CARBON FARMING

CRYSTAL POWERS  UNIVERSITY OF NEBRASKA – LINCOLN @UNLextCRYSTAL DARBY SPRINGS FARM @DARBYSPRINGS
• What is carbon farming?
• How is it done?
  • Annual crops
  • Perennial crops
  • Livestock
• Case study at Darby Springs Farm
What is carbon farming?
Carbon Cycle
SOIL ORGANIC MATTER

- Essential for soil physical, chemical and biological functions
- Organic matter is about 57% carbon (dry wt)
Benefits

• Carbon sequestration
• Water holding – drought resiliency
• Water infiltration – reduced flooding
• Soil fertility
• Soil tilth: erosion control, deeper rooting
• Biodiversity: pollinators, wildlife, birds
• Beauty
How is it Formed?
Mycorrhizal fungi

- Grow on roots
- Hyphae transfer nutrients and carbon
- 5-21% of photynthetically fixed carbon transferred to soil
**Glomalin**

- Protein formed on the surface of the mycorrhizal fungi
- Highest levels found in diverse pastures rotationally grazed
- Lasts 7-42 years
- Holds 27% of soil’s stored carbon
- Creates tilth: soil aggregates
  - Protects from erosion
PRAIRIE SOILS
SOIL CARBON DEPLETION

- Have lost 50-70% of carbon stock
- Soil disturbance
- Erosion
- Conventional nitrogen and phosphorous
- Herbicides & pesticides
ANNUAL CROPS
LOW SEQUESTRATION
Reduced or no tillage

- Rodale Institute: Organic No-till
COVER CROPS

- USDA SARE Cover Crops guide
Compost & Manure

- Provides stable carbon
- Mulch
- Reduces GHG from food waste & manure
- Marin Carbon Project
CROP ROTATION

Legume:
- peas
- lima beans
- beans
- edamame

Root:
- onions
- turnips
- carrots
- garlic
- beets
- radishes

Leaf:
- lettuce
- greens
- herbs
- cabbage
- spinach

Fruit:
- cucumbers
- tomatoes
- squash
- eggplant
- peppers
- melons
**Biochar**

- Made by burning organic matter with very low oxygen
- [International Biochar Initiative](http://www.thebiocharinitiative.org)
PERENNIAL CROPS
MODERATE SEQUESTRATION
TREE CROPS

• Fruits, nuts, bamboo, lumber, rubber, cork, fuel...
• Bagersett Research Corp (MN): Nut crops
• Arbor Day Foundation Hazelnut Project
AGROFORESTRY

- Alley cropping
- Nitrogen fixing trees
- Shade grown coffee
- Nuts, timber...
- Savanna Institute
- USDA Agroforestry:
  - funding and information
AGROFORESTRY

Riparian buffers

Windbreaks
PERENNIAL GRAINS

The Land Institute
LIVESTOCK
MODERATE SEQUESTRATION
Silvopasture

Tree fodder

Hedge rows
SILVOPASTURE
**Holistic Management / Planned Grazing**

Simulations of grazing frequency’s impact on perennial grass root growth

Fig. 4. Root growth of bunchgrass plants clipped at target heights to simulate grazing (http://managingwholes.com/new-topsoil.htm).

(LH) Grazed 6 times at one leaf stage

(Middle) Grazed 3 times at two leaf stage

(RH) Grazed twice at three leaf stage
Holistic Management / Planned Grazing

- Holistically Managed Land
  - More roots = more carbon stored, less carbon in the atmosphere

- Conventionally Managed Land
  - Less roots = less carbon stored, more carbon in the atmosphere
Pasture cropping

- Winter annual with pasture
- 9 tC carbon/ha/annually
- 4 t/ha oats
- More info
PERMACULTURE METHODS
MODERATE TO HIGH SEQUESTRATION
GUILDS/ POLYCULTURES

Nine Layers of the Edible Forest Garden

1. Canopy/Tall Tree Layer
2. Sub-Canopy/Large Shrub Layer
3. Shrub Layer
4. Herbaceous Layer
5. Groundcover/Creeper Layer
6. Underground Layer
7. Vertical/Climber Layer
8. Aquatic/Wetland Layer
9. Mycelial/Fungal Layer
Keyline Design

- Uses a subsoiler or swales to move water from wet valleys to drier ridges
- Introduces oxygen to subsoil & compacted areas
- Introduction to the method
Hugelkultur

Images courtesy Paul Wheaton / RichSoil.com
Broad Scale Permaculture Design
CASE STUDY AT DARBY SPRINGS FARM
North fenceline

May 4
Grazing Tall
October 11, Graze line
Wetland guild

Aug 14
GRAZED (6 SEASONS) VS UNGRAZED

Aksarben
Silty Clay
Loam
HUGELKULTUR

May 19
GUILD (5 yr) VS LAWN VS CROP FIELD

Aksarben Silty Clay Loam
SOME (MORE) RESOURCES

• *The Carbon Farming Solution* by Eric Toensmeier
• *Restoration Agriculture* by Mark Shepard
• *Soil Carbon Cowboys* (10min video)

Thank You!

Email me: cpowers2@unl.edu

Check out our farm: Darby Springs Farm