What is Carbon Farm PLANNING?

Planning on-farm CONSERVATION practices to:

- Increase biological carbon
- Reduce GHG emissions
- Quantify carbon benefits of conservation practices relative to current condition
What is Carbon Farm PLANNING?

Managing Carbon (Energy!) Flow Through The Ecosystem

First trophic level: Photosynthesizers
Second trophic level: Decomposers Mutualists Pathogens Parasites Root-feeders
Third trophic level: Shredders Predators Grazers
Fourth trophic level: Higher level predators
Fifth and higher trophic levels: Higher level predators
Why Carbon Farm PLANNING?

• Carbon can be beneficially stored long-term in soils and vegetation through biological carbon sequestration

• Agriculture can provide solutions to climate change

• Increasing global soil OM by 0.4% annually would offset all global CO2 emissions

Creating a Carbon Farm Plan

1. Farm Assessment
2. Document farming options
3. Prioritize options into a working Plan
Creating a Carbon Farm Plan

1. Farm Assessment
   - Producer’s objectives
   - Producer’s operations
   - Producer’s interest
   - Producer’s landscape
Creating a Carbon Farm Plan

2. Document farming options
Explore with the Carbon Lens!

- Is there potential for Seq-C Soil AND Seq-C Vegetation?
- NRCS - 34 climate beneficial practices
- Site analysis
- Maps: Google Earth, GIS, Soil Survey, other plans
Creating a Carbon Farm Plan

3. Prioritize options into a working Plan

Compatibility of practices with:

- Grower’s priorities
- Crop production
- Farm ecology
- Costs
- Quantitative impacts of practices

Goal is IMPLEMENTATION
Calculating Carbon Potential

LOCAL DATA; other sources
CREEK CARBON: D.Lewis et al 2015
Example Ranch:

Potential terrestrial carbon sequestration through implementing conservation practices identified through a Carbon Farm Planning Process

CO2e reduction at Maturity = 708,270 Metric Tons =

149,109 Passenger vehicles driven for one year!
Components of a Successful Carbon Farm Plan

- Evolving and dynamic
- Reflects priorities of producer
- Collaborative product
- Implementation schedule & strategies
- Can complement other Farm Plans
- Multi-benefit
Carbon Farm Planning and LandSmart

MARIN CARBON PROJECT

Carbon Cycle Institute + LandSmart

A program of
Resource Conservation District (RCD)
and Natural Resources Conservation Service (NRCS)
Sonoma RCD, Gold Ridge RCD, Mendocino RCD, Napa RCD, Marin RCD

By March 2017:
- Vineyard Carbon Farm Plan Template (already complete)
- Orchard Template
- Rangeland Template
- Forestry Template
Vineyard Carbon Farm Plan Template

• Site Description
• Assessment of Potential Carbon Beneficial Practices
  – WATER-RELATED ENERGY
  – VINEYARD VEHICLES
  – VINEYARD FARMING PRACTICES
  – VINEYARD MANAGEMENT
  – VEGETATION IN AND AROUND THE VINEYARD
• Monitoring Soil Carbon
• Carbon Farm Plan Summary & Map
C16. Tillage is minimized or no-tillage is practiced in efforts to promote a healthy soil ecosystem for maximizing soil carbon sequestration potential.

☐ Yes – Describe current practice:

☐ No (Consider practice # 2 in Table C4 below)

*Opportunities and farming practices to reduce tillage:*

E.g. use alternative equipment, reduce depth, reduce frequency
Planned (NRCS) Practices are Assembled in Tables

<table>
<thead>
<tr>
<th>Conservation Practice</th>
<th>NRCS Practice Title</th>
<th>Current Practice</th>
<th>Planned Implementation Date</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Conduct soil analysis for organic matter</td>
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<tr>
<td>2. Reduce tillage (permanent perennial or no-till annual cover crop is ideal for reducing GHG emissions and improving soil health and carbon sequestration).</td>
<td>Residue and Tillage Management (329, 345), Conservation Cover (327), Cover Crop (340)</td>
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<td></td>
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</tr>
<tr>
<td>3. Incorporate grazing animals into vineyard management to reduce equipment needs, increase nutrient cycling and enhance cover crop performance.</td>
<td>Prescribed Grazing (528)</td>
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</tr>
<tr>
<td>4. Utilize organic contact herbicide, hand hoe, mow or graze to control vegetation under the vines.</td>
<td>Integrated Pest Management (595)</td>
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</tr>
<tr>
<td>5. Apply ≥ 4 inches of mulch under vine rows to suppress weed growth, conserve water and increase soil organic matter.</td>
<td>Mulching (484)</td>
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<tr>
<td>6. Apply ½” – 1” of compost in alleys and 1”-2” in vine rows to increase soil organic matter, conserve water and improve soil</td>
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</tr>
</tbody>
</table>
# Carbon Farm Plan Summary

<table>
<thead>
<tr>
<th>Ranch/ Property ID</th>
<th>XXXXX</th>
<th>NRCS CPS</th>
<th>Practice Description</th>
<th>Field Location</th>
<th>Acres</th>
<th>Current Practice</th>
<th>Proposed Practice</th>
<th>Implementation Date</th>
<th>CO2e per acre per year</th>
<th>CO2e Annual Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>329</td>
<td></td>
<td>329</td>
<td>Covventional Tillage to No Tillage</td>
<td>Blocks A, B, C, D, E</td>
<td>4</td>
<td>Alternate row tillage. Alternate no till &amp; alternate till</td>
<td>Full no tillage. Very minimal tillage may be incorporated from time to time for breaking up tractor compaction and for soil amendments</td>
<td>2017-2019</td>
<td>0.74</td>
<td>2.96</td>
</tr>
<tr>
<td>391</td>
<td></td>
<td>391</td>
<td>Riparian Forest Buffer Establishment</td>
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<tr>
<td>379</td>
<td></td>
<td>379</td>
<td>Multistory Cropping</td>
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<tr>
<td>422</td>
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<td>422</td>
<td>Hedgerow Plant</td>
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<tr>
<td>590</td>
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<td>590</td>
<td>Nutrient Management/Compost Application</td>
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<tr>
<td>340</td>
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<td>340</td>
<td>Cover Crop establishment</td>
<td></td>
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</tr>
<tr>
<td>380</td>
<td></td>
<td>380</td>
<td>Windbreak /Shelterbelt Establishment</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>657</td>
<td></td>
<td>657</td>
<td>Wetland Restoration</td>
<td></td>
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</tr>
</tbody>
</table>

*Monitor and Evaluate fuel and electricity usage.*
Huichica Creek Vineyard
Sustainable Agriculture Demonstration
Made possible by a grant from the California State Coastal Conservatory
www.naparcd.org
Huichica Creek Vineyard

1. Farm Assessment

- Producer’s objectives
- Producer’s operations
- Producer’s interest
- Producer’s landscape
Huichica Creek Sustainable Demonstration Vineyard

- 21 Acres, 13 Acres Chardonnay & Pinot, 1 Acre cider apples
- 4 acres Wetland
- Huichica Creek frontage
- 26 years of site restoration: oak trees, creeping wild rye, hedgerows
- Recent grant funding to
  - Improve water management (DWR)
  - Redevelop 3-acre block with climate beneficial farming practices (NRCS CIG)
Huchica Creek Vineyard

2. Farming Options

CPS 329
Conventional Tillage to No Tillage

CPS 391
Riparian Buffer

CPS 380/ 657
Wetland Restoration
Wind Break
Huchica Creek Vineyard

2. Farming Options

- CPS 379 Multistory Cropping/ Diversifying
- CPS 340 Cover Crop Establishment
- CPS 422 Hedgerow Planting
- CPS 590 Nutrient Management / Compost
Huichica Creek Vineyard
Farming Options to quantify for the Future

- Fuel and Energy Usage
- Graze Livestock for weed management and soil fertility
- More Multistory cropping and Diversification
- Biochar application as tool to promote carbon sequestration and soil fertility.
Huchica Creek Vineyard

3. Prioritize options into a Plan

Napa County RCD - Carbon Farm Plan
Huchica Creek Sustainable Demonstration Vineyard

Legend and Current Practices
- Blocks A-E: Alternate Row Till
- Block G: No Till
- Replant Block F: No Till
- Apple Cider Orchard
- 5 Foot Contour
- Huchica Creek
- Deer Fence
- Existing Hedgerow

Planned Conservation Practices
- Compost Application in all vineyard blocks
- Riparian & Wetland Restoration
- Future Hedgerow
- Multistory Cropping
- Conventional Tillage to No-Till

Carbon Farm Practices (NRCS Practice)
1. Compost Application Mulching (484)
2. Conventional Tillage to No Tillage (329)
3. Hedgerow Planting (422)
4. Nutrient Management (590)
5. Riparian Forest Buffer (391)
<table>
<thead>
<tr>
<th>NRCS CPS</th>
<th>Practice Description</th>
<th>Field Location</th>
<th>Acres</th>
<th>Current Practice</th>
<th>Proposed Practice</th>
<th>Implementation Date</th>
<th>CO2e per acre per year</th>
<th>CO2e Annual Total</th>
<th>CO2e 20yr Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>329</td>
<td>Conventional Tillage to No Tillage</td>
<td>Blocks A,B,C,D,E</td>
<td>4</td>
<td>Alternate row tillage. Alternate no till &amp; alternate till</td>
<td>Full no tillage. Very minimal tillage may be incorporated from time to time for breaking up tractor compaction and for soil amendments</td>
<td>2017-2010</td>
<td>0.74</td>
<td>2.96</td>
<td>59.20</td>
</tr>
<tr>
<td>391</td>
<td>Riparian Forest Buffer Establishment</td>
<td>Huichica Creek top of banks</td>
<td>2.76</td>
<td>Restoration plantings and volunteers have re-vegetated the creek</td>
<td>Restore areas that with native plantings where noxious weeds have populated or where there open areas.</td>
<td>2016-2025</td>
<td>16.34</td>
<td>45.10</td>
<td>901.97</td>
</tr>
<tr>
<td>379</td>
<td>Multistory Cropping</td>
<td>Block F - Apple Orchard</td>
<td>0.75</td>
<td>Vineyard</td>
<td>Plant cider apples on standard rootstock. Establish a diverse grassland understory.</td>
<td>2016</td>
<td>1.63</td>
<td>1.22</td>
<td>24.45</td>
</tr>
<tr>
<td>422</td>
<td>Hedgerow Plant</td>
<td>Along access road and Block F</td>
<td>0.15</td>
<td>grasses</td>
<td>Plant native flowering shrubs</td>
<td>2017-2018</td>
<td>1.32</td>
<td>0.20</td>
<td>3.96</td>
</tr>
<tr>
<td>590</td>
<td>Nutrient Management/Compost Application</td>
<td>All blocks</td>
<td>14</td>
<td>No compost application</td>
<td>Apply 10-15 tons compost per acre, every 2-3 years.</td>
<td>2015-Lifetime of vineyard</td>
<td>0.44</td>
<td>6.16</td>
<td>123.20</td>
</tr>
<tr>
<td>340</td>
<td>Cover Crop establishment</td>
<td>Blocks A,B,C,D,E</td>
<td>4</td>
<td>Alternate row tillage. Alternate no till &amp; alternate till</td>
<td>Maintain annual and/or perennial soil cover. Very minimal tillage may be incorporated from time to time for breaking up tractor compaction and for soil amendments</td>
<td>2017-2018</td>
<td>0.37</td>
<td>1.48</td>
<td>29.60</td>
</tr>
<tr>
<td>380</td>
<td>Windbreak /Shelterbelt Establishment</td>
<td>Block A</td>
<td>0.5</td>
<td>No windbreak/shelterbelt</td>
<td>Replace one row vines in replant. Establish shelterbelt at windward fenceline</td>
<td>2018-2020</td>
<td>2.09</td>
<td>1.05</td>
<td>20.90</td>
</tr>
<tr>
<td>Monitor and Evaluate fuel and electricity usage</td>
<td>Entire Vineyard Operation</td>
<td></td>
<td></td>
<td></td>
<td>Planning</td>
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</tbody>
</table>

**TOTAL** 66.52 1330.48
Practice map shows planned and implemented practices

Napa County RCD - Carbon Farm Plan
Huichica Creek Sustainable Demonstration Vineyard

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3. Hedgerow Planting (422)
4. Nutrient Management (590)
5. Riparian Forest Buffer (391)
Relative Impact of Practices

- Conventional Tillage to No Tillage: 68%
- Riparian Forest Buffer Establishment: 13%
- Multistory Cropping: 9%
- Hedgerow Plant: 4%
- Nutrient Management/Compost Application: 2%
- Cover Crop establishment: 2%
- Windbreak /Shelterbelt Establishment: 2%
- Wetland Restoration: 0%
Take Home Message:

Carbon Farm Planning is a possible Climate Change Solution for Growers
QUESTIONS?

Charles Schembre
Charles@NapaRCD.org
707-252-4189 x3112
**Carbon-Soil-Water-Climate Connection**

**IF**

CA’s vineyards (~ 500,000 acres) increase SOC by 1% (1% to 2%) in the plow layer

**THEN**

- Water holding capacity increase by ~41,667 acre feet
- CO2e sequestered > 16 million metric tons (MMg).

**WHICH MEANS**

- **25%** reduction in CA’s annual vineyard water use (1.7 million AF)
- **38%** of the CA’s annual Commercial/Residential energy emissions offset (~ 42 MMg CO$_2$e) OR CA’s annual livestock emissions

**ASSUMPTIONS**

- Based on plow layer (top 6.7”) only; including deeper soil strata increases potential
- 1% increase in SOM results in 1 acre-inch increase in soil water holding capacity per acre;
- 1% increase in SOC represents 2% increase in SOM;
- 1 metric ton (2,200 lbs) of soil C represents 3.67 metric tons of CO2e;
- 1% increase in (plow layer only) SOC is about 10 short tons or 9 metric tons SOC/acre.
Excess sedimentation impairs aquatic habitat

- Suffocates fish eggs in spawning beds
- Loss of aquatic habitat
Key Elements of Carbon Farm Plan

- Evolving and dynamic
- Reflects priorities of producer
- Provide recommendations
- Implementation schedule
- Implementation strategies
Why Carbon Farm PLANNING?

– Assess whole farm
– Track progress towards goals
– Use limited resources efficiently
– Develop a farmer who has documented options for the future

Latest CO₂ reading
April 13, 2016

408.90 ppm

Short Term Impacts of Practices are Significant as Well

December 2013
Photos from Marin Carbon Project
Soil Monitoring

- RCDs and NRCS have a standard protocol (thank you Josh!)

### 4. MONITORING SOIL CARBON

**Background:** Use this table to monitor and track soil health over time.

<table>
<thead>
<tr>
<th>Date</th>
<th>Sample Location (show on map if possible)</th>
<th>Bulk Density</th>
<th>Total Organic Carbon</th>
<th>Active Carbon</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>gm/cm³</td>
<td>%</td>
<td>Tons per acre</td>
<td>%</td>
<td>Tons per acre</td>
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<td></td>
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