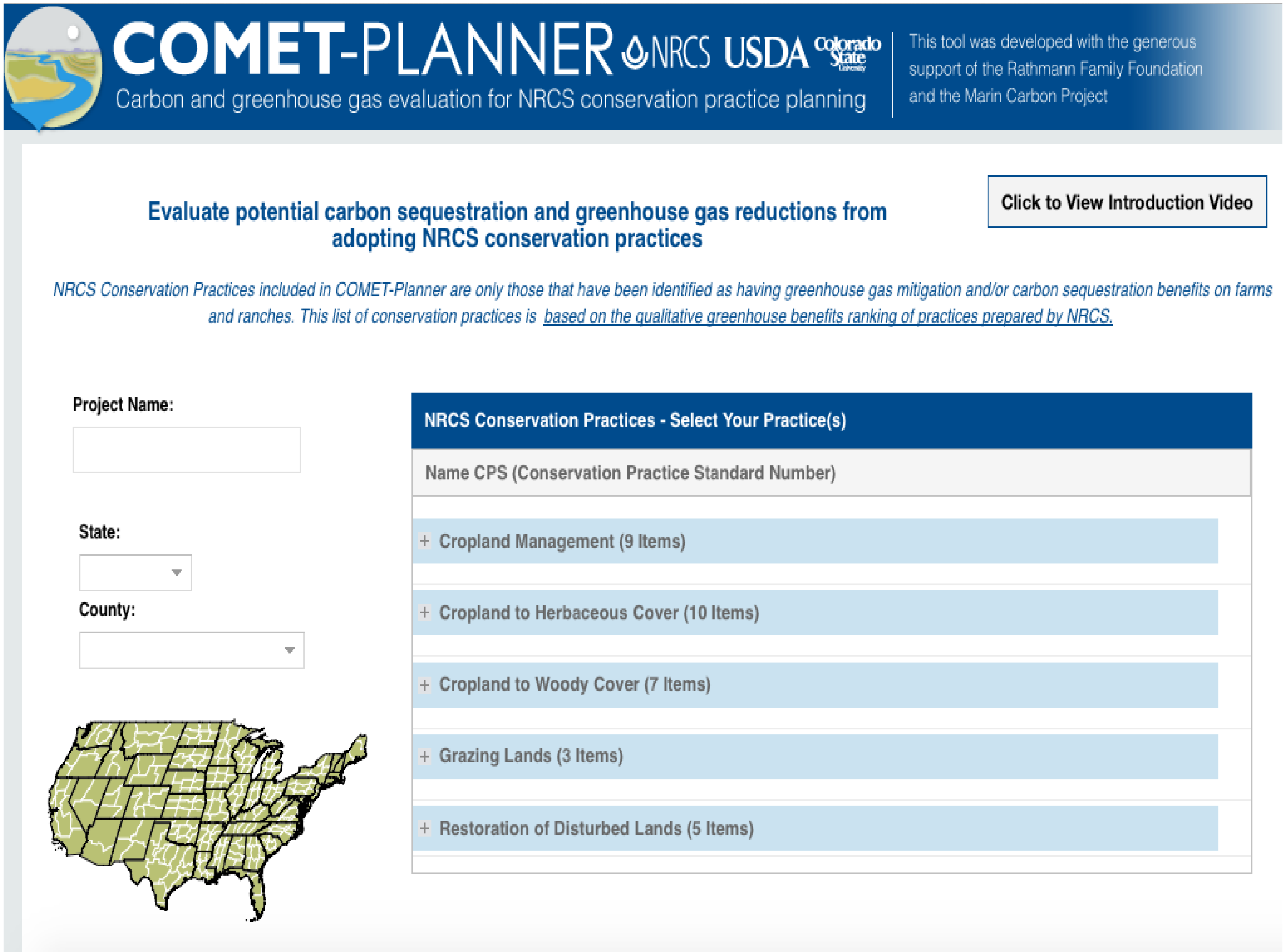


Estimating Carbon capture potential

LOCAL DATA where available.

COMPOST: R.Ryals et al 2013; M.DeLonge et al 2013

CREEK CARBON: D.Lewis et al 2015

Estimated Additional Soil Water Holding Capacity With Carbon Farm Plan Implementation, 8,000 acre Ranch, Santa Barbara County, CA Compost alone adds over 600 AF of additional water holding capacity in these rangeland and cropland soils.

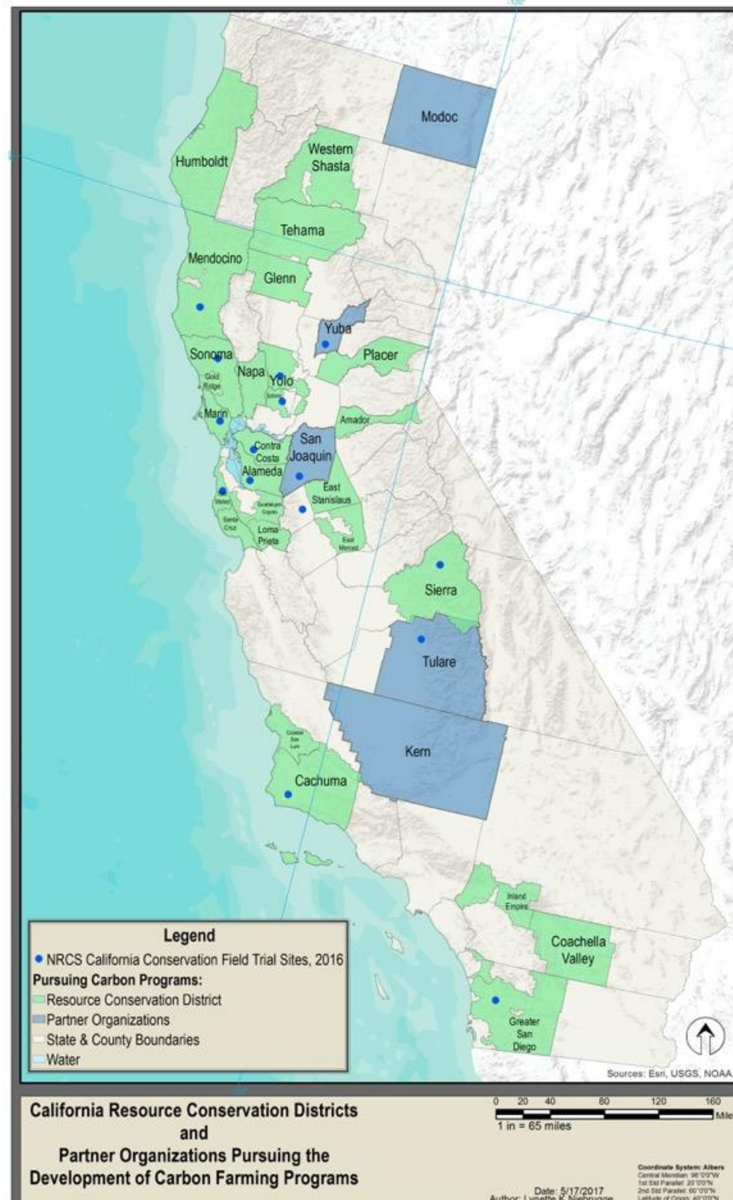
Table 15. Estimated Additional Soil Water Holding Capacity (WHC) With Plan Implementation

PRACTICE	DESCRIPTION	20 YEAR SOM INCREASE (Mg)	ANNUAL WHC INCREASE BY YEAR 20 (AF)
Compost application on Rangeland (NRCS practice standard in development)	Application of 1/4" of compost to 4300 acres of permanent pasture.	53867 Mg	493.78
Compost application on Cropland (590)	Application of 1" of compost to 617 acres of cropland.	23637.05 Mg	216.67
Shelterbelt (380)	13.6 miles (90 acres) of 50' wide shelterbelts	1068.12 Mg	9.79
Prescribed Grazing (528)	Grazing management to favor perennials and improve production on 7300 acres.	15912.80 Mg	145.86
Riparian Restoration	Restoration of 94 acres of riparian system along 7.75 miles of stream corridor Planting of native trees and shrubs.	3043.23 Mg (derived from Lewis et al 2015)[1]	27.89
No-till system-Tillage Management (512).	Convert tilled forage fields to permanent pasture; minimize tillage on croplands	425.06 Mg	3.89
Minimum-Tillage (345)	Conversion of tilled crop fields to minimum tillage on	1089.91 Mg	9.99
Silvopasture (381)	Establish trees on approximately 1,000 acres) of treeless pasture.	4027.24 Mg (derived from Gaman 2008)	36.91
TOTAL		103,070	917.52

[1] Lewis et al 2015 model coefficients indicate annual increases of soil carbon = 0.2 kg/m^2. 1 acre = 4046.85642 m^2.

Scaling Up Carbon Farming with RCDs

- Why RCDs?
  - Statewide
  - Local knowledge
  - Successful implementation
  - AND Partners: **NRCS,** land trusts, Point Blue and others.



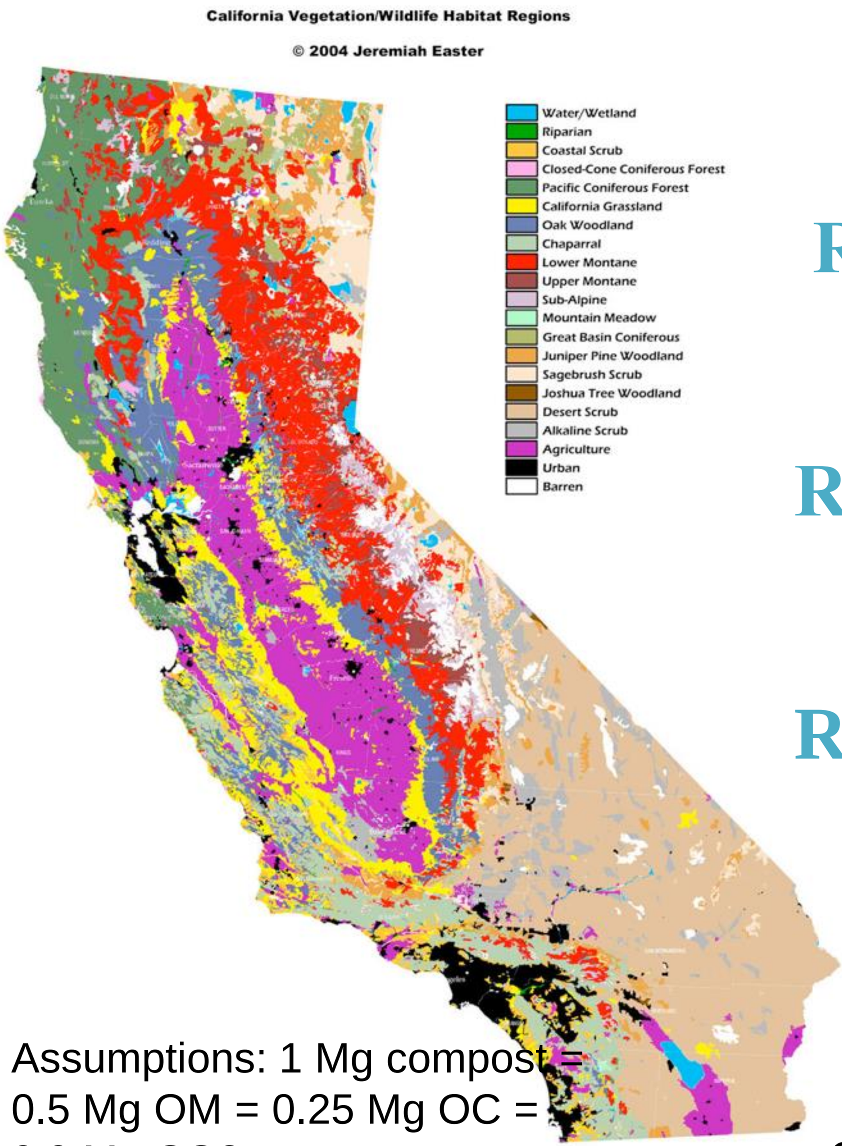
Local example: Sierra RCD Carbon Management Program

- Identify and quantify opportunities to enhance on-farm carbon capture in plant biomass and soils.
- Barriers (economic, regulatory, outreach, education and others).
- RCD assets, needs and potential partners.
- Potential sources of funding for implementation.
- Introduce carbon management in the Long Range Plan.

Source: Sierra RCD

California Cropland Soil Carbon Sequestration Potential With Compost Additions (Compost C Only)

Assumes 9 million acres of cropland suitable for compost application.



At a rate of 3 tons Compost $ac^{-1}y^{-1}$
= 27 MMT(Tg) CO_2e/y^{-1};
Recycles: 54 MMT "waste"/year

At a rate of 6 tons Compost $ac^{-1}y^{-1}$
= 54 MMT (Tg) of CO_2e/y^{-1};
Recycles: 108 MMT "waste"/year

At a rate of 20 tons Compost $ac^{-1}y^{-1}$
= 180 MMT (Tg) of CO_2e/y^{-1};
Recycles: 180 MMT "waste"/year

- Livestock
  ~ 15 MMT $CO_2e\ y^{-1}$
- Commercial/residential
  ~ 42 MMT $CO_2e\ y^{-1}$
- Electrical generation
  ~112 MMT $CO_2e\ y^{-1}$

Assumptions: 1 Mg compost = 0.5 Mg OM = 0.25 Mg OC = 0.9 Mg CO2e

CarbonCycle.org

Ag “Waste Disposal”
Or
Resource Conservation
critical to meeting our
“Healthy Soils” goals?

Our Choice