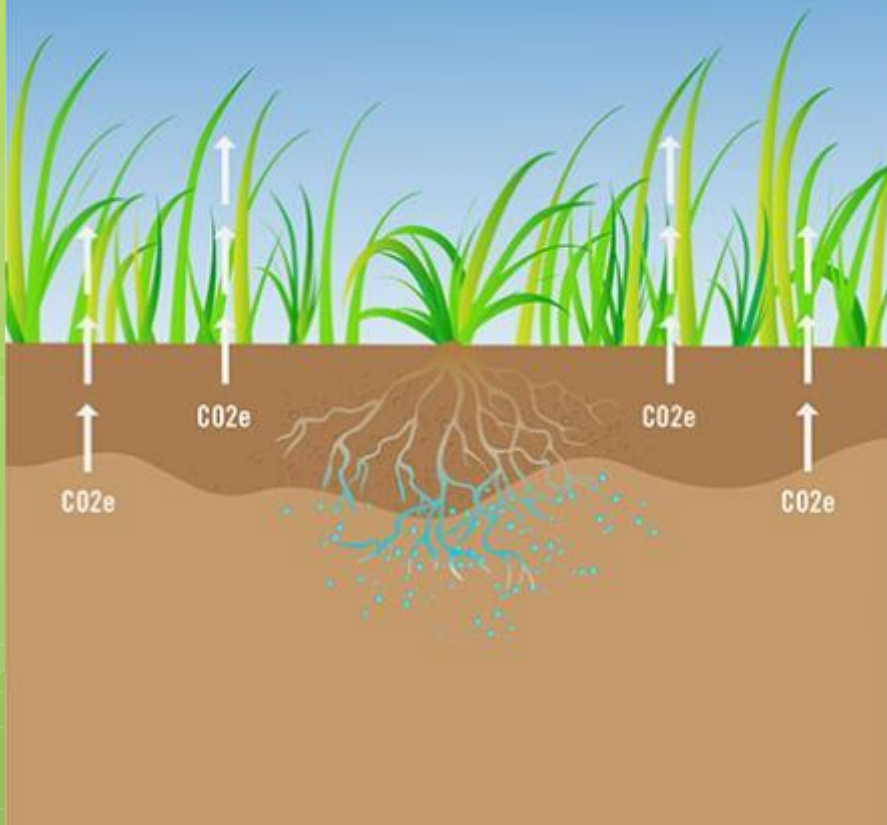
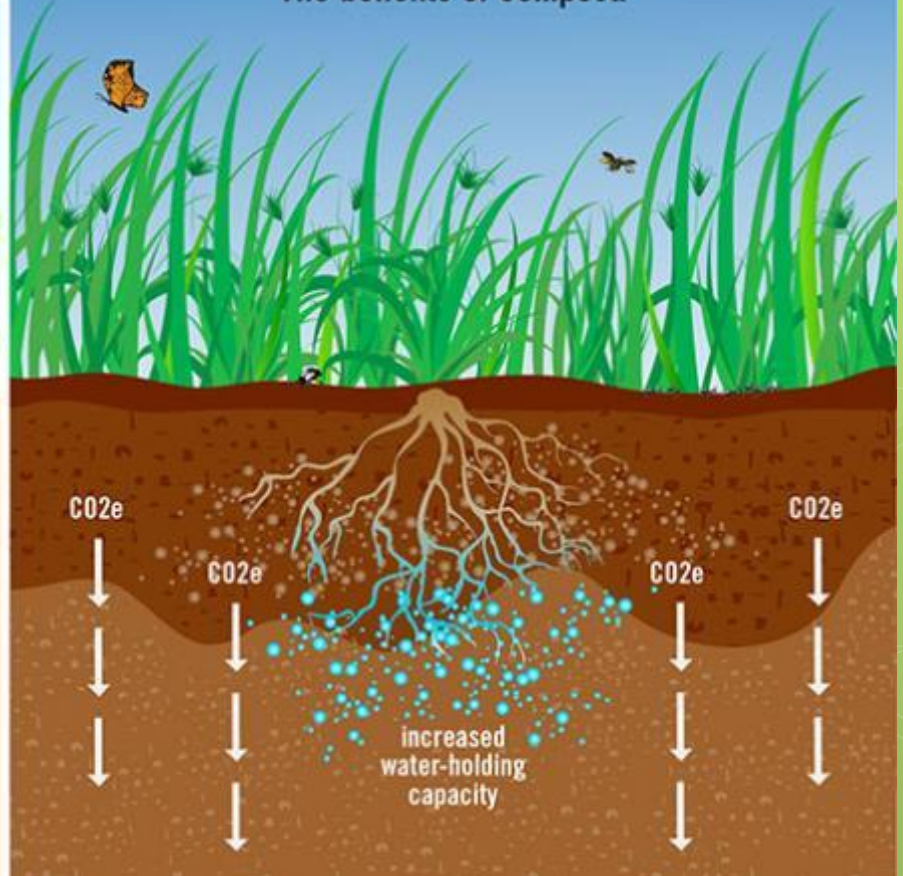


Carbon Farming

Rangelands are losing carbon.



The benefits of compost!



Tomales Bay



Water Quality in Marin



- Water quality standards approved in 2007 by EPA
- 2008-Present. All dairies, livestock operations and horse boarding facilities must have water quality plans and implement projects

West Marin Compost Project



- 1 dairy, 10 horse boarding facilities, county roads, tree service companies
- 12,000 yd³ each from dairy, horse boarding and county road/tree service
- Organic material
- C:N ratio 20:1
- Used for dairy operations – bedding
- UC Berkeley Research (Dr. Sintanta, Vergara)

Research



UC Berkeley Studies

- Ryals, R., M. Hartmann, W.J. Parton, M.S. DeLonge, and W.L. Silver. In press. Simulating soil carbon and greenhouse gas dynamics in grasslands amended with compost. *Ecological Applications*.
- Ryals, R., M. Kaiser, M.S. Torn, A.A. Berhe, and W.L. Silver. 2013. Impacts of organic matter amendments on carbon and nitrogen dynamics in rangeland soils. *Soil Biology and Biochemistry*. 68: 52-61.
- DeLonge, M.S., R. Ryals, and W.L. Silver. 2013. A lifecycle model to evaluate carbon sequestration potential and greenhouse gas dynamics of managed grasslands. *Ecosystems*. 16: 963-979.
- Ryals, R. and W.L. Silver. 2013. Effects of organic matter amendments on net primary productivity and greenhouse gas emissions in annual grasslands. *Ecological Applications* 23:49-59.
- Silver, W.L., R. Ryals, and V.E. Eviner (2010) Soil carbon storage in California rangelands. *Rangeland Ecology and Management*. DOI: 10.2111/REM-D-09-00106.1

<http://www.marincarbonproject.org/marin-carbon-project-science>

Compost Application

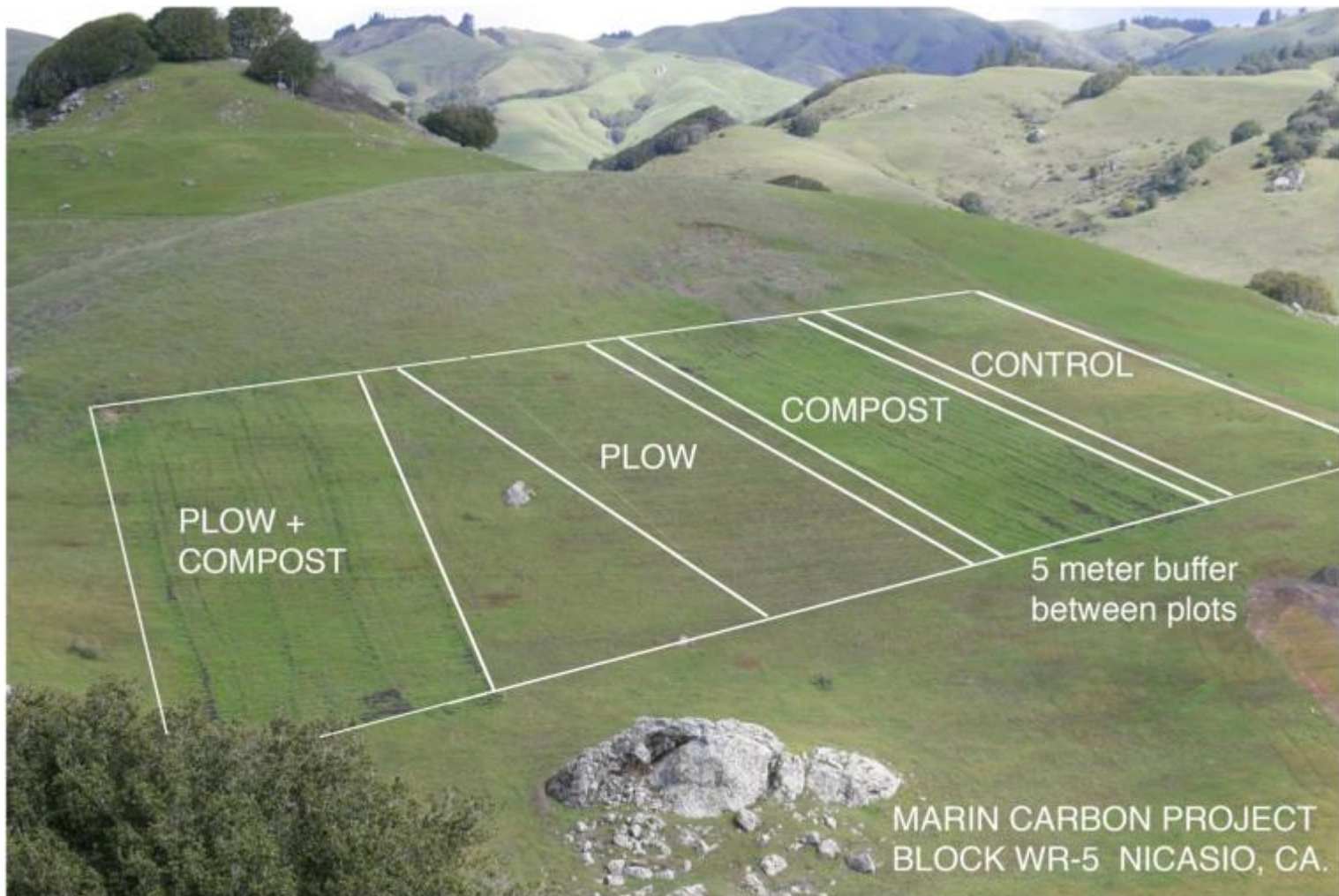
- One time application of 1/2" compost on grazed rangeland increased long term storage of carbon by 1 ton per hectare
- Increased soil water holding capacity by 17-25%
- Increased forage production by 40-70%
- Scale: If we increase soil organic matter from 1% to 2%, it would mitigate all California's residential, commercial and livestock emissions and increase water holding capacity by over 1 million acre-feet



Study Plots



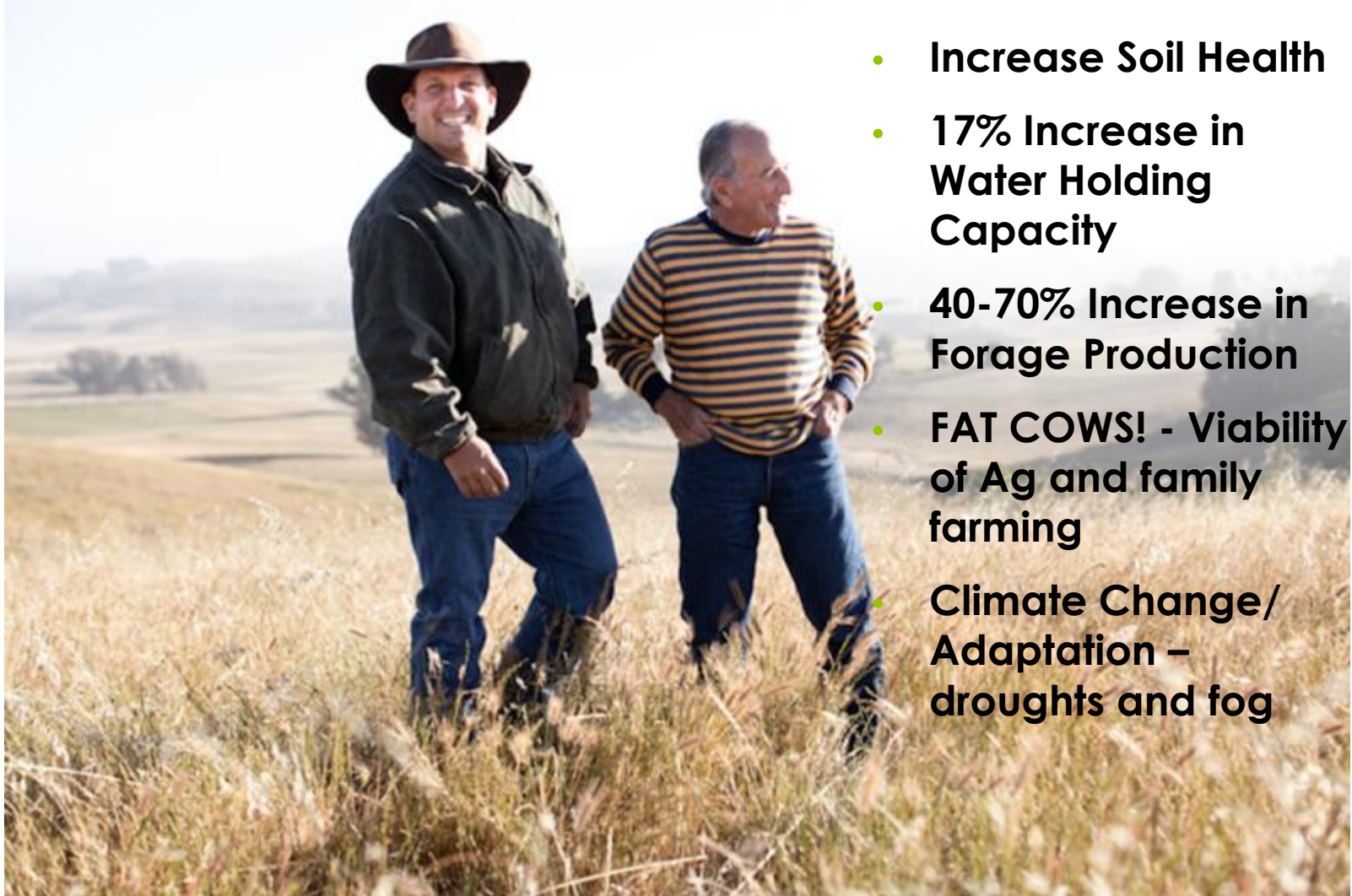
Study Plots



Study Plots



Why?



- **Increase Soil Health**
- **17% Increase in Water Holding Capacity**
- **40-70% Increase in Forage Production**
- **FAT COWS! - Viability of Ag and family farming**
- **Climate Change/ Adaptation – droughts and fog**

Study Plots



Marin Carbon Project

Evaluate the soil carbon sequestration potential on rangelands and provide ecological and agricultural benefits to producers in regard to climate change.

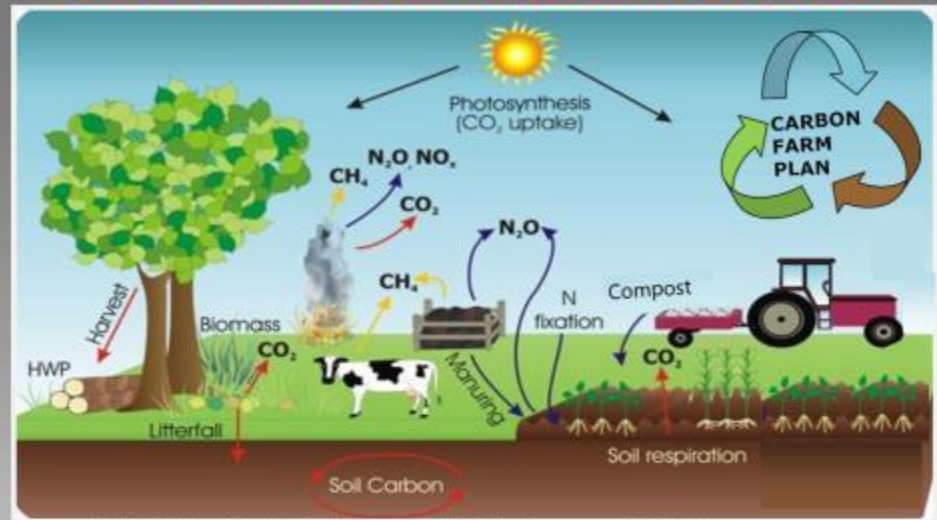


- Carbon Cycle Institute
- Marin Agricultural Commissioner
- Marin Agricultural Land Trust
- Marin Resource Conservation District
- Nicasio Native Grass Ranch **and many more!**
- UC Cooperative Extension – Novato
- UC Berkeley
- USDA Natural Resources Conservation Service

Selecting Farms



Carbon Farm STEWARDSHIP FUNDING



Sources and sinks of GHG emissions in agriculture, forests, and other land use systems (IPCC 2006)

Carbon Farming:

We are pleased to announce the availability of funds to develop and implement Carbon Farm Action Plans on up to 3 ranches. Projects will focus on the implementation of carbon beneficial practices on predominantly permanent pasture based livestock systems in Marin County.

Participation Requirements:

- Producers must be eligible for USDA Natural Resources Conservation Service EQIP programs.
- Must maintain involvement throughout project and maintain conservation practices a minimum of 10 years or duration of EQIP contract.
- Willing to be a demonstration Carbon Farm.
- Private land in Marin
- Adhere to Grazing Management Plan

The Project will Fund:

- 1) Ranch Planning and Permitting
- 2) Technical/Engineering Expertise
- 3) Construction of Conservation Practices
- 4) Monitoring of Project Practices.

Conservation Practices:

- Compost Application, Purchase
- Critical Area Planting: Grasses, Shrubs and Trees
- Crop Rotation and Cover Crop
- Hedgerows and Windbreaks
- Filter Strips and Grassed Waterways
- Nutrient Management, Fertilizer Alternatives
- Pasture and Hay Planting
- Rangeland Management: Prescribed Grazing, Range Planting
- Residue Management: No-Till, Strip Till, Seasonal Tillage, Mulch Till
- Creek and Wetland Restoration

DEADLINE IS AUGUST 16th!!! CONTACT:

Marin Resource Conservation District

Nancy Scolari or Lynette Niebrugge

Phone: (415)663-1170

Email: marinrcd@marinrcd.org

Marin Agricultural Land Trust

Patricia Hickey or Jim Jensen

Phone: (415)663-9721

Support for the Marin Carbon Project is provided by grants from the Marin Community Foundation, Sara and Evan Williams Foundation and the 11th Hour Project.

What is in a plan?

- Streambank Revegetation
- Forest Revegetation
- Windbreaks & Hedgerows
- Wetland Restoration
- Grassed Waterways
- Rangeland Management:
 - prescribed grazing,
 - range planting
- Residue Management (No-till)
- Pasture & Hay Planting
- **Compost Application (NRCS Mulching Practice Code 484)**
- Nutrient Management
 - (Fertilizer Alternatives)
- Crop Rotations
- Cover Cropping

The screenshot shows the USDA Natural Resources Conservation Service website. The main heading is "GHG and Carbon Sequestration Ranking Tool" under "NRCS Practice Standards for Greenhouse Gas Emission Reduction and Carbon Sequestration". A navigation menu on the left includes "Air" and "Air Quality", with "USDA Agricultural Air Quality Task Force" selected. A "Qualitative Ranking" scale is shown as "N = Neutral", with a visual scale from 1 (red) to 7 (green) and a smiley face icon. Below the scale is a table of practice standards.

Qualitative Ranking N = Neutral	Practice Code	Practice Standard and Associated Information Sheet	Beneficial Attributes
	327	Conservation Cover (Information Sheet)	Establishing perennial vegetation on land retired from agriculture production increases soil carbon and increases biomass carbon stocks.
	329	Residue and Tillage Management, No-Till/Strip-Till/Direct Seed	Limiting soil-disturbing activities improves soil carbon retention and minimizes carbon emissions from soils.
	366	Anaerobic Digester	Biogas capture reduces CH ₄ emissions to the atmosphere and provides a viable gas stream that is used for electricity generation or as a natural gas energy stream.
	367	Roofs and Covers	Capture of biogas from waste management facilities reduces CH ₄ emissions to the atmosphere and captures biogas for energy production. CH ₄ management reduces direct greenhouse gas emissions.
	372	Combustion System Improvement	Energy efficiency improvements reduce on-farm fossil fuel consumption and directly reduce CO ₂ emissions.
	379	Multi-Story Cropping	Establishing trees and shrubs that are managed as an overstory to crops increases net carbon storage in woody biomass



COMET-PLANNER NRCS Colorado State University

Carbon and greenhouse gas evaluation for NRCS conservation practice planning

This tool was developed with the generous support of the Rathmann Family Foundation and the Marin Carbon Project

COMET
Farm

 NRCS 



Whole Farm and Ranch
Carbon and Greenhouse Gas
Accounting System

from

[Click to View Introduction Video](#)

... gas mitigation and/or carbon sequestration benefits on farms and ranches. This list of conservation practices is [based on the qualitative greenhouse benefits ranking of practices prepared by NRCS.](#)

Project Name:

Wool Symposium

State:

CA

County:

Marin



NRCS Conservation Practices - Select Your Practice(s)

Name CPS (Conservation Practice Standard Number)

– Restoration of Disturbed Lands (5 Items)

Land Reclamation, Abandoned Mined Land (CPS 543)

Land Reclamation, Currently Mined Land (CPS 544)

Land Reclamation, Landslide Treatment (CPS 453)

Critical Area Planting (CPS 342)

Riparian Restoration

Approximate Carbon Sequestration and Greenhouse Gas Emission Reductions¹ (tonnes CO₂ equivalent per year)

Enter Acreage	Carbon Dioxide (CO ₂)	Nitrous Oxide (N ₂ O)	Methane (CH ₄)	Total CO ₂ -Equivalent
NRCS Conservation Practices (Click Practice Name for Documentation)				
Riparian Restoration [delete]	5	0	0	5
Total	5	0	0	5

CO₂e Reduction-Sequestration for one ranch

Practice	Average Annual CO ₂ e Reduction	20 yr CO ₂ e Reduction	CO ₂ e Reduction at Maturity
Rangeland Compost (Interim Practice 777)	88 Mg	1,760 Mg	1760 Mg
Range Planting (550)	44Mg	880 Mg	880 Mg
Windbreaks (380)	3.65 Mg	73 Mg	406 Mg
Prescribed Grazing (528)	56 Mg	1,120 Mg	1,120 Mg
Riparian Forest Buffer (391)	77 Mg	1,555 Mg	6,241 Mg
Riparian Herbaceous Cover (390)	36 Mg	720 Mg	720 Mg
No Till (329)	24.5 Mg	490 Mg	490 Mg
Critical Area Planting (342/390)	18.7 Mg	374 Mg	374 Mg
Field Border (386)	12 Mg	240 Mg	966 Mg
Silvopasture (381/612)	49 Mg	991 Mg	3988 Mg
Totals (metric tonnes)	408 Mg	8,203 Mg	16,945 Mg

CO₂e Reduction-Sequestration

402 Mg = ?

- Annual GHG emissions from **86** passenger vehicles
- GHG emissions from **977,835** miles driven by an average passenger vehicle
- Energy use from **43** homes in one year

* Estimates derived from EPA GHG Equivalencies Calculator

Methane Digester

Reduction of 1,645 Mg CO₂e annually



Riparian Restoration

Reduction of 16,203 Mg CO₂e annually per km of restoration



Plant creeks

Fence

Water developments

Marin Carbon Project - Carbon Farm Plan

STEMPLE CREEK RANCH

Legend

Property Boundary

Ranch Infrastructure

Fencing

Permanent

Electric

Perennial Stream

Compost Demonstration Site

Compost Application: 40 acres, 2013

Carbon Farm Practices Planned

Compost Application, 200 acres

Nutrient Management, 300 acres

Pasture Planting, 300 acres

Range/Prescribed Grazing, 300 acres

Agroforestry Systems Planned

Windbreak Planting: 18,000 linear feet

Low and Medium

Medium

Medium (double)

Medium and Tall

Low, Medium and Tall

Tree & Shrub Establishment, 18 acres

Silvopasture, 21 acres

Riparian Forest Buffer, 25 acres

USDA Approved Practice Standards (NRCS Practice#)

1. Compost Application/ Mulching (484)
2. Fencing/Access Control (382/472)
3. Hedgerow Planting/ Windbreak/Shelterbelt (422/380/601)
4. Nutrient Management (590)
5. Pasture/ Forage and biomass Planting (512)
6. Range Management/ Prescribed Grazing (528)
7. Riparian Forest Buffer (391)
8. Silvopasture; tree establishment (381/612)
9. Water Development (516/614)



Compost Application: Completed 2013
40 acres Compost Applied = 59.6 Mg CO₂e
(Ryals and Silver 2013 Local Data)

Riparian Forest Buffer: Completed 2015
179 Trees and Shrubs Planted
1.5 Acre = 5.8 Mg CO₂e
(Lewis, UCCE Local Data)

Windbreak:
400 linear feet
Planned 2017

Compost Application: Completed 2014
50 acres Compost Applied = 74.5 Mg CO₂e
(Ryals and Silver 2013 Local Data)

Facilities currently leased to dairy operation:
approx. 251 acres

Critical Area Planting: Completed 2015
30-50 Willow Sprigs Planted
.5 Acre = 0.5 Mg CO₂e
(COMET-Planner)

Riparian Forest Buffer: Completed 2015
175 Redwoods Planted
.75 Acre = 3.08 Mg CO₂e
(Lewis, UCCE Local Data)

Source: Soil, field, and air data; Earthstar 9 maps; WEBSITE to US, USDA, USFS, CALIF. Department of Agriculture, NRCS, and the 913 local community; Soil, HERE, Baidu, Google, Mapbox, © OpenStreetMap contributors, and the GIS data community

1 inch = 930 feet
0 325 650 1,300 1,950 2,600 Feet

Results

Straus Family Creamery – Albert Straus

“On-farm composting and use should be encouraged and be part of the program. Reduced odors, sequestering carbon, reducing bacteria and converting nutrients are some of the benefits.”

Corda Ranch – Hank Corda

“We have seen an increase in the pasture production plus it appears there is increased water retention capacity of the soils.”

Stemple Creek Ranch – Loren Poncia

“We have seen an increase in perennial grasses and a positive change in the water cycle where we have applied compost. I would recommend compost application be included as standard practice to positively influence rangeland, decrease soil erosion, increase water retention and organic matter in the soil.”

Countywide



30 applicants in 1st year of opening the program county-wide

11 ranches representing 7,000 acres enrolled thus far.

Marin Climate Action Plan goal to reduce GHG emissions by 84,160 tonnes of CO₂e

Marin Climate Action Plan goal can be offset with 5.2 km (3.2 miles) of stream revegetation

Marin Climate Action Plan goal can be offset with compost application over 6% of Marin's rangelands over 3 years.

Statewide

Statewide Efforts	Funding
Santa Barbara/ Marin RCD & Rangelands	11 th Hour, Rathmann, Marin Community Foundations, State Coastal Conservancy, USDA NRCS
Gold Ridge RCD & Orchards	State Coastal Conservancy, USDA NRCS
Sonoma & Napa RCDs & Vineyards	State Coastal Conservancy, USDA NRCS
Mendocino RCD & Forestry	State Coastal Conservancy, USDA NRCS
San Mateo RCD & Biochar	USDA NRCS, Department of Conservation





Thank You

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