The Marin Carbon Project

CARBON FARMING:
Increasing Carbon Capture on California's Working Lands

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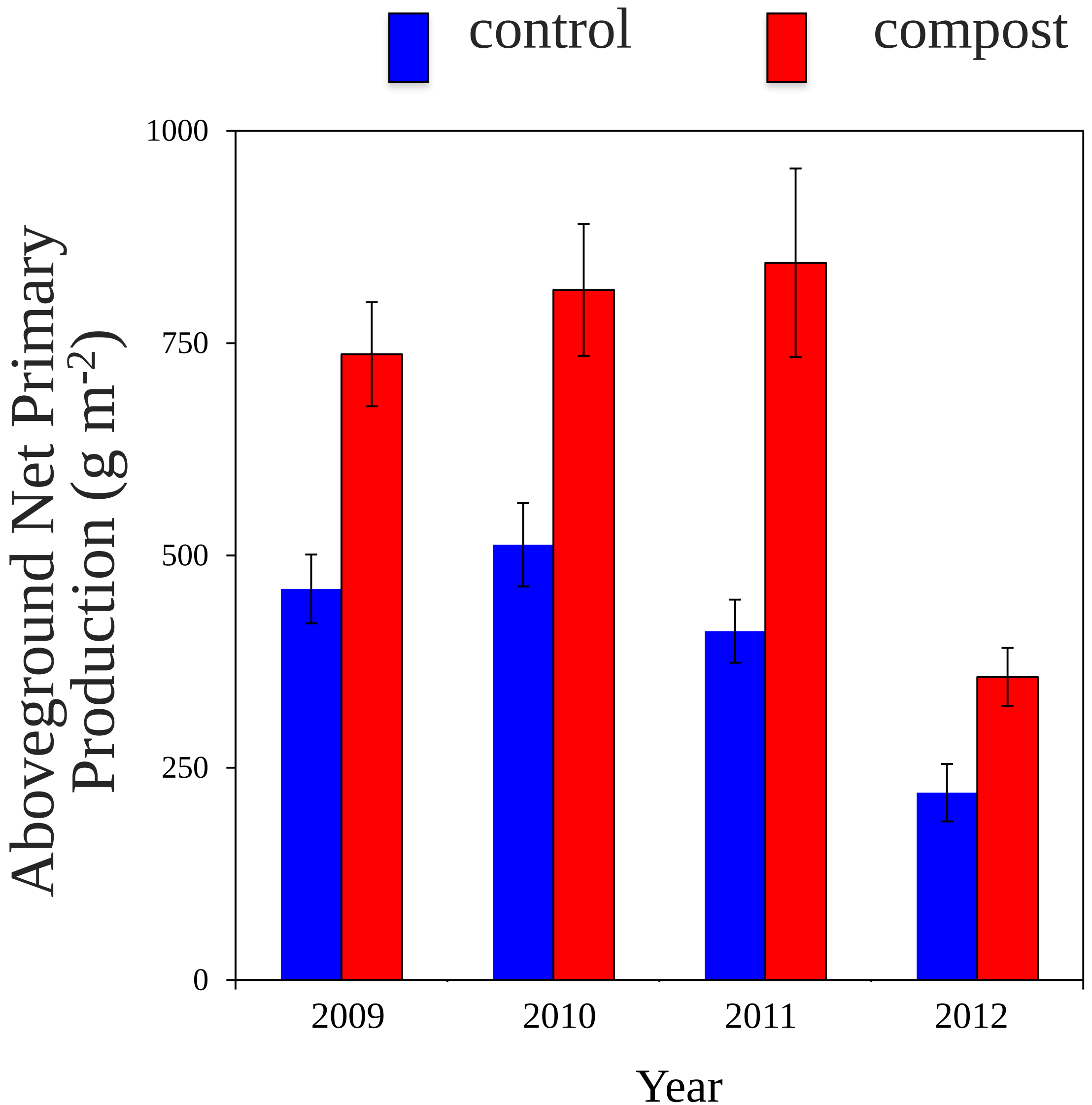
Nicasio Native Grass Ranch

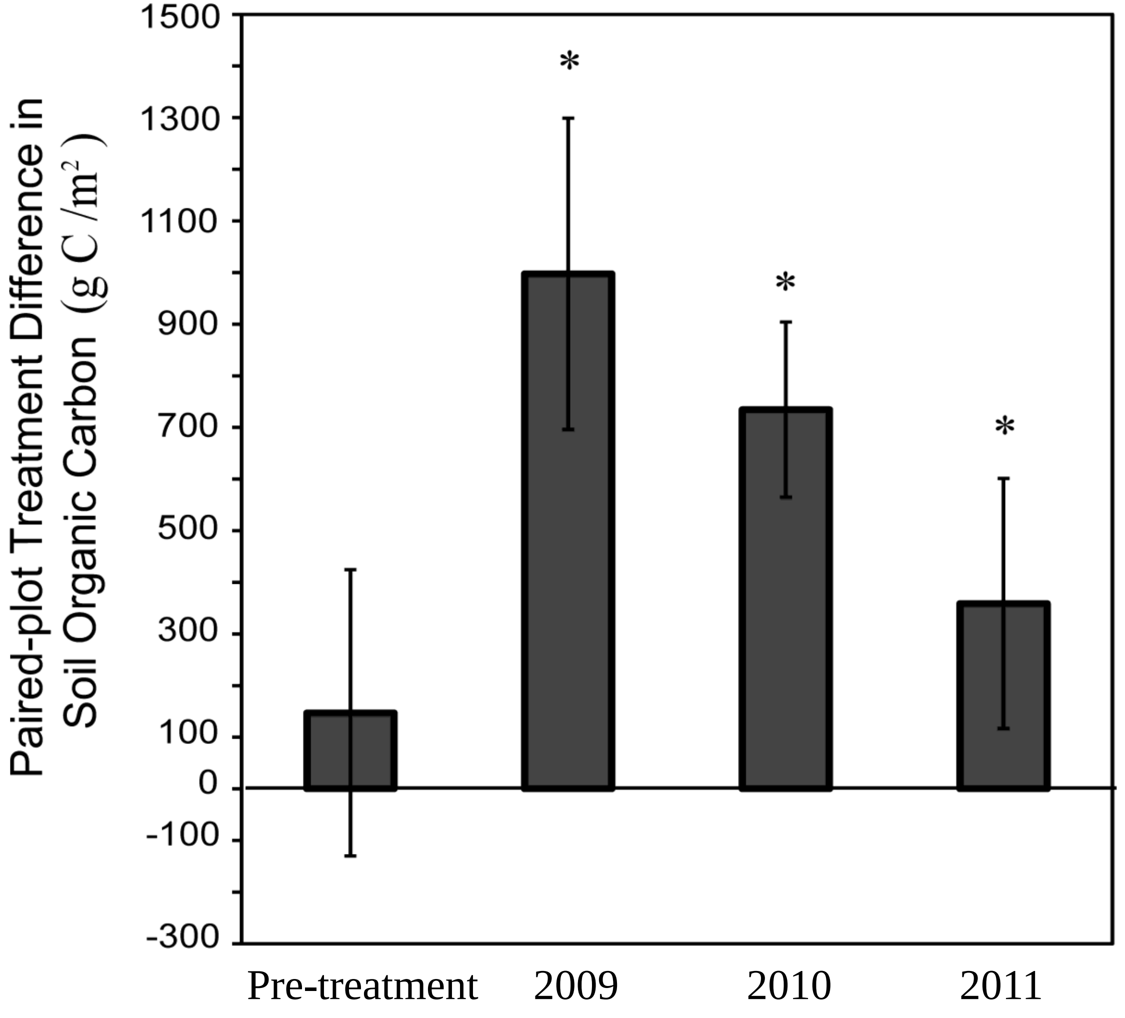
Can management ***measurably*** increase soil carbon; ***and what happens if we succeed?***

Results: Above-ground production (forage) has exceeded controls by 40-70% ***every year*** following the single ½" compost application in 2008



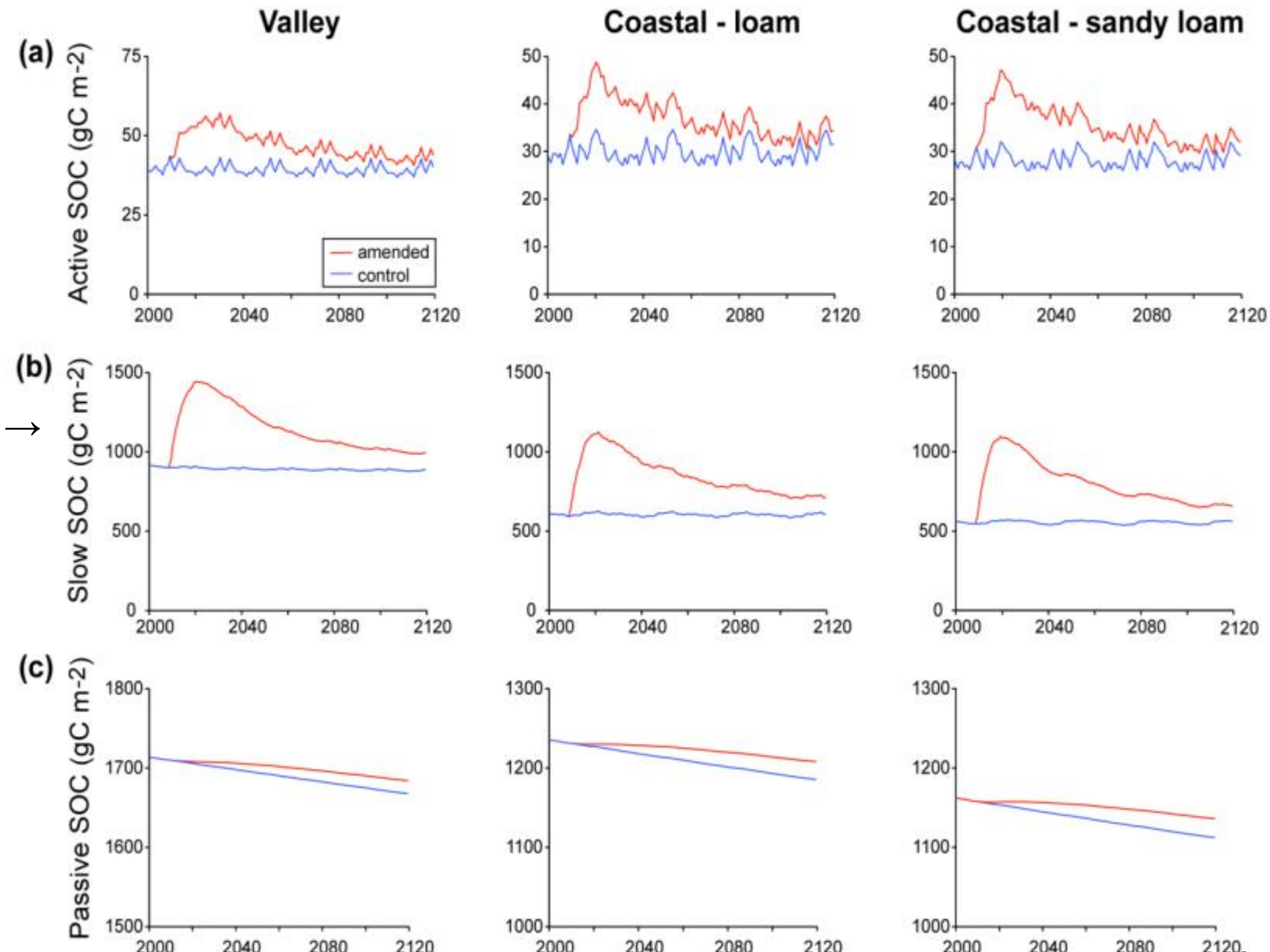
Ryals and Silver 2012

Compost increased soil C (above compost C alone)



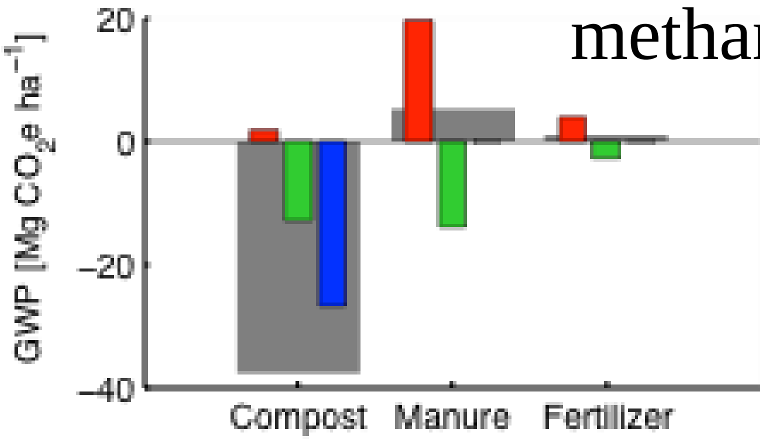
Ryals et al. 2013

Models suggest that the C increase effect persists for 30-100 years

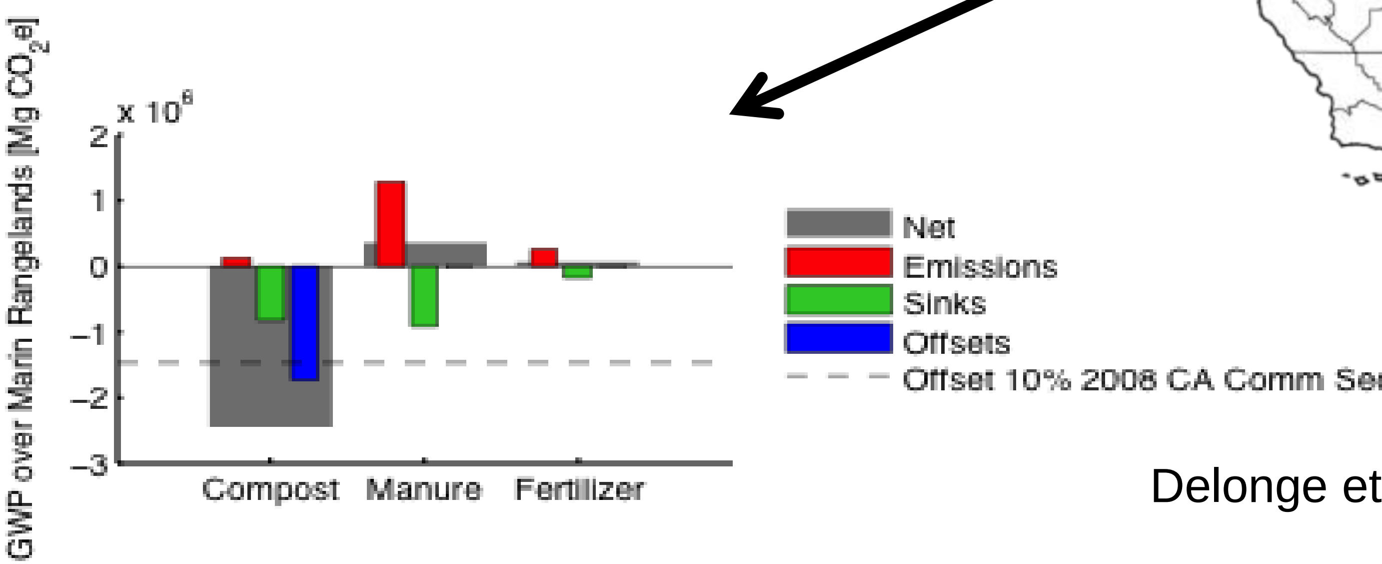


Ryals et al 2013

Lifecycle Assessment: diverting organic materials from anaerobic storage and disposal to aerobic composting and land application leads to large offsets from avoided methane emissions

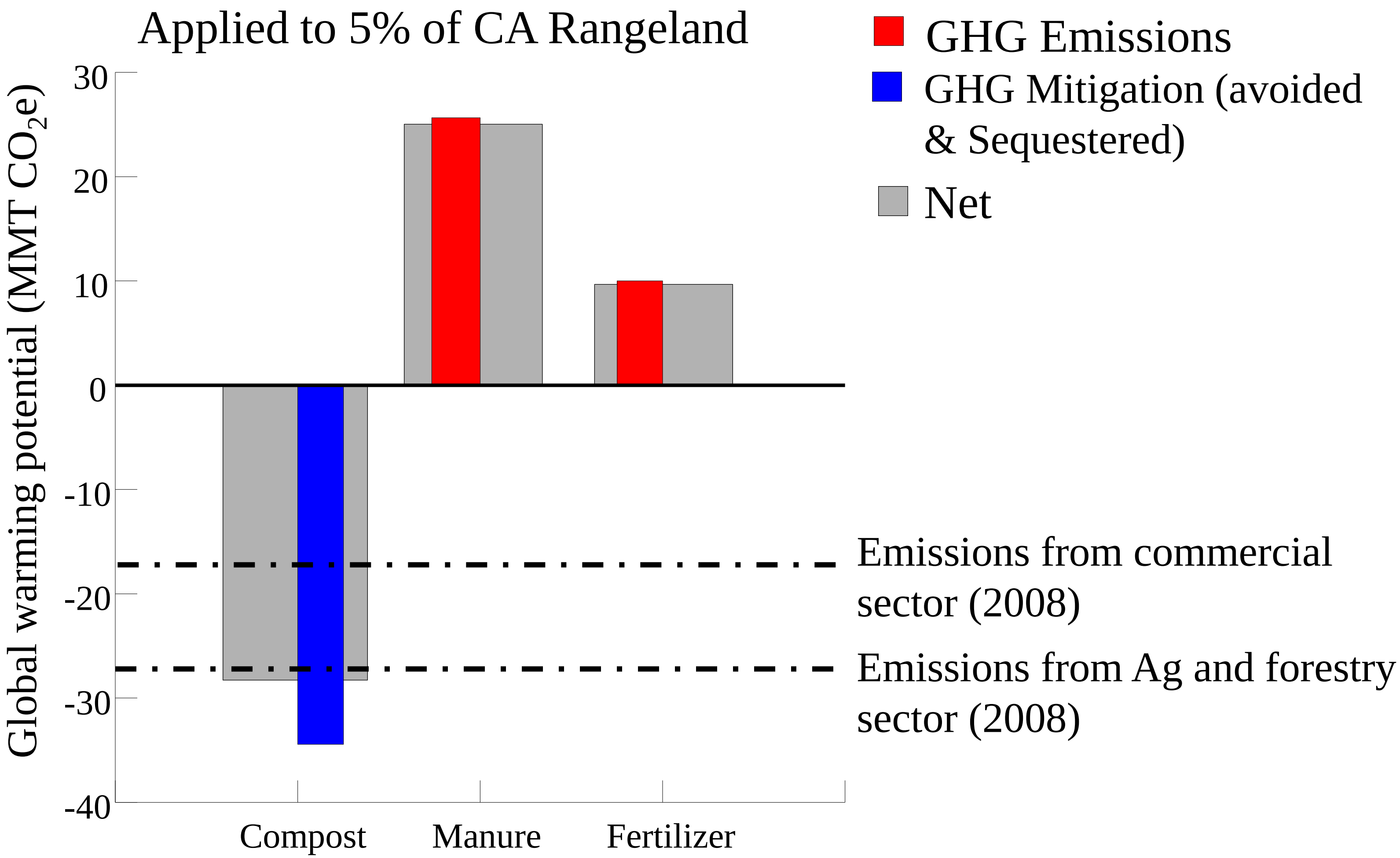


65,000 ha
Marin
Rangelands



Delonge et al. 2013

Life Cycle Assessment suggests significant GHG mitigation potential statewide

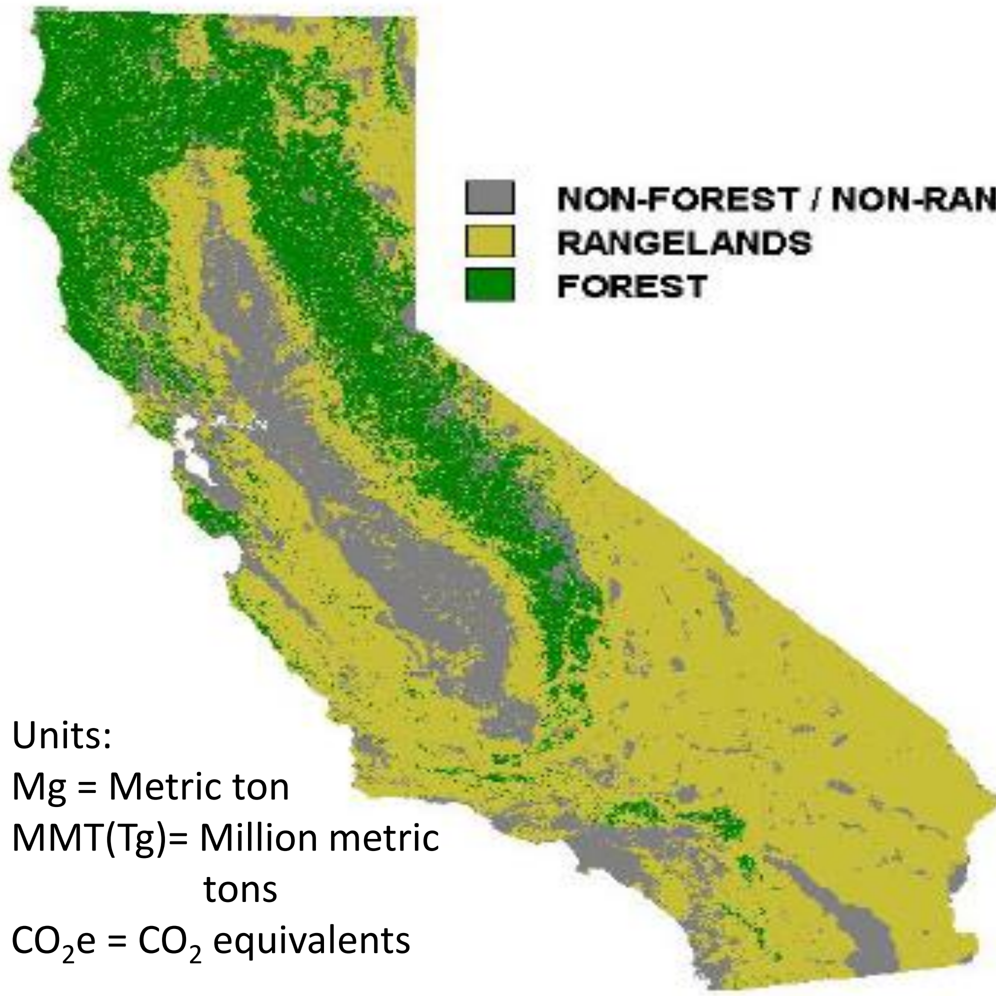


Redrawn from DeLonge et al. 2013

California Rangelands Carbon Sequestration Potential With Compost Additions

23 million hectares (57 million acres) of rangeland in California: 67% (38 million acres) is grasslands and pastures.

(Without avoided methane emissions)



At a rate of 0.5 Mg C ha^{-1} y^{-1}
= 28 MMT(Tg) CO_2e y^{-1}

At a rate of 1 Mg C ha^{-1} y^{-1}
= 56 MMT(Tg) CO_2e y^{-1}

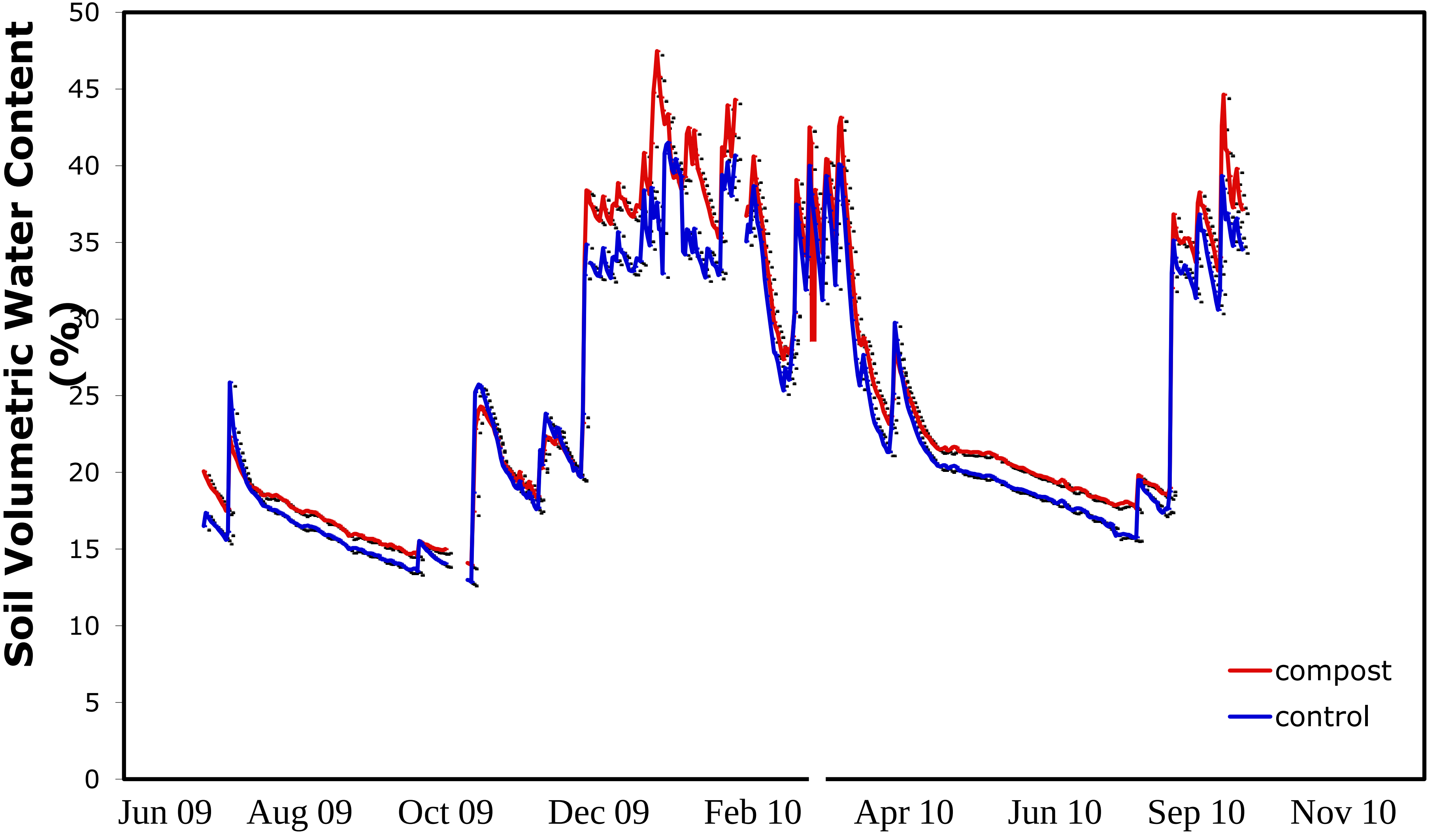
At a rate of 3 Mg C ha^{-1} y^{-1}
= 169 MMT (Tg) of CO_2e y^{-1}

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

Emissions data: CA GHG Inventory 2010

Units:
Mg = Metric ton
MMT(Tg)= Million metric tons
CO_2e = CO_2 equivalents

Compost also increased soil moisture….



UCSFREC, Browns Valley, Ryals and Silver 2013

Moderating Climate Change with Soil Carbon Management

CARBON CYCLE INSTITUTE

MARIN CARBON PROJECT

USGS
science for a changing world

INTRODUCTION

- Climate change is ongoing with changes in weather patterns and increases in extreme events, such as the current California drought.
- Biosequestration removes carbon from the atmosphere and stores it in plants and soil, increases soil water holding capacity, increases net primary productivity, and enhances other ecosystem services.
- Marin Carbon Project (MCP)research showed increases in soil water holding capacity (WHC) associated with topical applications of compost.
- The 25% WHC increase modeled here is based on first year increases in soil carbon on MCP treatment plots. (Ryals, R and W. Silver, 2013. Ecological Applications, 23(1), pp. 46–59).
- Composting is a particularly powerful biosequestration strategy due to both the avoidance of methane production by diversion of organic materials away from anaerobic decomposition in landfills and manure lagoons, and through enhanced NPP resulting from soil quality improvement following compost application. (DeLonge et al, 2013, Ecosystems 16: 962–979).

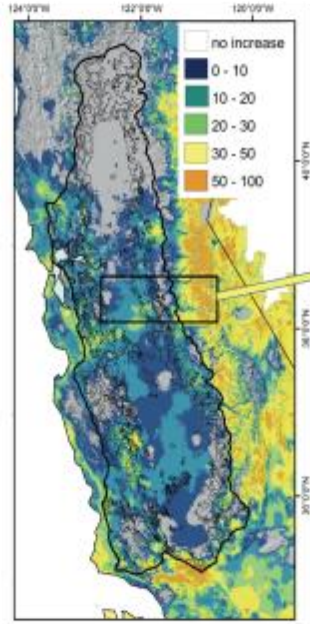
CLIMATE CHANGE AND HYDROLOGY

- The hydrologic impacts of climate change include changes in water availability and increases in demand for water.
- This translates into environmental stress that relates to wildfire, forest die-off, desertification, and loss of riparian zones and groundwater.
- Climatic water deficit is a key indicator of landscape stress.

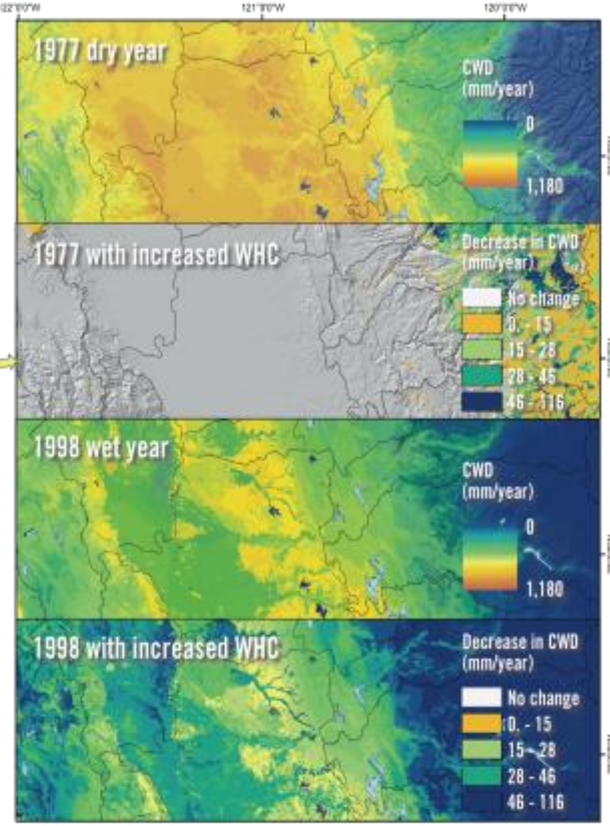
CLIMATIC WATER DEFICIT (CWD)

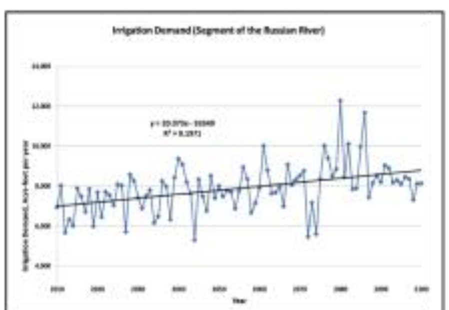
- Annual evaporative demand that exceeds available water
- CWD = potential – actual evapotranspiration
- Defines the level of hydroclimatic stress on the landscape
- Integrates climate, energy loading, drainage, and available soil moisture storage and addresses irrigation demand

Projected Increase in CWD by 2085 (mm/year)

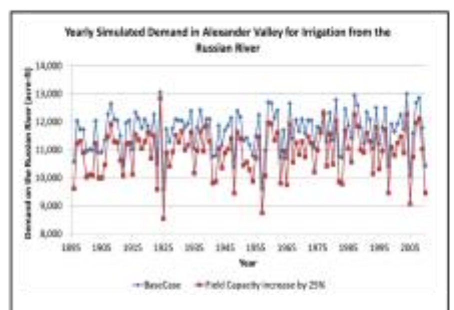


Much of California's rangelands are projected to increase in CWD by 10 to 30 mm (or 527,000 to 5,278,000 AF for the entire state) by end-of-century.





CWD has been shown to correlate to irrigation demand in the Russian River's Alexander Valley. Projections indicate a potential increase in demand of nearly 2,000 ac-ft/yr by the end of the century.



If we increase water holding capacity of the soil by 25%, we reduce CWD and correlated losses due to demand from the Russian River by approximately 6.6% or 776 AF/year.

Climatic water deficit is shown for a wet year, 1998, and dry year, 1977, for a slice across the Central Valley and up into the Tuolumne River basin. Also shown is the change in CWD when soil water holding capacity is increased by 25%. Whereas in a dry year compost only contributes to reducing CWD in relatively shallow soils (because there isn't enough precipitation to fill the increased WHC in deeper soils), in wetter years all soils see a big decrease in CWD due to filling of soils including the increased WHC. Thus, all else being equal, benefits of increased WHC accrue primarily in shallower, non-irrigated soils in drier years. In addition, when rainfall occurs in less frequent, more intense events, as expected in CA under climate change scenarios, the effects of increased soil organic matter, including increased rates of infiltration, increased pore space, and increased hydraulic conductivity, result in the capacity to absorb and hold more rainfall, and sustain the landscape through the season.

IMPLICATIONS AND NEXT STEPS

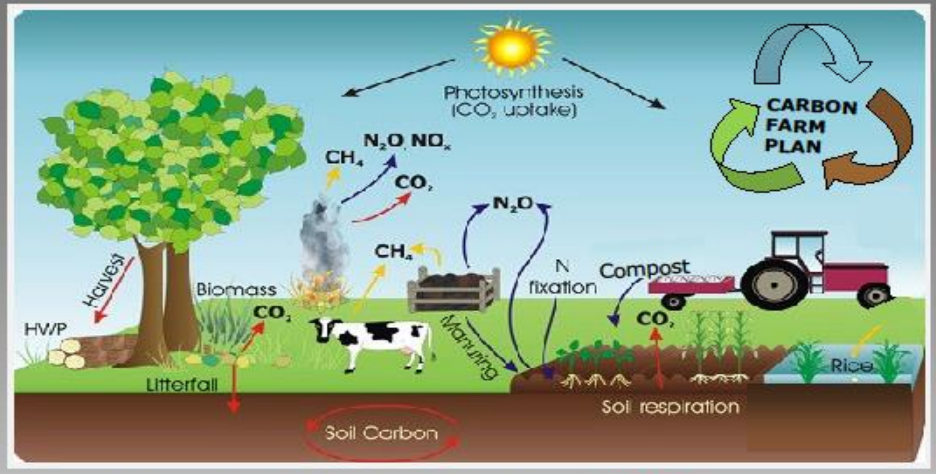
- Climate change is likely to reduce the extent and productivity of both rangelands and arable lands due to increases in climatic water deficit.
- Increases in evaporative demand and irrigation demand will reduce groundwater and surface water availability.
- Increases in soil water holding capacity and infiltration rate can increase ecosystem resilience by reducing the climatic water deficit, increasing productivity and available water, and helping to compensate for changing climatic conditions, including drought, increased rainfall intensity, and decreased rainfall predictability.
- Amendments of compost to rangelands can sequester carbon in soils, mitigate greenhouse gas emissions and increase soil water holding capacity and infiltration rate.
- Sensitivity analyses can help identify soil types that may benefit the most from strategic soil management and addition of compost.
- Local experimentation is needed to provide confidence in the mapping of climatic water deficit and changes due to compost amendments.
- These quantification and mapping methods can be applied to regions, river basins, or continents.

Carbon Farm Planning and Implementation

Implementation Activities

- Identify demonstration C-Farms and conduct farm assessments, including soil sampling (2013).
- Apply compost on rangelands at scale (2013)
- Develop list of other carbon beneficial NRCS practices, plus;
- Complete 3 C-Farm Action Plans
- Calibrate GHG accounting models with COMET-Farm/CSU and C-Farm data.
- Provide C-Farm permit assistance, technical expertise, implementation funding and monitoring assistance.
- Implement C-Farming workshops for farmers and ranchers (2015)
- Confirm roles of project partners and scalability to other counties.

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 EQIP programs.
- Must maintain interest and 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

The Project will Fund:

1) Ranch Planning and Permitting
2) Technical/Engineering Expertise
3) Construction of Conservation Practices

Conservation Practices:

- Compost Application, Purchase
- Erosion Protection Planting: Grasses, Shrubs and Trees
- Crop Rotation and Cover Crop
- Hedgerows and Windbreaks
- Filter Strips and Grassed Waterways
- Forest Establishment
- 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 1ST!!! CONTACT:

Marin Resource Conservation District
Nancy Scolari or Lynette Niebrugge
Phone: (415) 663-1170
Email: marinrcd@marinrcd.org

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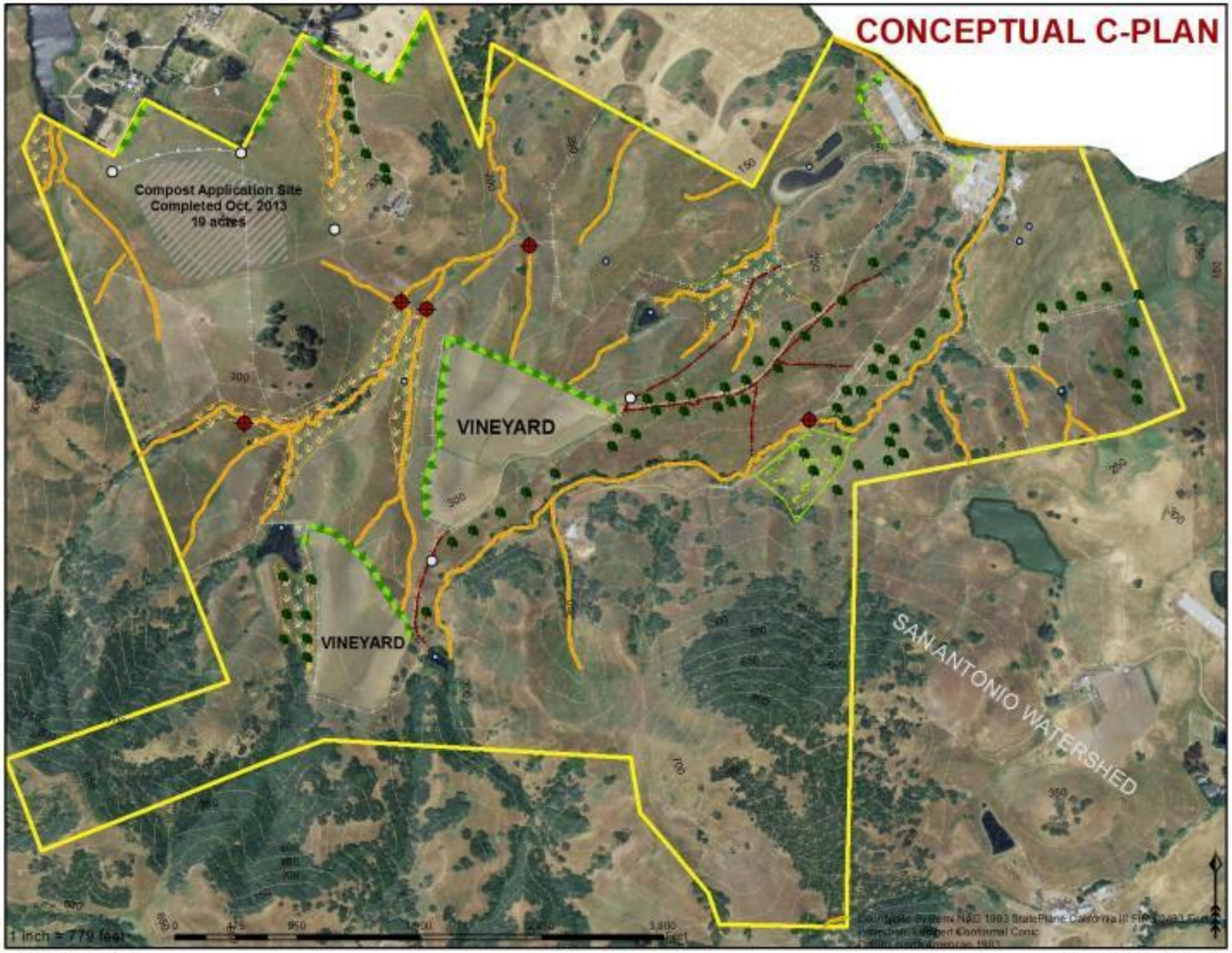
MARIN AGRICULTURAL LAND TRUST

Marin Carbon Project
DRAFT
Carbon Farm Plan
CORDA RANCH

MARIN RESOURCE CONSERVATION DISTRICT



Author: Lynette K Niebrugge

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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)

Quantifying C-Farm Impacts

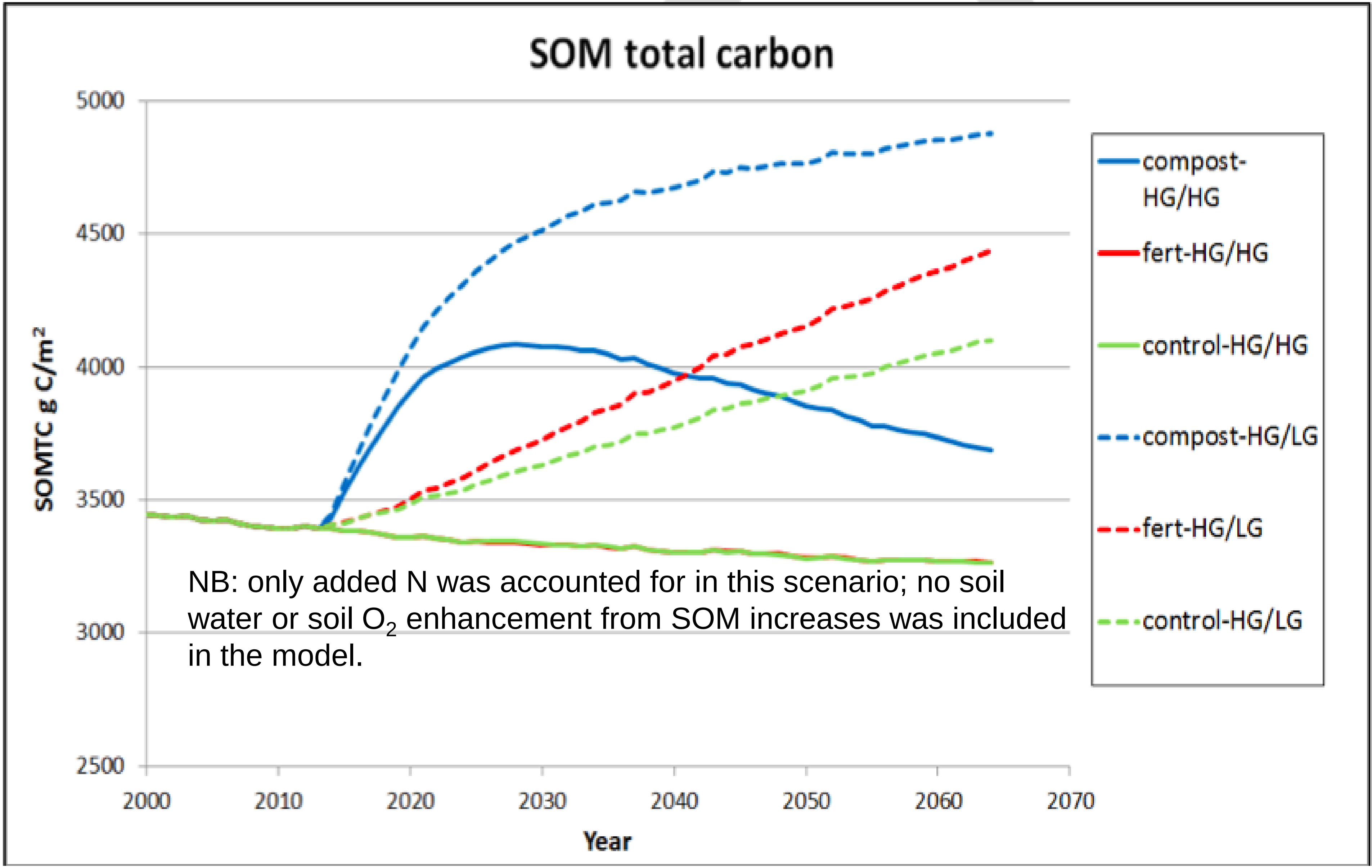
The COMET-Farm Tool
(http://cometfarm.nrel.colostate.edu)
has potential to allow a relatively rapid and thorough assessment of the greenhouse gas benefits of Integrated Carbon Farms

Working with CSU's NREL to use and refine the methods and models behind the COMET-Farm tool to:

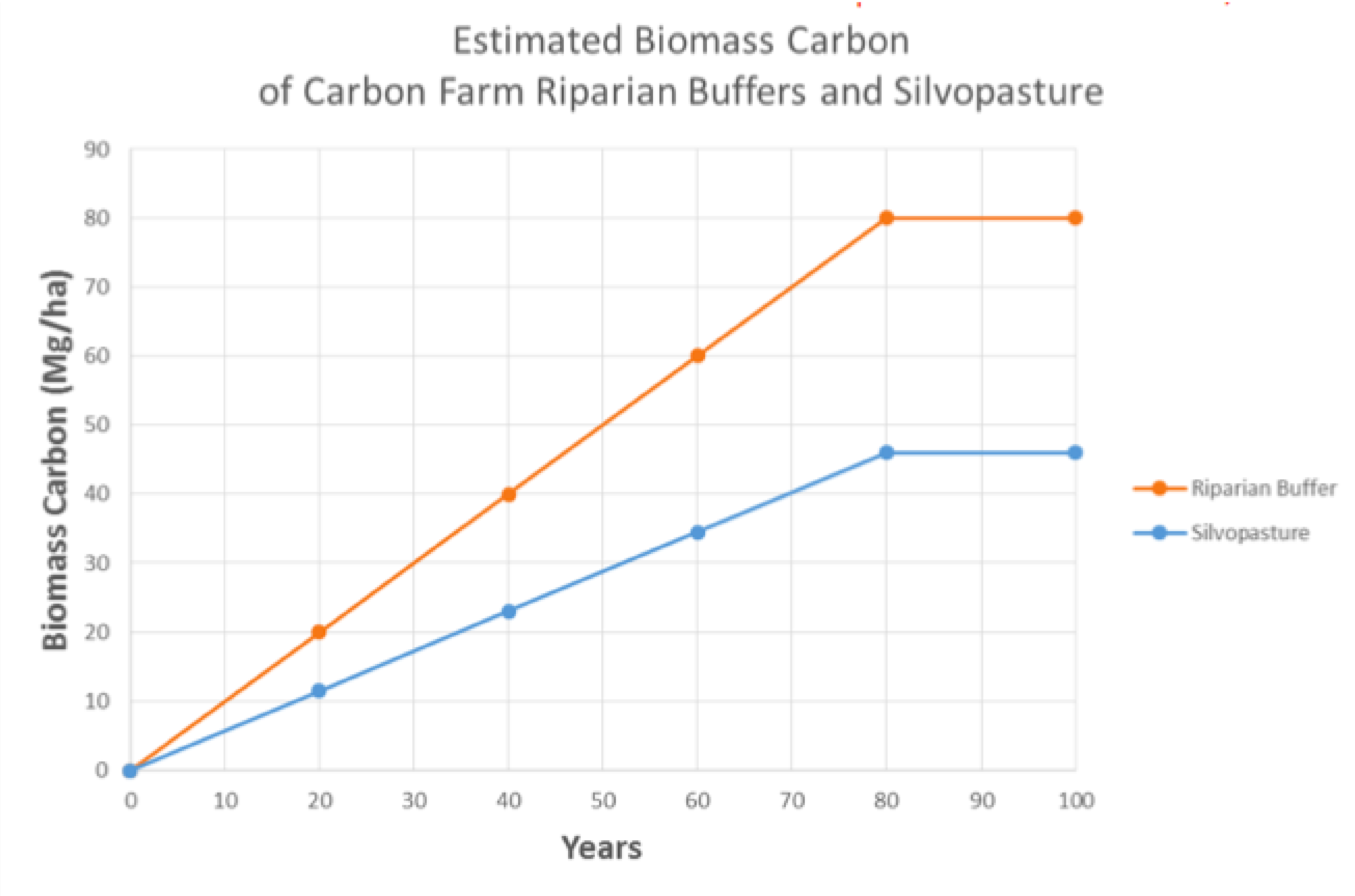
1)calculate the greenhouse gas benefits of proposed practices for our three demonstration carbon farms and;

2)Develop a rapid-assessment on-farm conservation practice carbon capture planning tool:

COMET-Planner Tool
(http://comet-planner.nrel.colostate.edu)



Carbon capture synergies
resulting from "stacking" of compost addition and improved grazing practices


Estimated Biomass Carbon
of Carbon Farm Riparian Buffers and Silvopasture
Biomass Carbon (Mg/ha)
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Years
Riparian Buffer
Silvopasture

Questions?

www.marincarbonproject.org

Photo: http://restlesspilgrim.net