Agroforestry, Biochar & Climate Resilient Farming

Climate Farm School

September 29, 2022

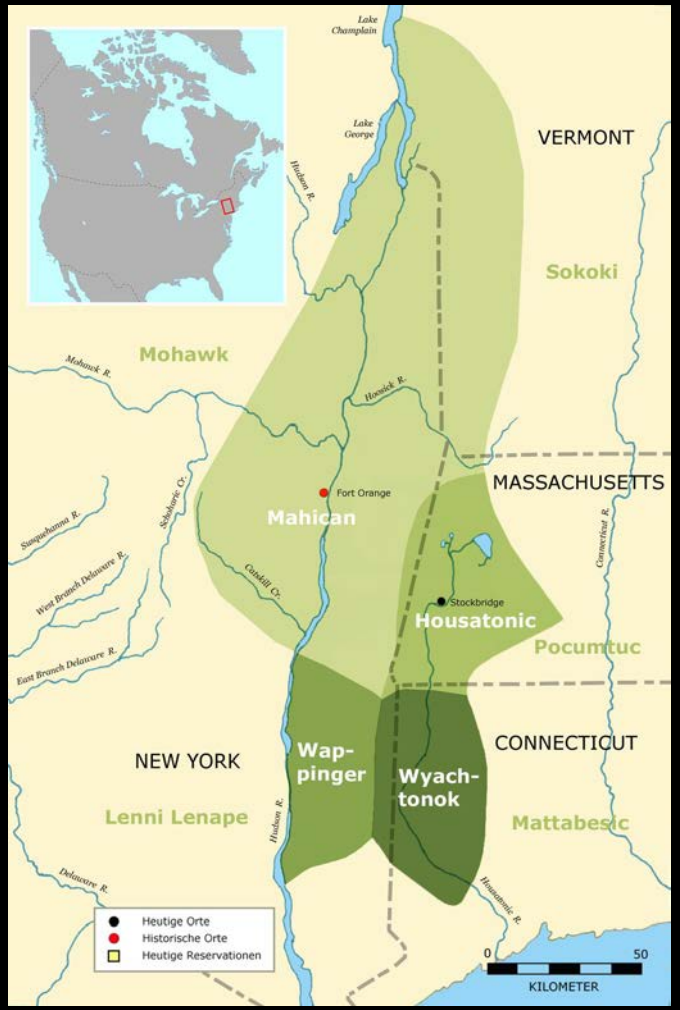
Ghent, New York

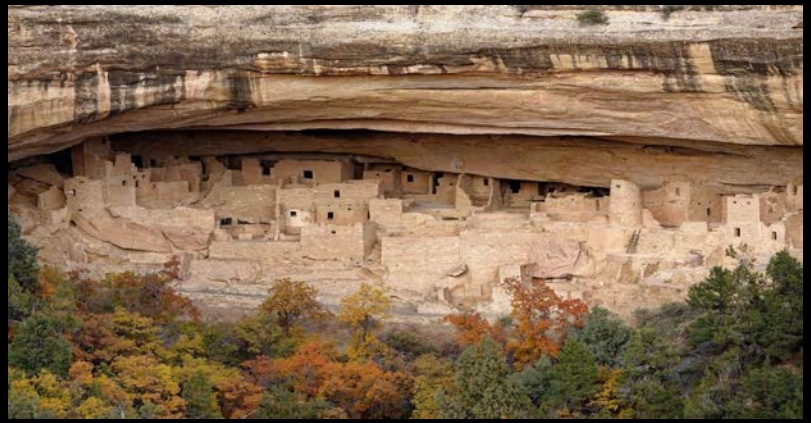
ARTHUR'S POINT FARM

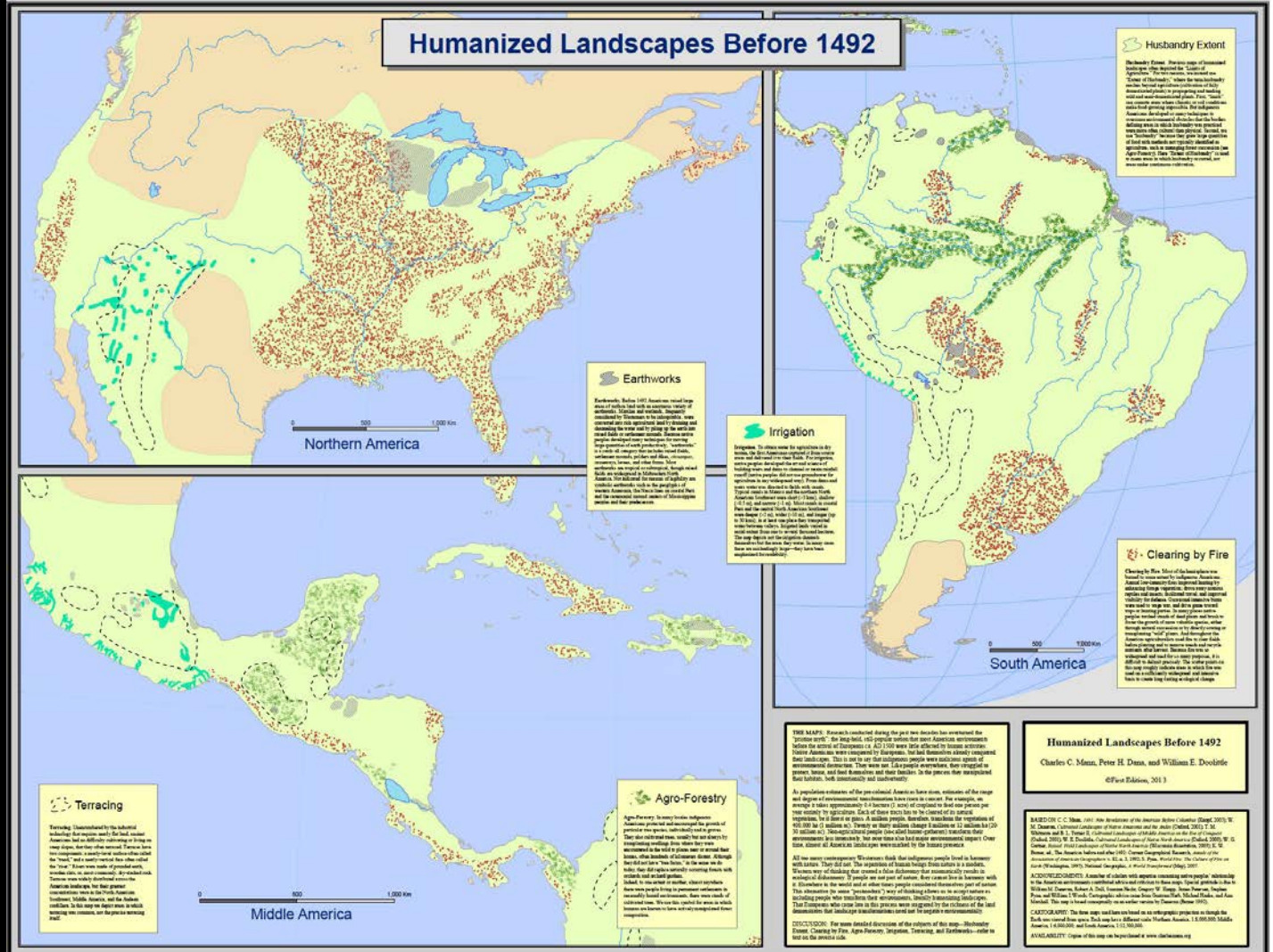
Welcome to Arthur's Point Farm

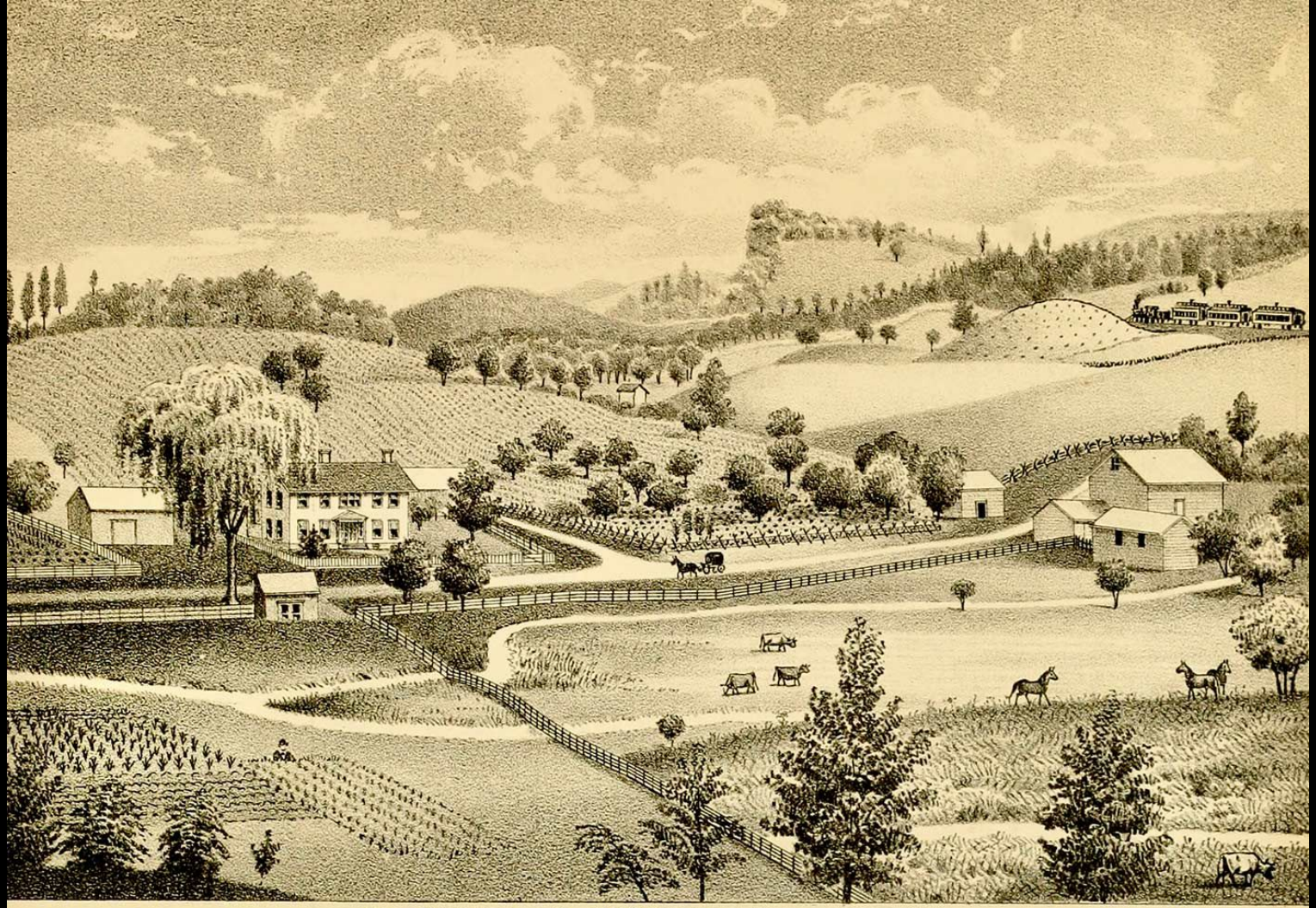

Cordilleran
Ice Sheet
Laurentide Ice Sheet

“The Mohicans’ lives were rooted in the woodlands in which they lived. These were covered with red spruce, elm, pine, oak, birch and maple trees. Black bear, deer, moose, beaver, otter, bobcat, mink and other animals thrived in the woods, as well as wild turkeys and pheasants. The sparkling rivers teemed with herring, shad, trout and other fish. Oyster beds were found beneath the river’s overhanging banks for some distance up the Mahicannituck. Berries, cherries and nuts were abundant. It was a rich life.”






Humanized Landscapes Before 1492
Northern America
Earthworks
Irrigation
Husbandry Extent
Clearing by Fire
South America
Terracing
Agro-Forestry
Middle America
THE MAPS: Research conducted during the past two decades has overturned the "pristine myth," the long-held, still-popular notion that most American environments before the arrival of Europeans c.a. AD 1500 were little affected by human activities. Native America was conquered by Europeans, but had themselves already conquered their landscapes. This is not to say that indigenous people were malicious agents of environmental destruction. They were not. Like people everywhere, they struggled to construct homes, and feed themselves and their families. In the process they manipulated their habitats, both intentionally and inadvertently.
As population estimates of the pre-colonial Americas have risen, estimates of the range and degree of environmental transformation have risen in concert. For example, on average it takes approximately 0.4 hectares (1 acre) of cropland to feed one person per year entirely by agriculture. Each of these tracts has to be cleared of its natural vegetation, be it forest or grass. A million people, therefore, transform the vegetation of 400,000 ha (1 million ac). Twenty or thirty million change 8 million or 12 million ha (20-30 million ac). Non-agricultural people (also called hunter-gatherers) transform their environments less intensively, but over time also had major environmental impact. Over time, American landscapes were transformed by the human presence.
All too many contemporary Westerners think that indigenous people lived in harmony with nature. They did not. The separation of human beings from nature is a modern, Western way of thinking that created a false dichotomy that systematically results in ecological dishonesty. If people are not part of nature, they cannot live in harmony with it. Elsewhere in the world and at other times people considered themselves part of nature. This alternative (to some "postmodern") way of thinking allows us to accept nature as including people who transform their environments, thereby humanizing landscapes. That Europeans who came late in this process were staggered by the richness of the land demonstrates that landscape transformation is novel not for capitalist environments.
DISCUSSION: For more detailed discussion of the subjects of this map—Husbandry Extent, Clearing by Fire, Agro-Forestry, Irrigation, Terracing, and Earthworks—refer to text on the reverse side.
Humanized Landscapes Before 1492
Charles C. Mann, Peter H. Dana, and William E. Doolittle
©First Edition, 2011
BASED ON C.C. Mann, 1491: New Revelations of the Americas Before Columbus (Knopf, 2005); W. M. Denevan, Cultivated Landscapes of Native Amazonia and the Andes (Oxford, 2001); T. M. Whitmore and B. L. Turner II, Cultivated Landscapes of Middle America on the Eve of Conquest (Oxford, 2001); W. E. Doolittle, Cultivated Landscapes of Native North America (Oxford, 2000); W. G. Gerhart, Ancient Field Landscapes of Native North America (Wisconsin Academy Association, 2005); E. W. Benne, ed., The Americas before and after 1492: Current Geographical Research, Annals of the Association of American Geographers v. 82, n. 3, 1992; S. Pyne, World Fire: The Culture of Fire on Earth (Washington, 1997); National Geographic, A World Transformed (May) 2007.
ACKNOWLEDGMENTS: A number of scholars with expertise concerning native peoples' relationship to the Americas environment contributed advice and criticism to these maps. Special gratitude is due to William M. Denevan, Robert A. Dull, Suzanne Hecht, Gregory W. Knapp, Susan Peterson, Stephen Pyne, and William L. Wood. Cartographic advice came from Suzanne Hall, Michael Hanke, and Ann Moreland. This map is based conceptually on an earlier version by Denevan (Renne 1992).
CARTOGRAPHY: The three maps used here are based on an orthographic projection as though the Earth was viewed from space. Each map has a different scale: Northern America, 1:8,000,000; Middle America, 1:4,000,000; and South America, 1:12,500,000.
AVAILABILITY: Copies of this map can be purchased at www.charlesmann.org



FARM RESIDENCE OF C. JACOBIE, GHENT, COLUMBIA COUNTY, N. Y.

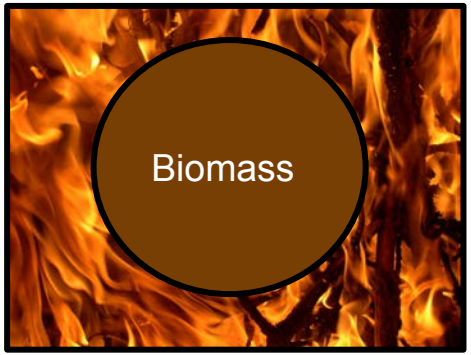
Biochar Overview

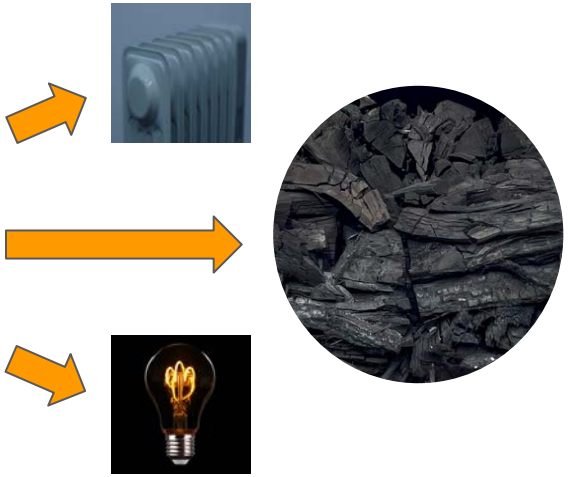
Feedstock

- Any biomass, including solid waste
- Construction debris
- Mill scraps
- Biocarbon crops (fast growing, easy to grow; e.g., willow, poplar)
- Forestry debris
- Carbon footprint - waste streams, locally-sourced, and minimal inputs to produce




Production Process



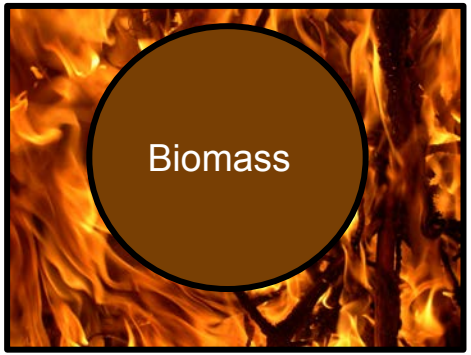


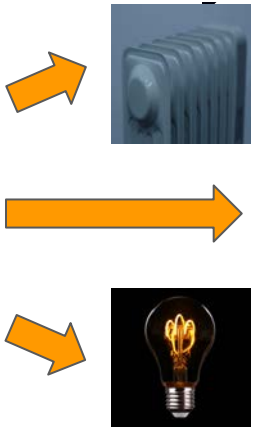
Feedstock

No O_2 + Heat (400-900℃)

Biochar
Heat
Power

Benefits & Ecosystem Services





Thermo-chemical conversion

Biochar + Power + Heat

Soil Amendment

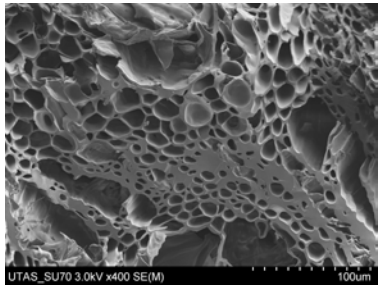
Carbon Sequestration

Manure Mgmt / Pollution Control

Livestock Digestive Health

Soil Health & Productivity

- Porous structure, large surface area, adsorptive/absorptive
- Water, micronutrients & microbial habitat
- Mycorrhizae and certain bacteria help plant nutrient availability
- Useful in depleted or sandy soils with low soil organic matter
- 18-28% productivity gains reported (but only annuals)
- Research needed given variability in biochars and uses
- Research needed for tree crops and other perennials



Climate Mitigation - Natural Carbon Sequestration

- Carbon capture and storage + reduction in fossil energy use
- Turning biomass into stable carbon for thousands of years
- Reduce nitrous oxide (N_20) & methane (CH_4) from tillage, fertilizers & livestock
- N_20 & CH_4 = 300 and 25 times potency of CO_2
- U.S. agriculture = 80% of N_20 and 40% of CH_4 emissions
- Biochar carbon credits being sold - scaling to small, medium farms a challenge

Manure Management & Pollution Control

- High cation exchange capacity & surface area binds ammonia & other malodorous substances
- Adsorptive (i.e., adhering) & absorptive (i.e., dissolving) qualities reduce nutrient leaching in the soil
- Protects groundwater & lowers acidification of the soil
- Reported to nearly double fertilizer efficiency of liquid manure treatments

Livestock Health & Productivity

- Feed supplement an ancient practice Cato the Elder (~200 BC)
- Common prescription in ag lit of early 20th century
- Nutrient uptake, adsorbs toxins, improve overall health
- Increased weight gain, feed efficiency, egg production, immunity, hygiene, odor control & lower vet costs (meta-analysis 27 studies)
- European Biochar Foundation has a certifications standard for use in animal feed

Probiotic Biochar Soil Amendment

- Enhances soil structure, fosters beneficial microbes & sequesters carbon
- 50% Pure Biochar – 85% Organic Carbon & Balanced pH (~7.8)
- 50% Microbial Soil Inoculant – 20 Species of Beneficial Bacteria & 7 Species of Soil Mycorrhizae + Microbial Nutrients

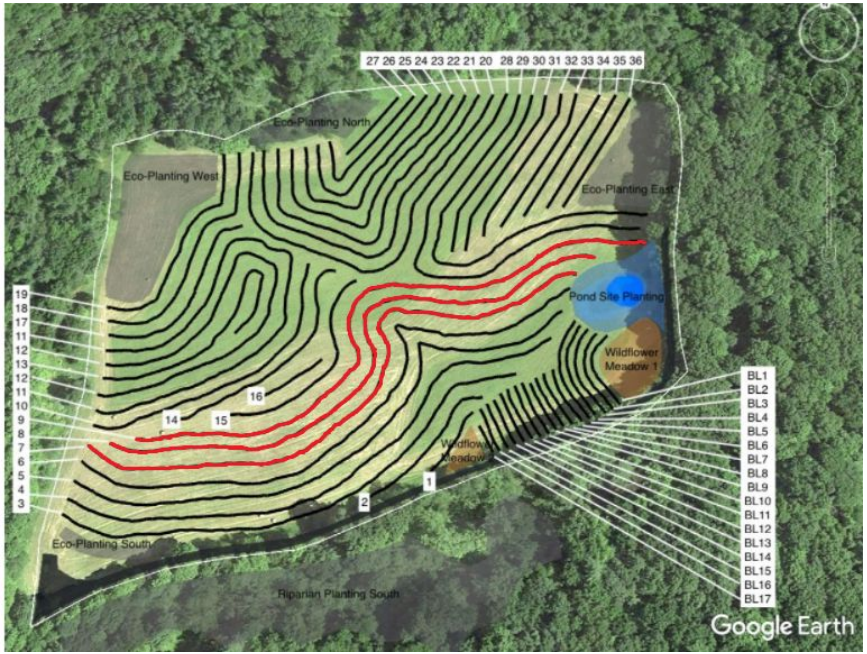
USDA SARE Research Project

- *Research Question* - How does biochar in various combinations with compost and a mix of microbes and minerals affect the health and productivity of soil and chestnut trees?
- *Goals:*
  - Assess efficacy of biochar in agroforestry
  - Generate knowledge to assist farmer decision making
  - Provide resources and networking for farmers
  - Identify barriers and opportunities for broader farmer adoption

SARE
Sustainable Agriculture
Research & Education

Experimental Design

- Three 800 ft rows
- Chestnut and black locust (10 ft spacing)
- Establishment: March ‘22
- Growing Seasons: ‘22, ‘23, ‘24
- Final Results in early ‘25



Research Treatments

T1 (Control) - Native soil

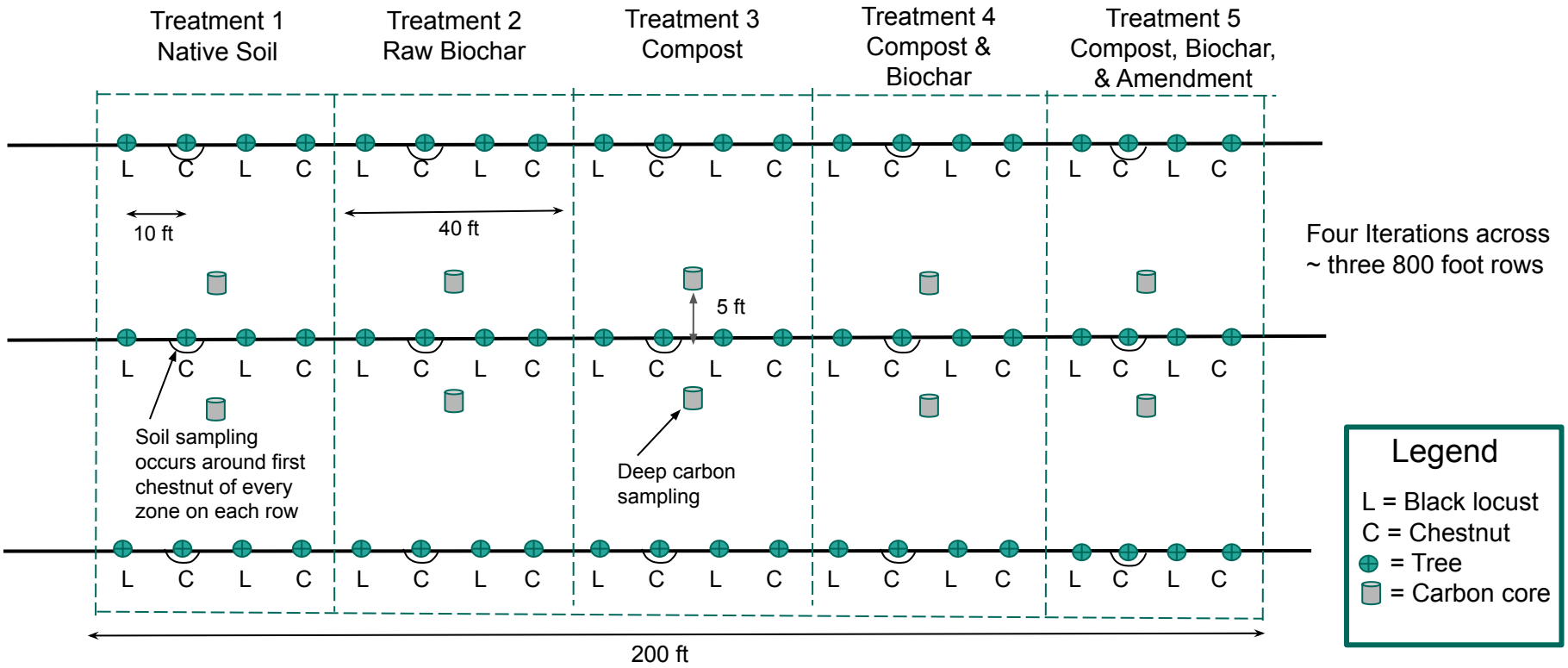
T2 - Raw biochar

T3 - Compost, top-dressed annually with compost

T4 - Biochar + compost, top-dressed annually w/ biochar-compost

T5 - Biochar + compost + microbial amendment, top-dressed annually w/ biochar-compost

Experimental Design



Research Hypotheses

- **Hypothesis 1:** Biochar + compost + amendment = ↑ soil microorganism abundance, ↑ nutrient bioavailability, ↑ tree health/vigor, ↑ carbon sequestration
- **Hypothesis 2:** Planting chestnuts only in native soil = ↓ vs. compost and biochar treatments across assessment metrics
- **Hypothesis 3:** Straight biochar w/o compost or amendment = ↓ nutrient bioavailability, ↓ inhibit tree health/vigor vs. compost and biochar treatments across assessment metrics

Farm Tour