Carbon Farming

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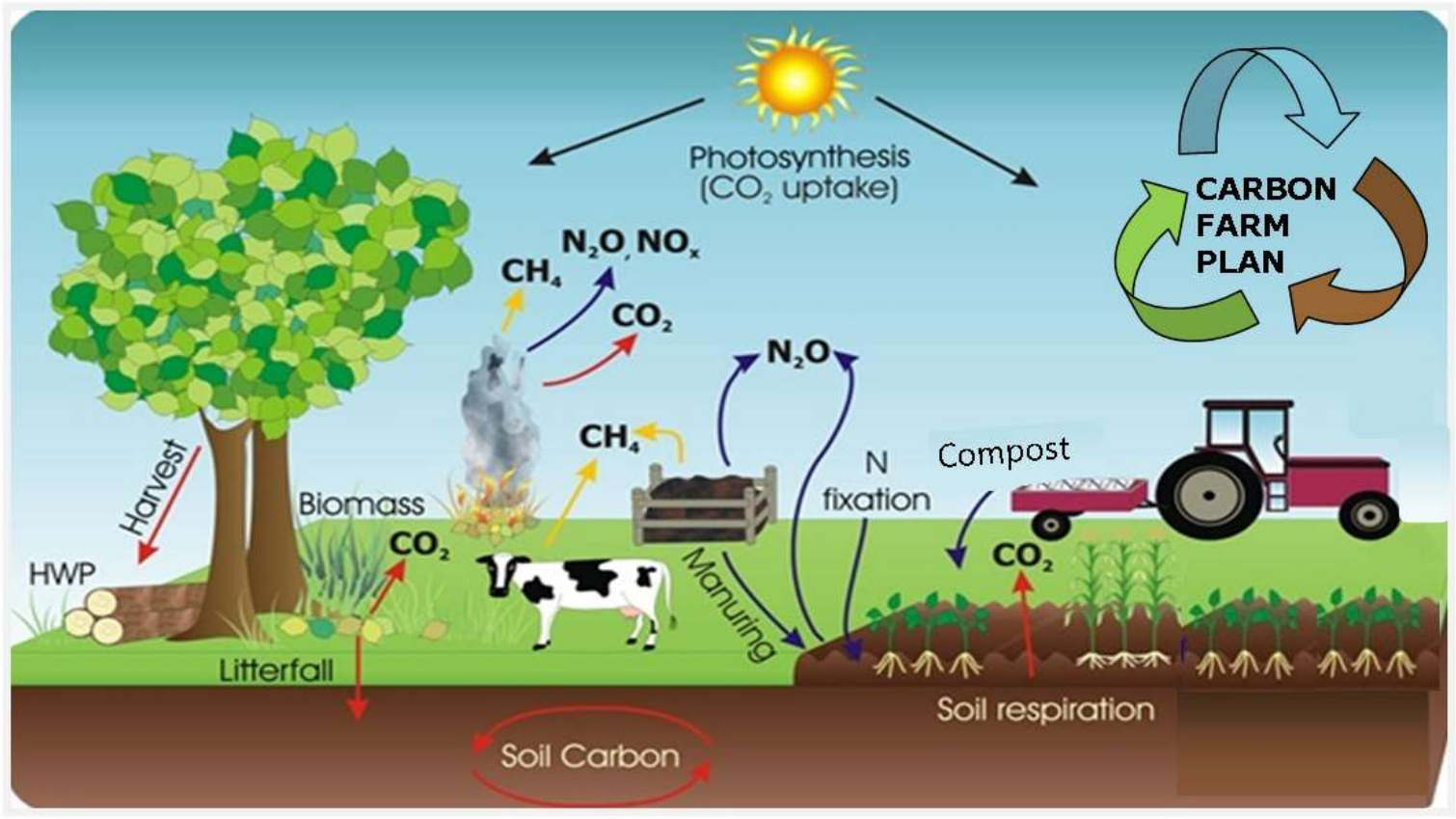
Darby Springs Farm @DarbySprings

- What is carbon farming?
- How is it done?
  - Annual crops
  - Perennial crops
  - Livestock
- Case study at Darby Springs Farm

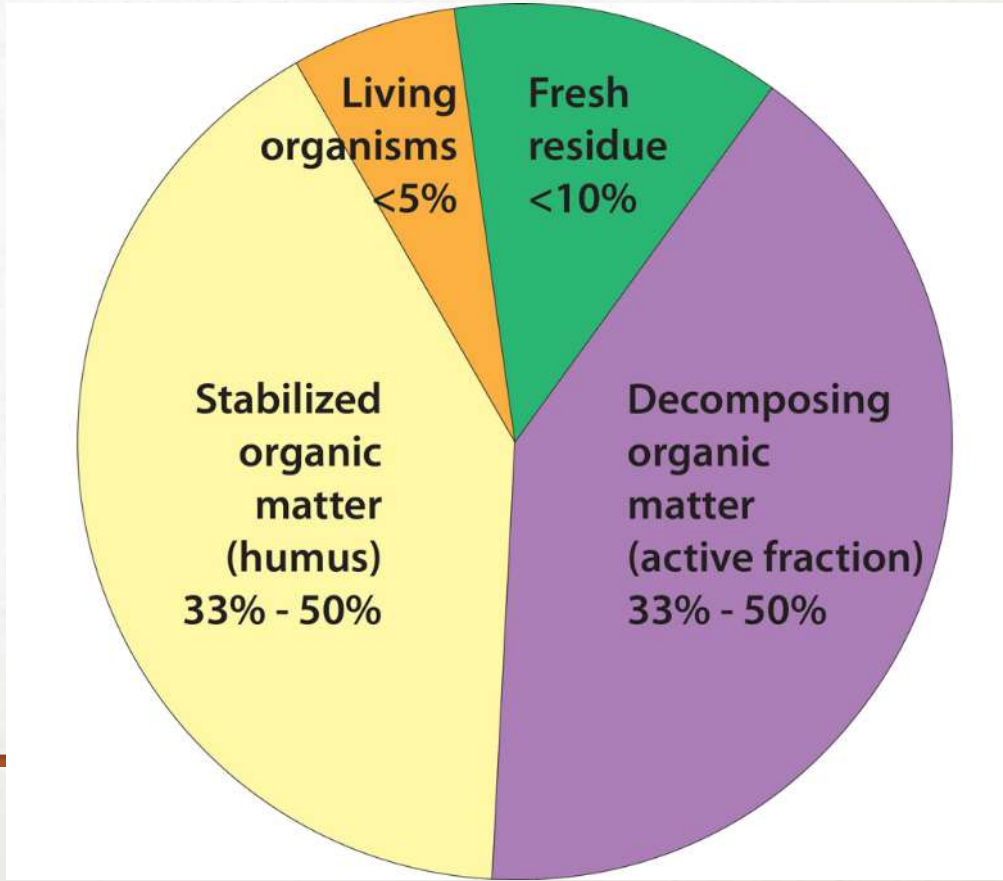
What is carbon farming?

CARBON CYCLE



Soil Organic matter

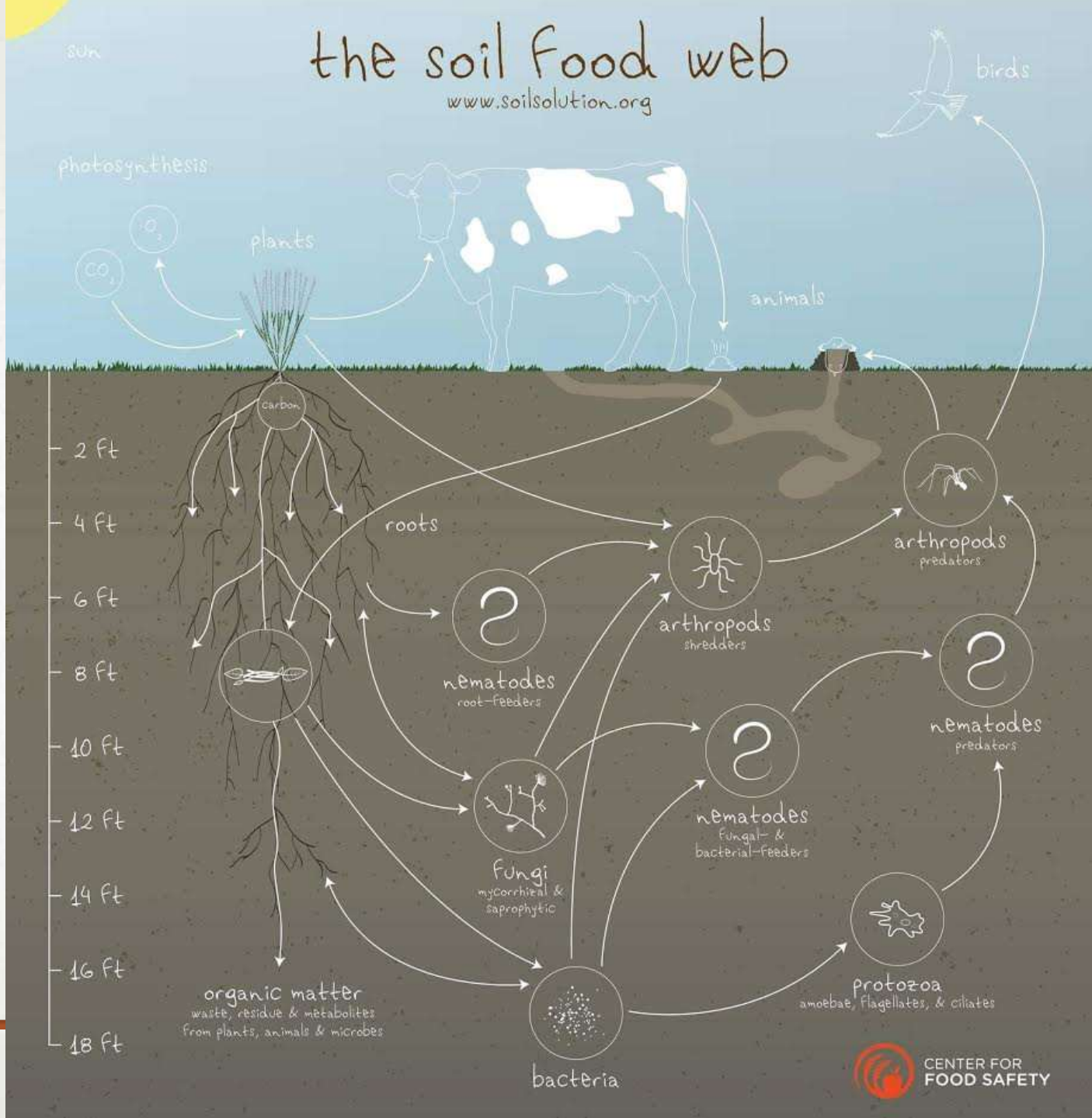
- Essential for soil physical, chemical and biological functions
- Organic matter is about 57% carbon (dry wt)



Benefits

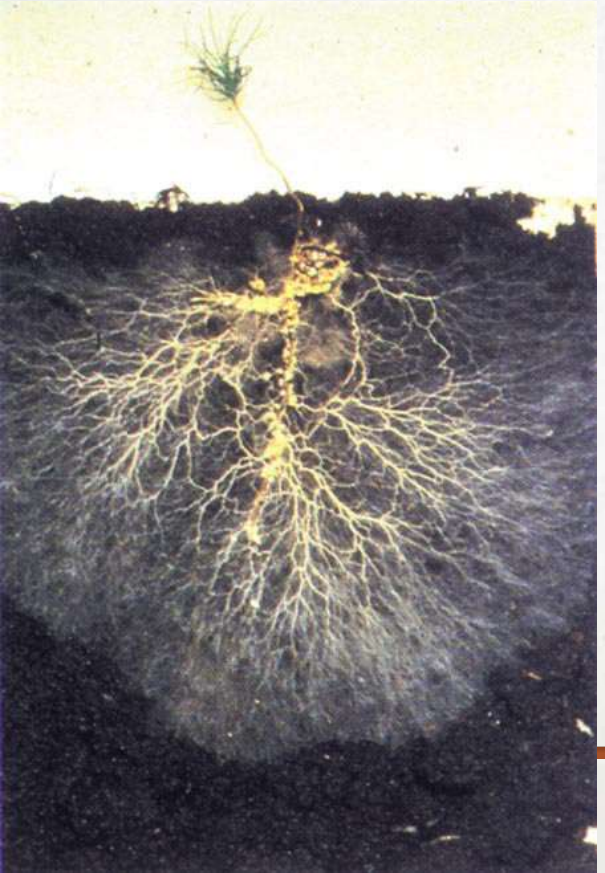
- Carbon sequestration
- Water holding – drought resiliency
- Water infiltration – reduced flooding
- Soil fertility
- Soil tilth: erosion control, deeper rooting
- Biodiversity: pollinators, wildlife, birds
- Beauty

How is it Formed?



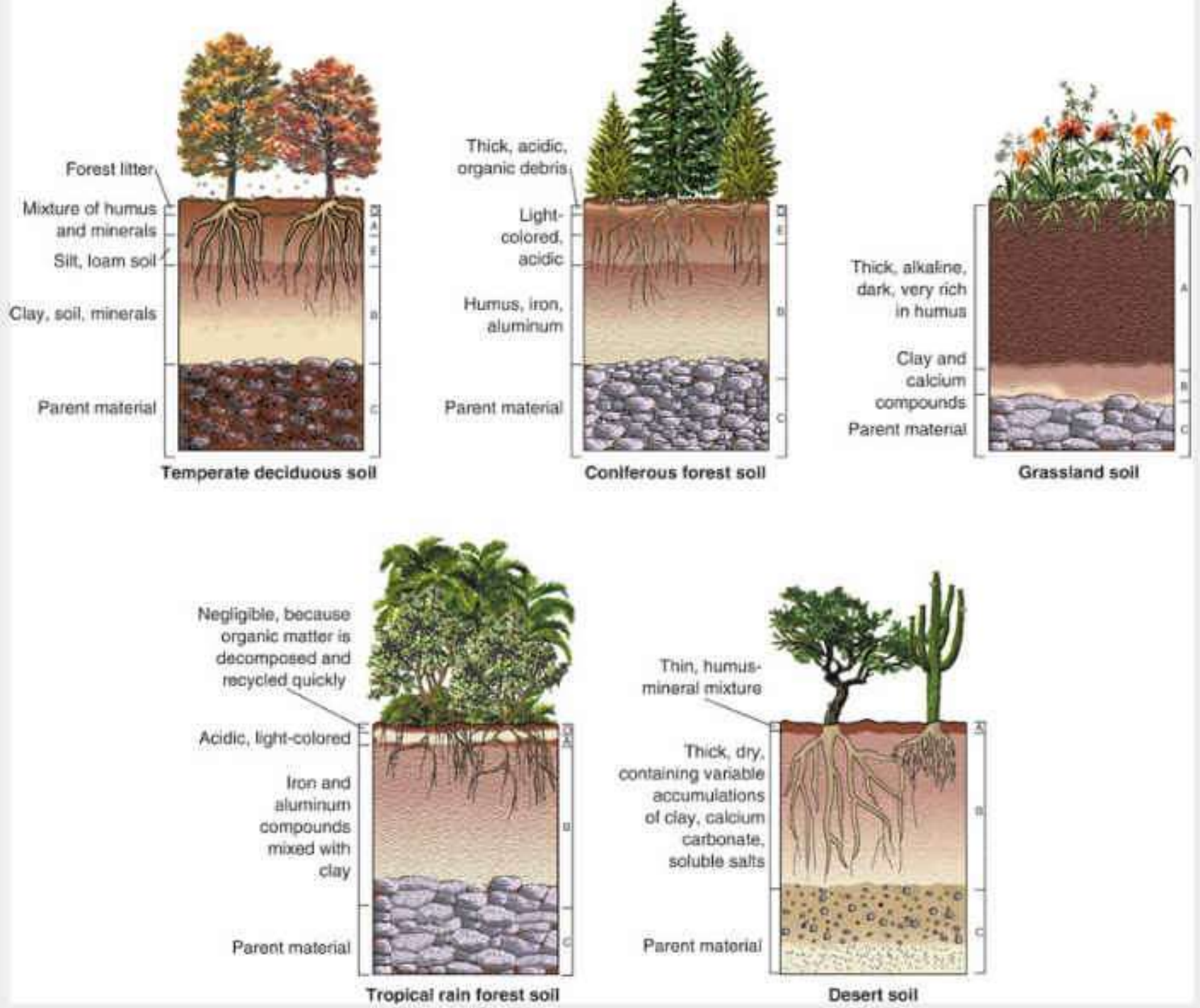
Mycorrhizal fungi

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

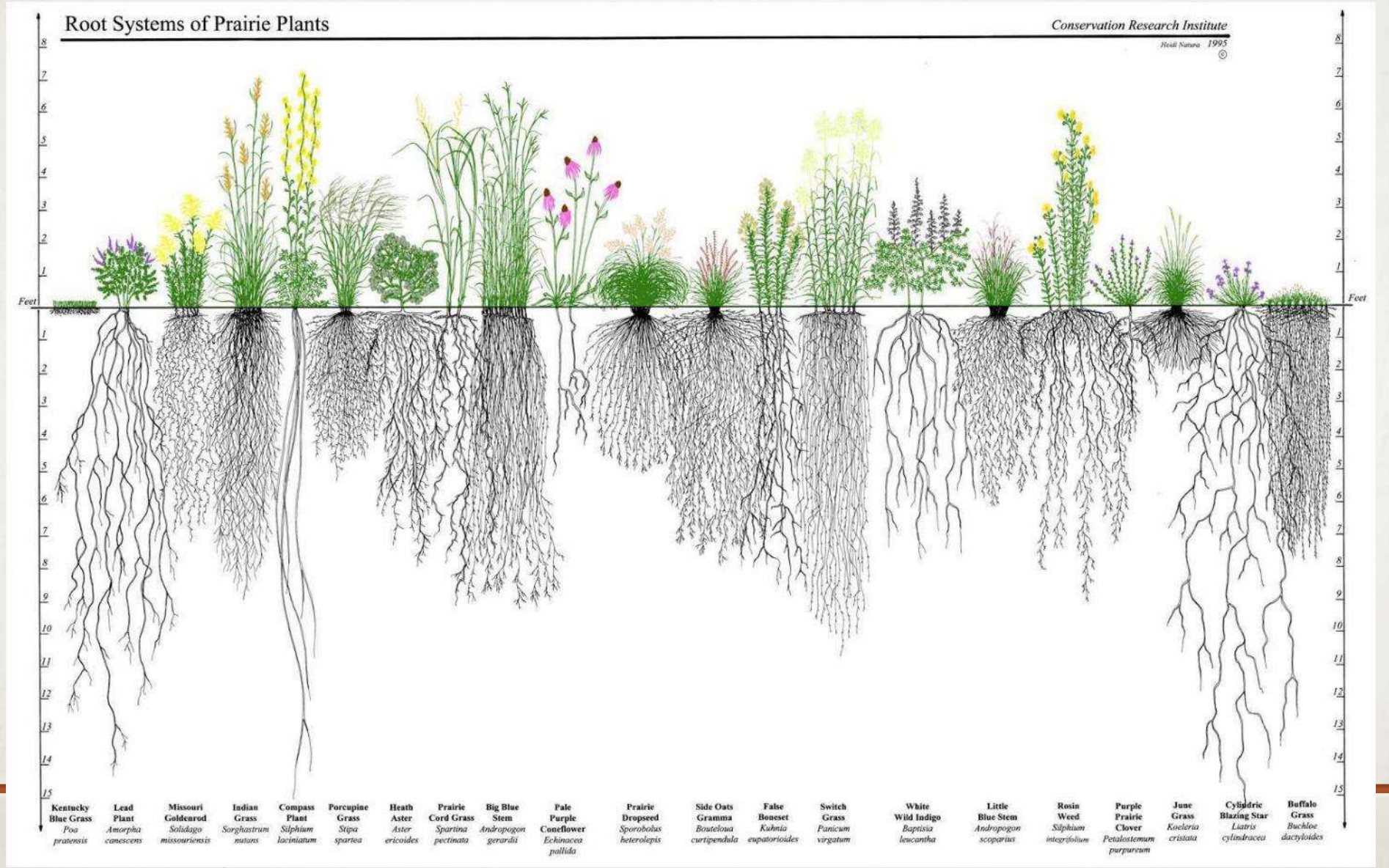


Glomalin

- 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

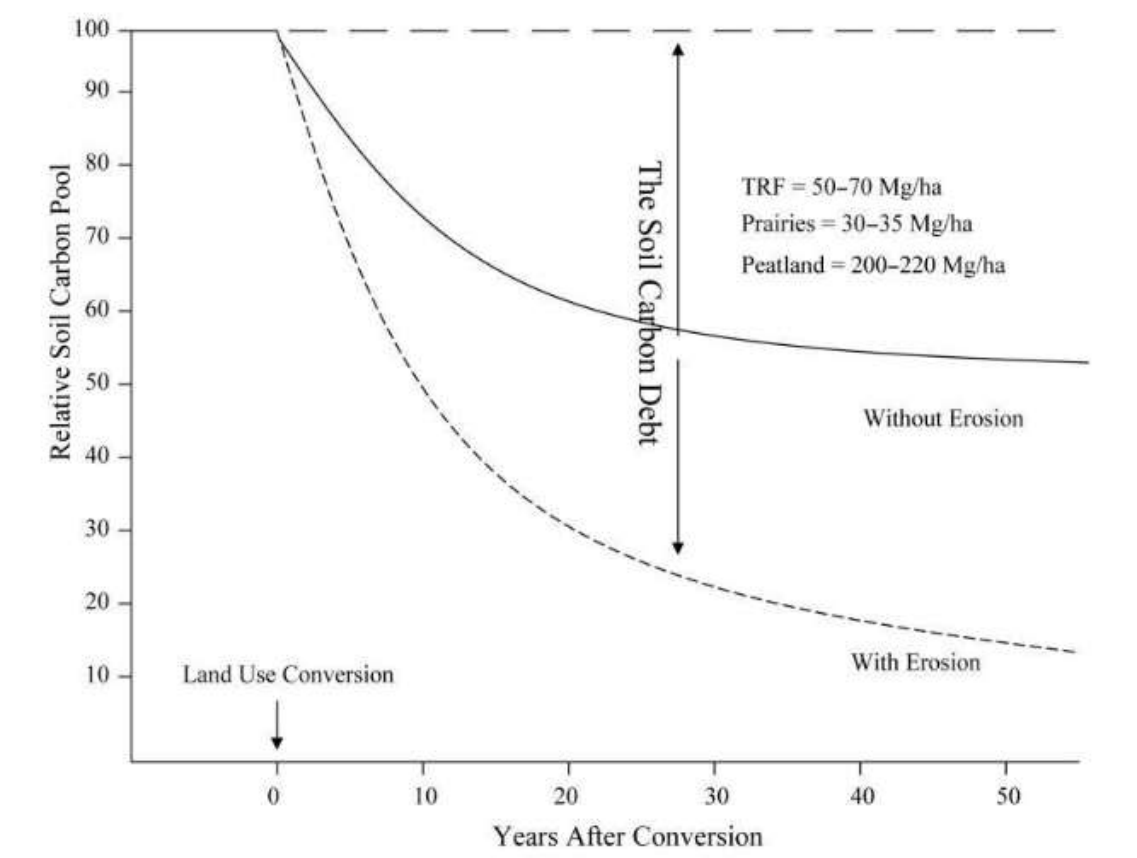

Forest litter
Mixture of humus and minerals
Silt, loam soil
Clay, soil, minerals
Parent material
A
E
B
C
Temperate deciduous soil
Thick, acidic, organic debris
Light-colored, acidic
Humus, iron, aluminum
Parent material
E
B
C
Coniferous forest soil
Thick, alkaline, dark, very rich in humus
Clay and calcium compounds
Parent material
A
B
C
Grassland soil
Negligible, because organic matter is decomposed and recycled quickly
Acidic, light-colored
Iron and aluminum compounds mixed with clay
Parent material
A
E
B
C
Tropical rain forest soil
Thin, humus-mineral mixture
Thick, dry, containing variable accumulations of clay, calcium carbonate, soluble salts
Parent material
A
B
C
Desert soil

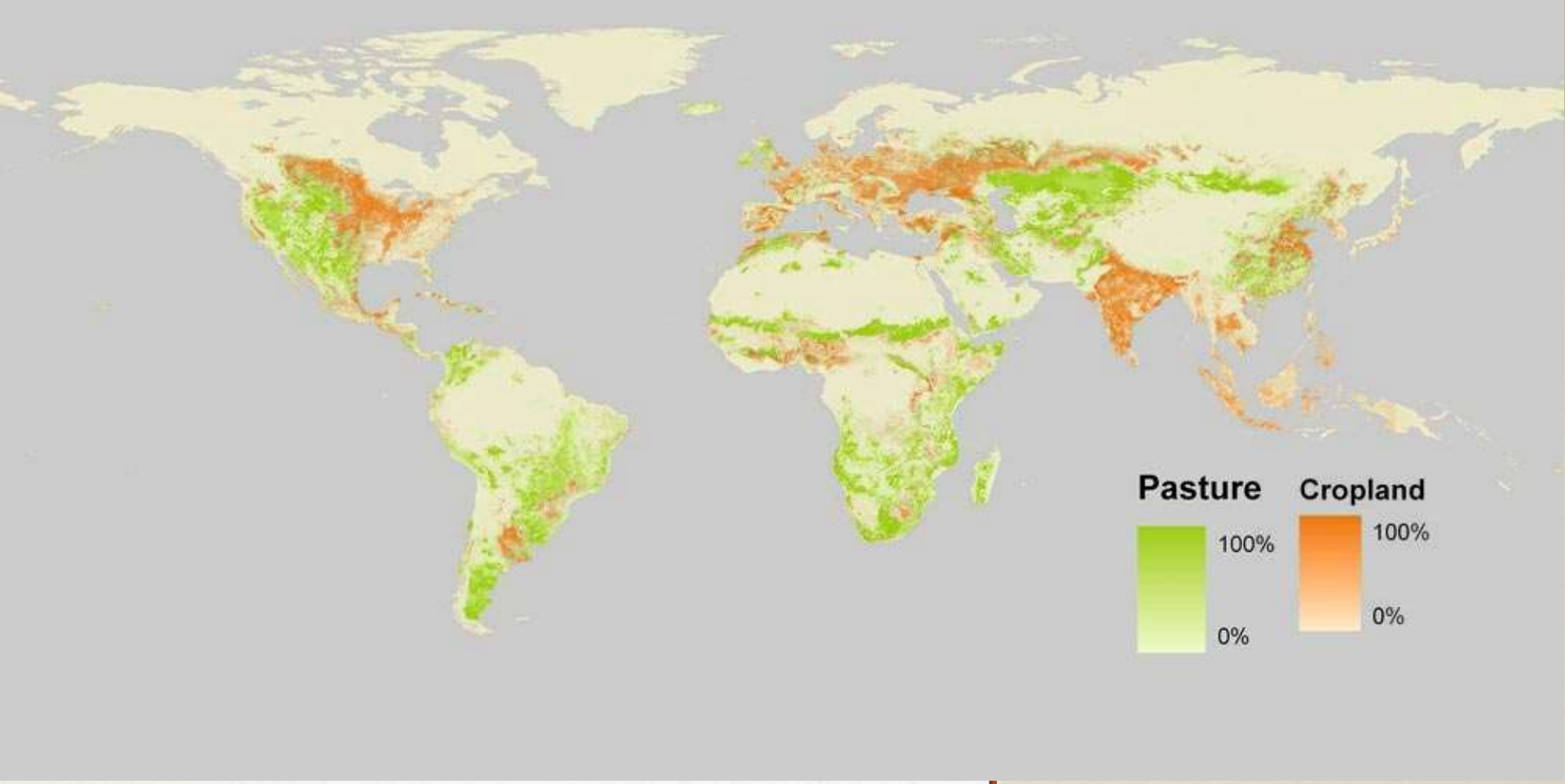
PRAIRIE SOILS



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

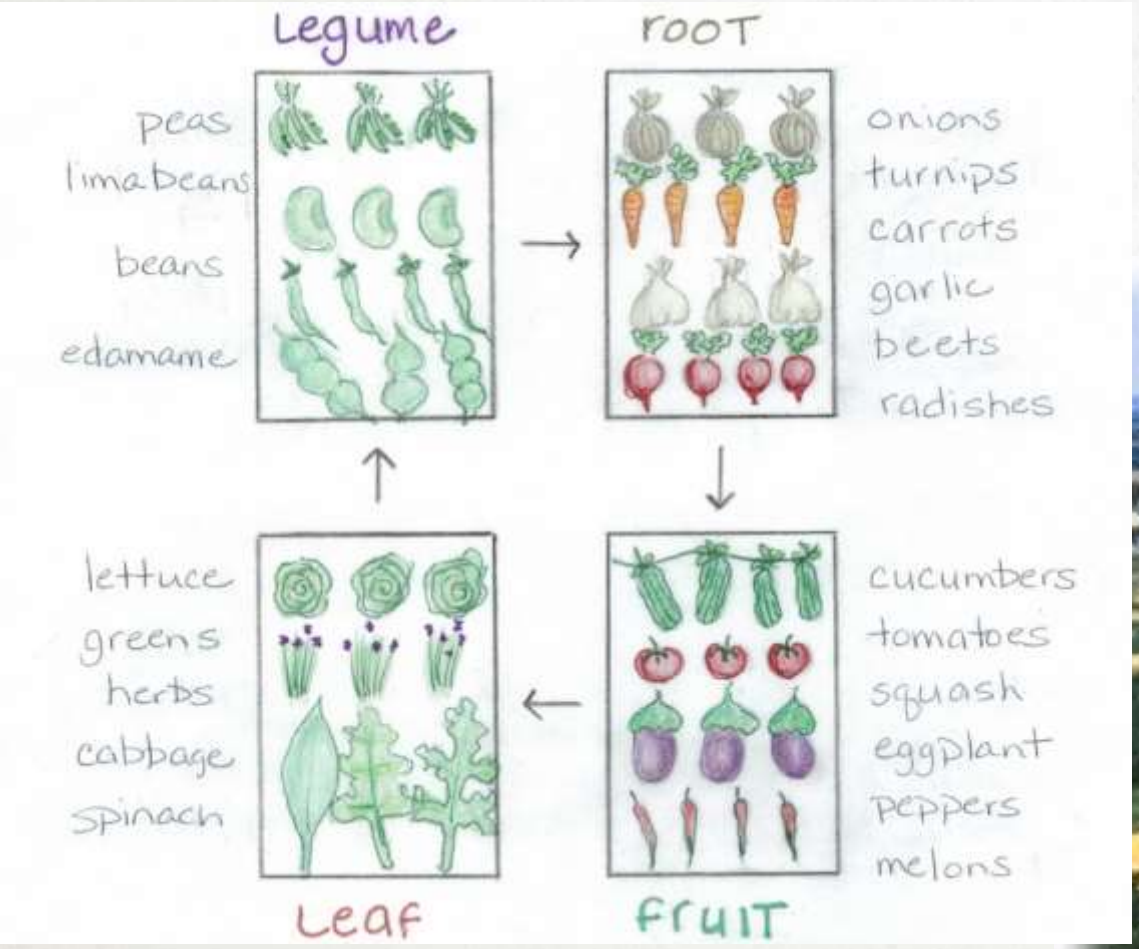
Cover crops

- USDA SARE Cover Crops guide

Compost & Manure

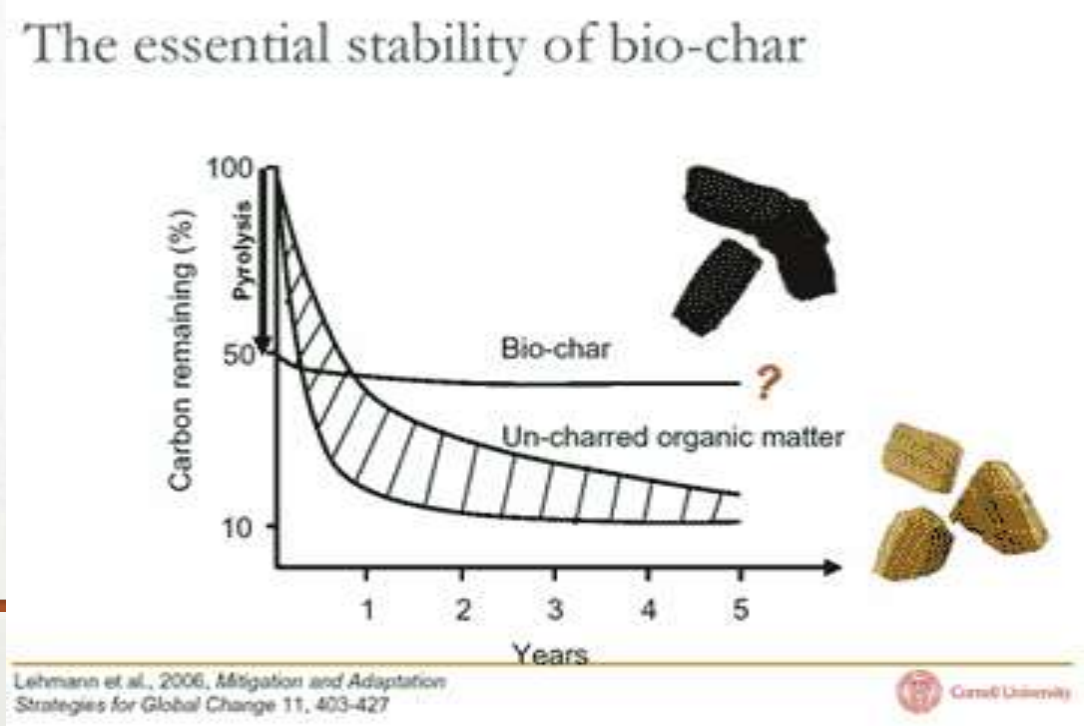
- Provides stable carbon
- Mulch
- Reduces GHG from food waste & manure
- Marin Carbon Project

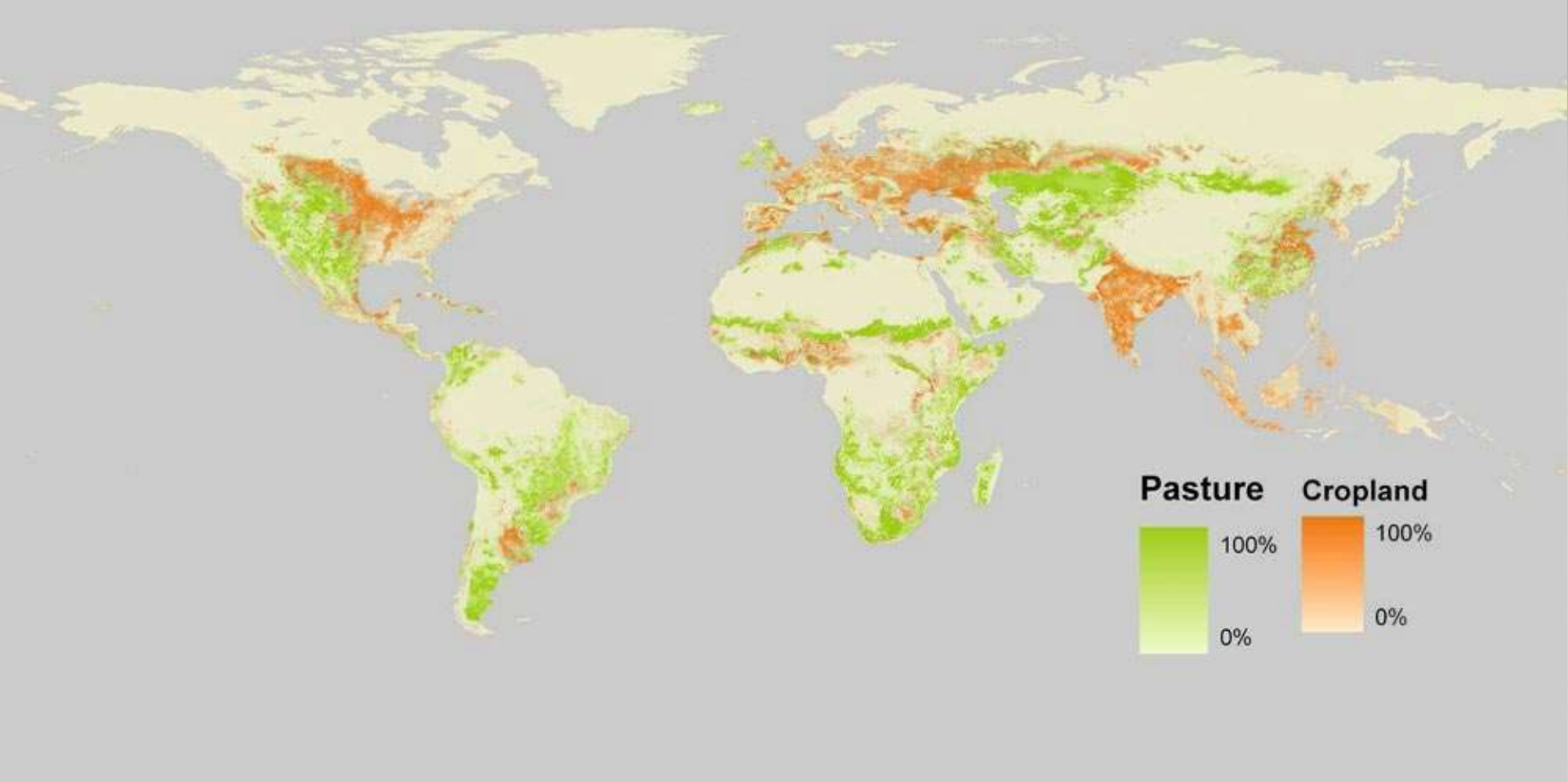
Crop rotation



BIOCHAR

- Made by burning organic matter with very low oxygen
- International Biochar Initiative





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

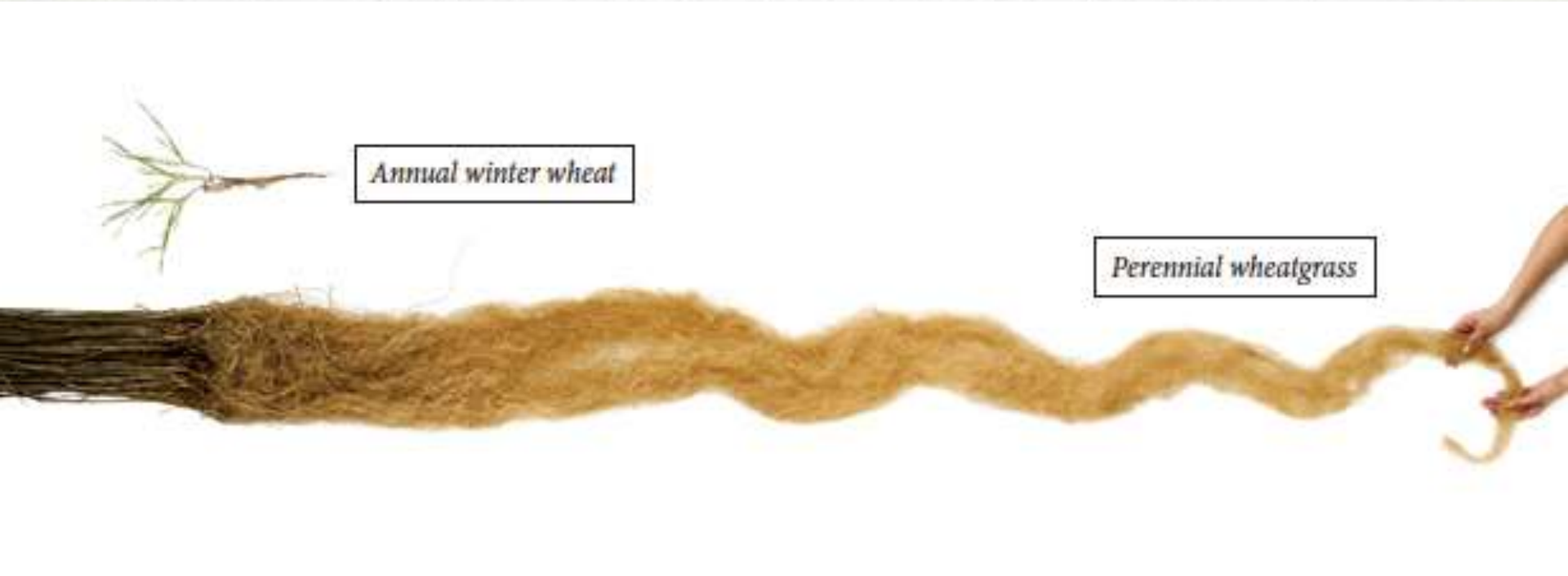
AGROFORESTRY

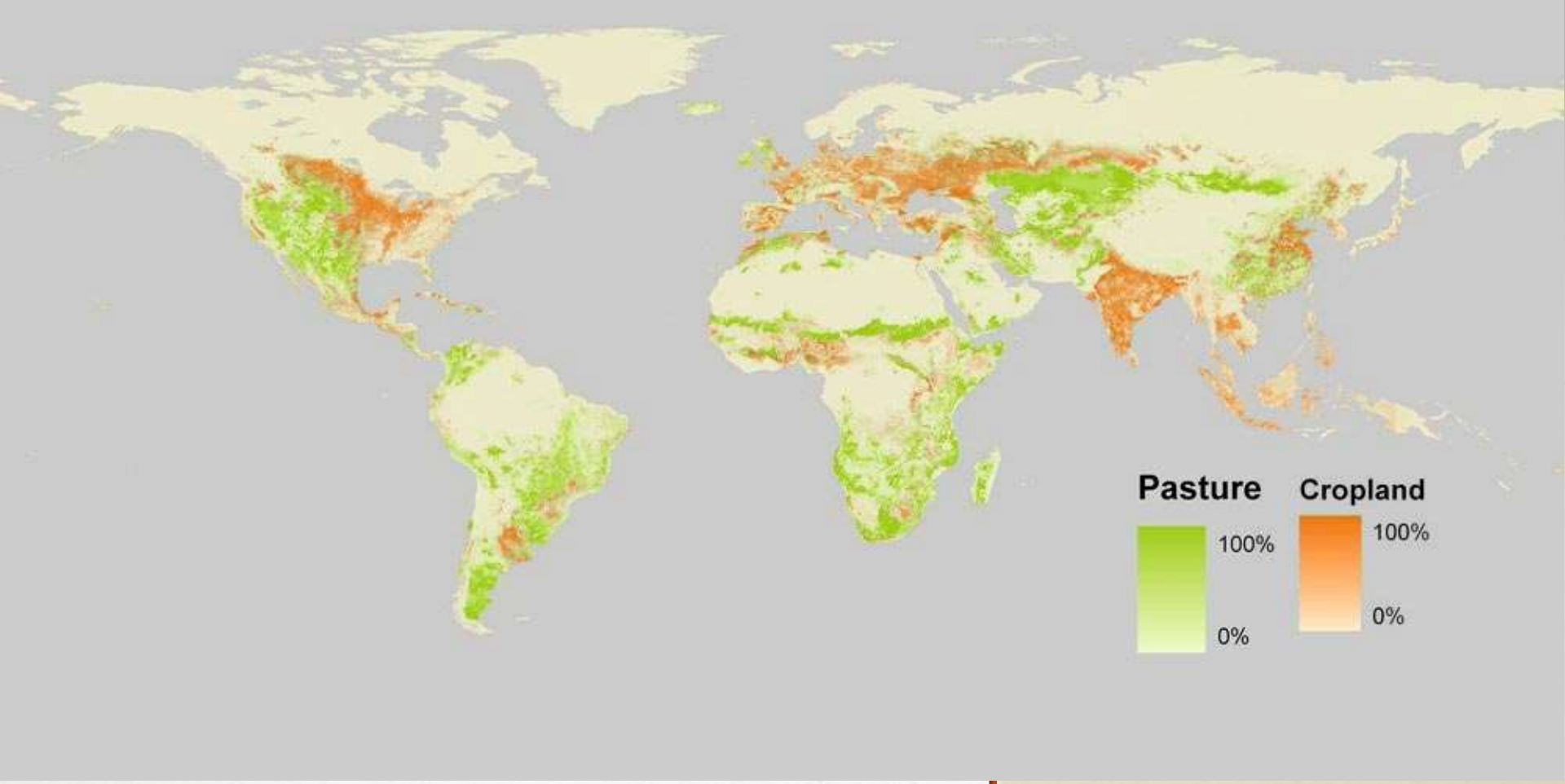
Riparian buffers

Windbreaks

Perennial grains

The Land Institute





LIVESTOCK

MODERATE SEQUESTRATION

SILVOPASTURE

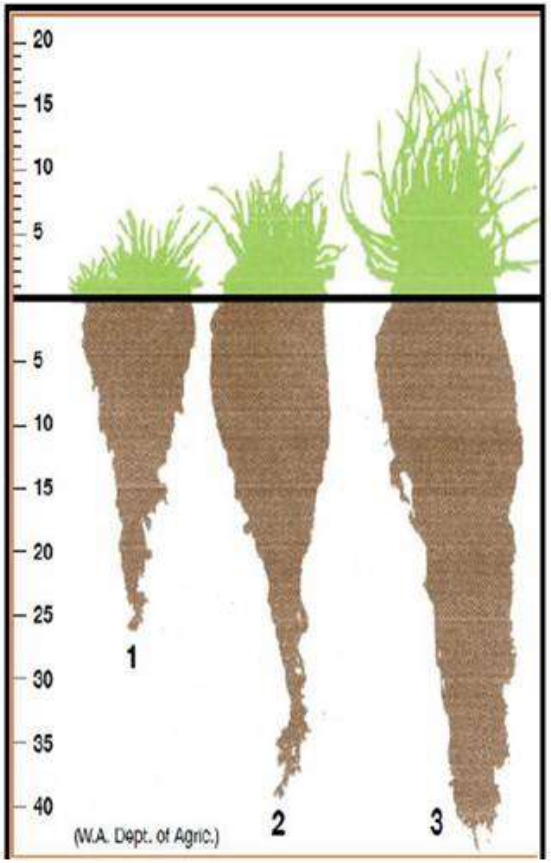
Hedge rows

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 to target heights to simulate grazing (http://managingwholes.com/new-topsoil.htm).

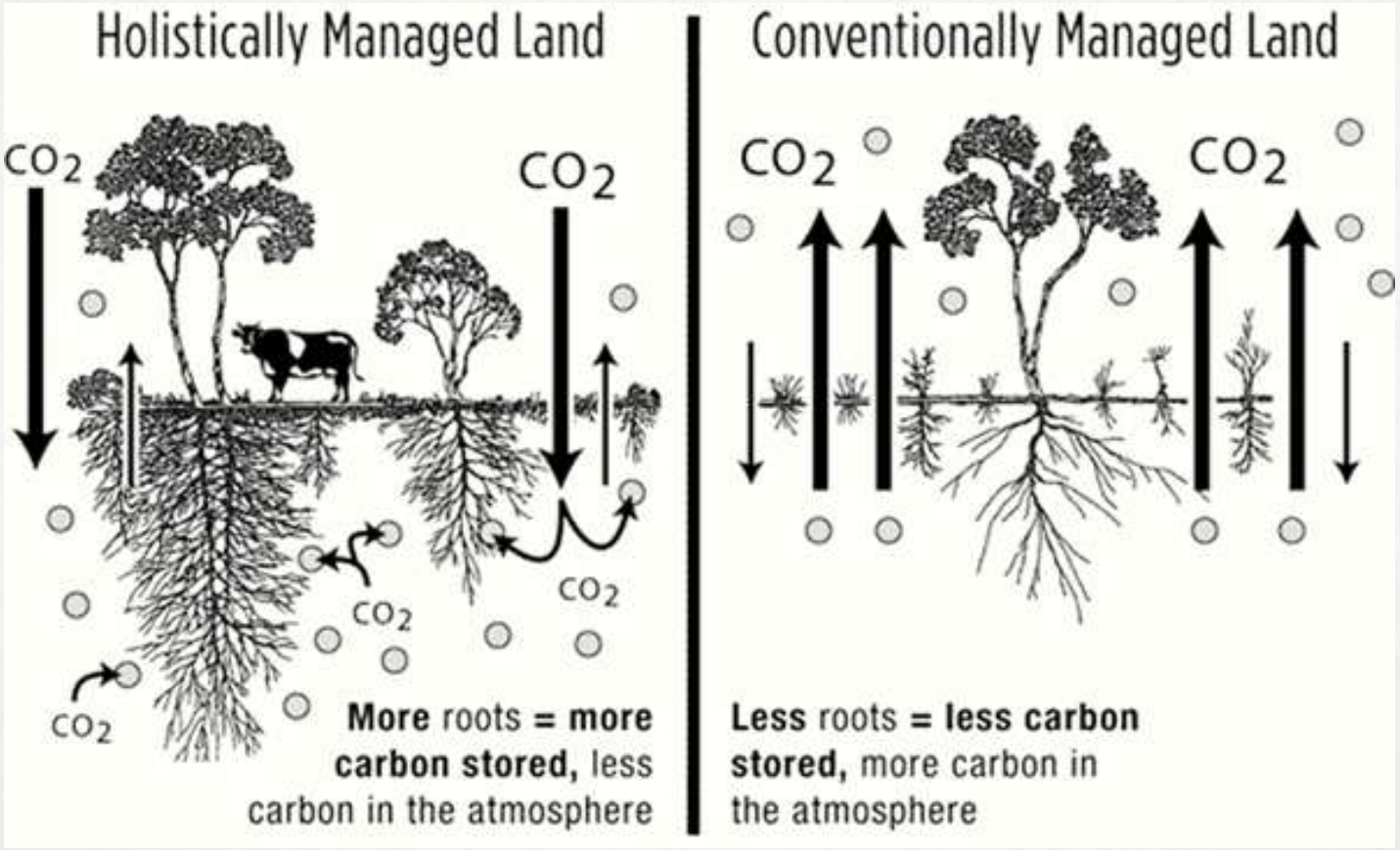


(LH) Grazed 6 times at one leaf stage

(Middle) Grazed 3 times at two leaf stage

(RH) Grazed twice at three leaf stage

Holistic Management/ Planned Grazing



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

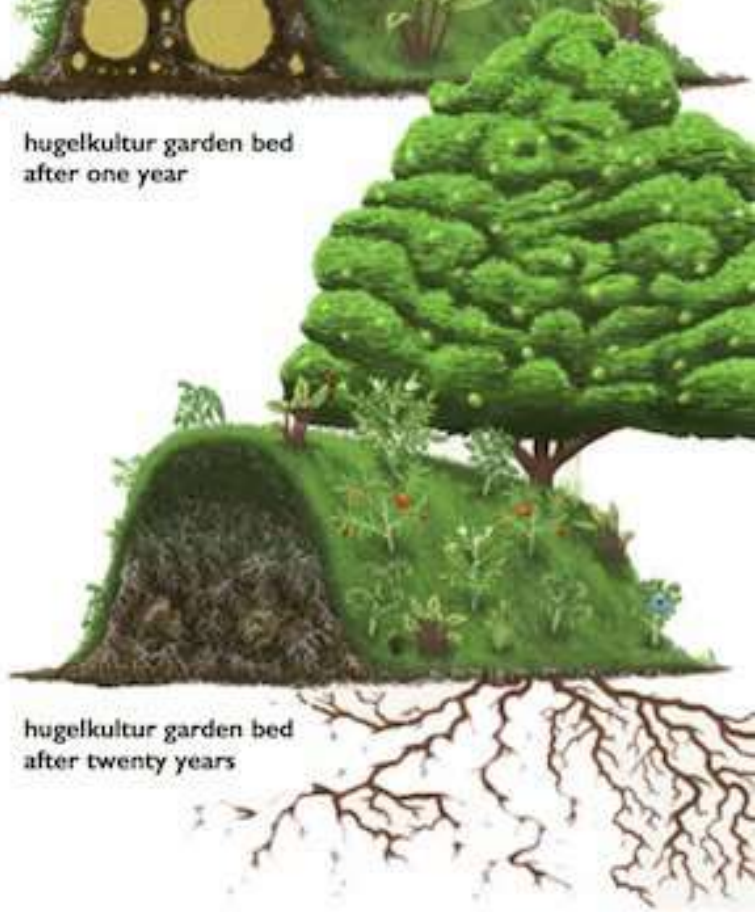
- Uses a subsoiler or swales to move water from wet valleys to drier ridges
- Introduces oxygen to subsoil & compacted areas
- Introduction to the method

HUGELKULTUR

hugelkultur garden bed
after one month

hugelkultur garden bed
after one year

hugelkultur garden bed
after two years



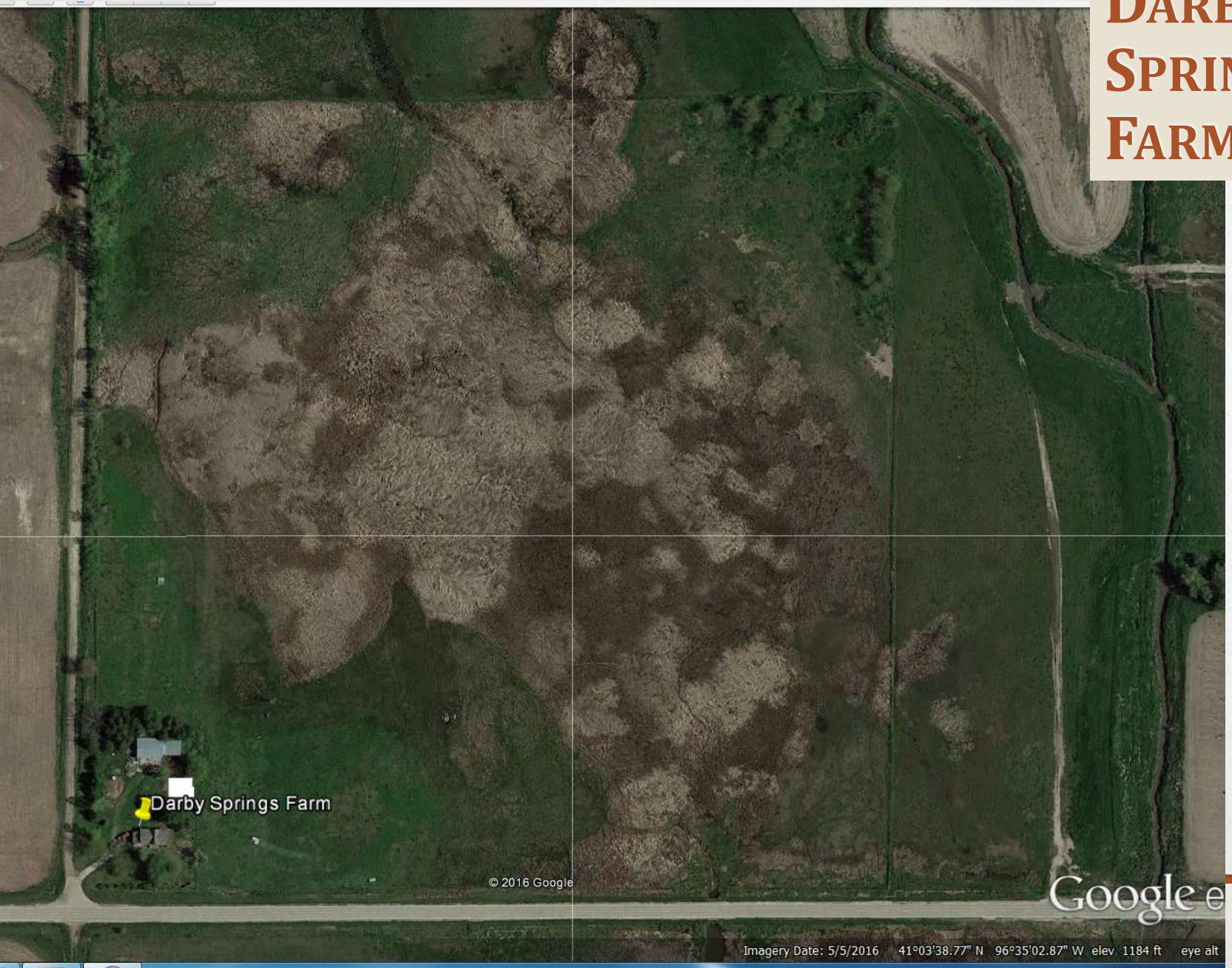
hugelkultur garden bed
after twenty years

images courtesy Paul Wheaton / RichSoil.com

Broad Scale Permaculture Design

Case study at Darby Springs Farm

Darby Springs Farm



15
15
15

NORTH FENCELINE

May 4

Grazing Tall

Oct 11

October 11, Graze line

WETLAND GUILD

Aug 14

Grazed (6 seasons) vs Ungrazed

Aksarben Silty Clay Loam

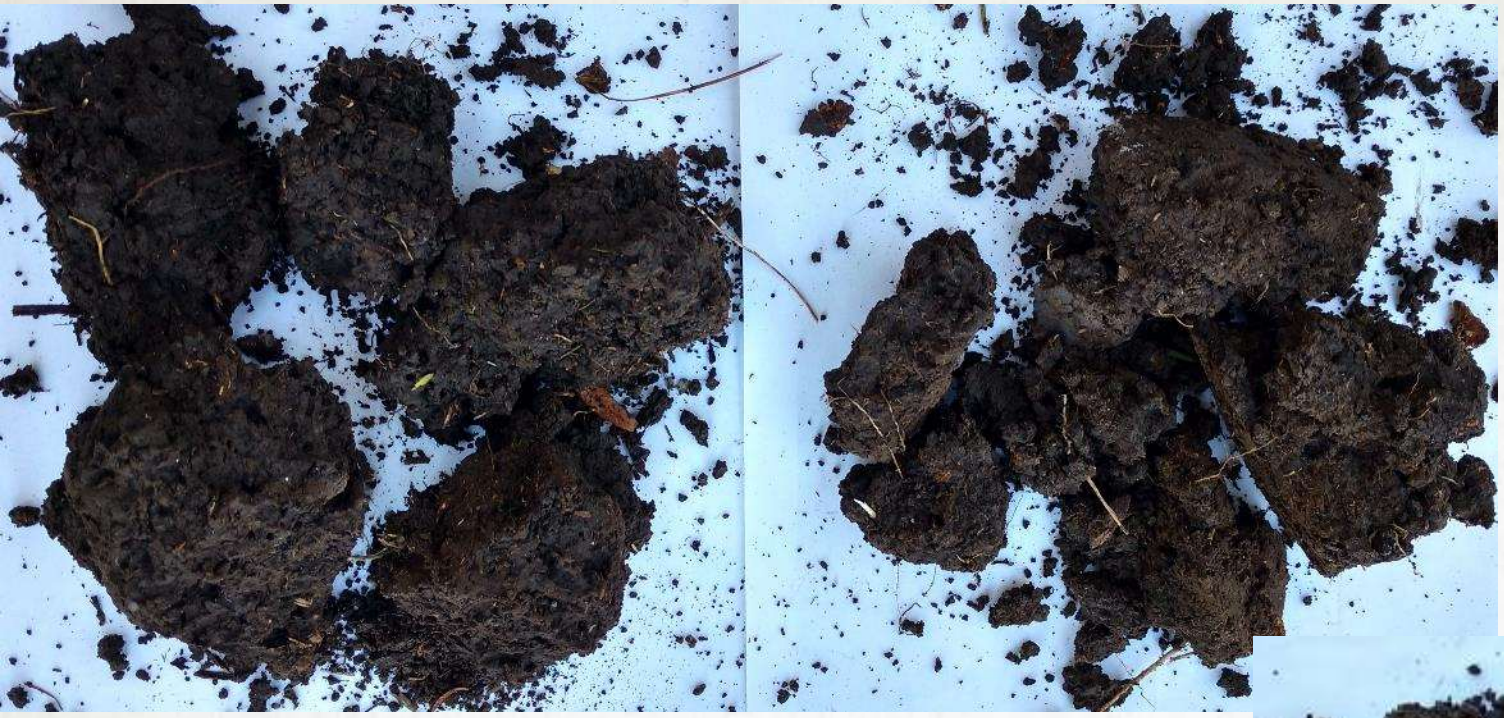
HUGELKULTUR

May 19

GUILDS

July 20

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