

**Objective:** Develop a Carbon Farming Plan to enhance site regeneration, productivity, resilience, and climate change mitigation.

*Carbon Farming* is a system of farming practices which increase carbon in terrestrial ecosystems to enhance ecosystem services and goods. The practices are known to improve the rate at which CO<sub>2</sub> is removed from the atmosphere and converted to plant material and/or soil organic matter for adaptation to and mitigation of climate change. The plan will serve as a dynamic, versatile, and flexible guide to maximize the capacity of the land to be healthy, productive, and resilient while achieving quantifiable benefits toward climate change mitigation and food production for all species. Implementation of identified practices will improve the long-term productivity and profitability of the farm while restoring and protecting natural resources, ecosystem services and resilience to extreme weather in USDA Zone 6. Productivity is the quantified yield (pounds per unit area) and measurement of ecosystem services. *Soil* is the largest carbon sink over which we have some control, and many small-scale farmers can collectively improve soil carbon on a large scale. Soil carbon sequestration and storage can regenerate land for both food security and climate security.

Stewardship Strategy	Type of Practice	Implementation & Timeframe when funds available	Monitoring Activity
Increase soil organic matter.	Establish/maintain perennial plant cover across the farmscape. Never till.	Sheet mulching with plain paper, vermicompost, sawdust, grass clippings & biochar; ongoing.	Evaluate planting areas at least 2x/season for integrity & effectiveness; soil & foliar testing every 3 years.
Increase soil's carbon & microbial content to aid plant growth.	Soil health improvement to sequester greenhouse gases.	Perennial cover crops: tall grass prairie, perennial fruits & vegetables – enhanced annually.	Conduct species inventories every 5 years. Measure yield (pounds & brix) of selected plants.
Diversify perennial plants.	Inventory trees and shrubs (iTree, lists by product type).	iTree April 2019; inventory lists ongoing.	Update every 3-5 years to include new plantings
Increase wildlife food & habitat in 1.2-acre pasture.	Plant trees and shrubs as revealed by iTree for increased carbon sequestration.	Annually plant trees & shrubs. Remove competing invasive species (ongoing).	Create planting map, assess survival, species diversity & abundance. Note invasive species “hotspots.
Regenerate and preserve biodiversity.	Increase species diversity in reconstructed tall grass prairie & forbs.	Annual seed and plug additions to existing inventory.	Conduct species inventories every 5 years.
Improve water management.	Monitor watershed functions, install contour forest strips.	Flowonthe go mobile app., source, acquire & install biodiverse trees & shrubs.	Record rainfall. Identify & seek funding opportunities to install sensors.
Protect from synthetic contaminants.	No synthetic inputs. Observe for neighborhood use.	Ongoing.	Never used, monitor if external contaminant event.
Protect pollinators.	Provide habitat & food sources.	Increase plant biodiversity annually.	Conduct species inventories every 5 years.
	Be prepared for opportunities to participate in cost-share programs.	Document practices to respond to requests for proposals.	Print and digital documentation.
Increase perennial vegetables.	Inventory current, investigate options (emphasize woody), source & install.	Annually.	Inventory & implement variety trial evaluations.
Enhance riparian forest border.	Inventory current, choose additions for biodiversity.	Identify diversity needs; source, acquire & install.	Create planting map for existing & new biodiversity.
Forest stands improvement.	Monitor for insects/disease. Remove invasive species competition (ongoing).	Identify diversity needs; source, acquire & install.	Create planting map for existing & new biodiversity.
Hedgerow/windbreak establishment.	Increase species diversity.	Identify diversity needs; source, acquire & install.	Record rainfall. Identify & seek funding opportunities.
Increase soil health - carbon sequestration/storage.	Apply biochar to new planting sites. Source locally.	Inoculate with farm compost.	Include in soil testing sites. Seek funding to support soil health testing.

## Resources:

- Apfelbaum, S., Haney, A. (2010). Restoring Ecological Health to Your Land. Washington, DC: Island Press
- Apfelbaum, S., Haney, A. (2012). The Restoring Ecological Health to Your Land Workbook. Washington, DC: Island Press
- Beresford-Kroeger, D. (2010). The Global Forest. N.Y.: Penguin Books.
- Brookfield, H. (2001). Exploring Agrodiversity. N.Y.: Columbia University Press.
- Bukowski, C. & Munsell, J. (2018). The Community Food Forest Handbook: How to Plan, Organize, and Nurture Edible Gathering Places. Vermont: Chelsea Green.
- Cliburn, J. & Klomps, G. (1997). A Key to Missouri Trees in Winter. Jefferson City, MO.: MDC.
- Crawford, M. (2010). Creating a Forest Garden: Working with Nature to Grow Edible Crops. Totnes: Green Books.
- Creasy, R. (1982). The Complete Book of Edible Landscaping. San Francisco: Sierra Club Books.
- Cullina, W. (2002). Native Trees, Shrubs, and Vines: A Guide to Using, Growing, and Propagating North American Woody Plants. Houghton Mifflin Harcourt.
- Daily, G. & Ellison, K. (2002). The New Economy of Nature. Washington: Island Press/Shearwater Books.
- Dirr, M. (1977). Manual of Woody Landscape Plants. Champaign, IL.: Stipes Publishing.
- Flader, S. & Callicott, (1991). The River of the Mother of God & Other Essays by Aldo Leopold. WI: U. of WI Press.
- Frey, D. & Czolba, M. (2017). The Food Forest Handbook: Design & manage a Home-scale Perennial Polyculture Garden. Canada: New Society Publishers.
- Fukuoka, M. (2009). The One Straw Revolution. New York: New York Review Books.
- Hawken, P. et.al. (1999). Natural Capital. Boston: Little, Brown, & Co.
- Hawken, P. (Ed.). (2017). Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming. Penguin Random House.
- Hightshoe, G. (1988). Native Trees, Shrubs, & Vines for Urban & Rural America: A Planting Design Manual for Environmental Designers. N.Y.: Van Nostrand.
- Hottes, A. (1948). The Book of Shrubs. N.Y.: A.T. De La Mare Co.
- Imhoff, D. & Baumgartner, J. (2006). Farming & the Fate of Wild Nature. Healdsburg, CA.: Watershed Media
- Jacke, D. & Toensmeier, E. (2005). Edible Forest Gardens, Vol. 1 & 2. Vermont: Chelsea Green.
- Jackson, D. & Jackson, L. Ed. (2002). The Farm as Natural Habitat. Washington: Island Press.
- Kareiva, P. et.al. Ed. (2011). Natural Capital: Theory & Practice of Mapping Ecosystem Services. N.Y.: Oxford U. Press.
- Keeler, H. (1927). Our Native Trees. N.Y.: C. Scribner's Sons.
- Kelsey, A. (2014). Edible Perennial Gardening: Growing Successful Polycultures in Small Spaces. Vermont: Chelsea Green.
- Kurz, D. (1997). Shrubs & Woody Vines of Missouri. Jefferson City, MO.: MDC.
- Kurz, D. (2003). Trees of Missouri. Jefferson City, MO.: MDC.
- Leopold, A. (1949). A Sand County Almanac. New York: Oxford Univ. Press.
- Mollison, B. (1988). Permaculture: A Designers' Manual. Tyalgum, Australia: Tagari Publications.

Mudge, K. & Gabriel, S. (2014). Farming the Woods. Vermont: Chelsea Green.

Peets, E. (1913). Practical Tree Repair: The Physical Repair of Trees, Bracing & the Treatment of Wounds & Cavities. N.Y.: McBride & Nast.

Platt, R. (1965). The Great American Forest. N.J.: Prentice-Hall.

Powers, R. (2018). Overstory. N.Y.: Norton & Co.

Reich, L. (2009). Landscaping with Fruit. North Adams, MA.: Storey Publishing.

Rogers, J. (1909). Trees Every Child Should Know. N.Y.: Grosset & Dunlap Publishers.

Silver, A. (2019). Trees of Power. Vermont: Chelsea Green.

Smaje, C. (2020). A Small Farm Future. Vermont: Chelsea Green.

Smith, J. R. (1953). Tree Crops: A Permanent Agriculture. N.Y.: Devin Adair.

Stefferd, A. (1949). Trees – The Yearbook of Agriculture. Washington, D.C.: U.S. Government Printing Office.

Sternberg, G. & Wilson, J. (1995). Landscaping with Native Trees. Shelburne, VT.: Chapters Publishing.

Toensmeier, E. (2016). The Carbon Farming Solution, Vermont: Chelsea Green.

Weiseman, W., Jalsey, D., Ruddock, B. (2014). Integrated Forest Gardening: The Complete Guide to Polycultures & Plant Guilds in Permaculture Systems. Vermont: Chelsea Green.

Wilson, M. et al, (2018). Planting Tree Crops. WI: Savanna Institute.

Winchester, S. (2021) Land. N.Y.: HarperCollins.

Yeomans, K. Ed., (2008). Water for Every Farm, Keyline Designs: Australia.

<http://www.carboncycle.org/wp-content/uploads/2018/02/carbon-farm-planning-step-by-step.pdf>

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0234611>

<https://oceanservice.noaa.gov/facts/carbon-cycle.html>

<https://www.itreetools.org/tools/i-tree-eco>

<https://globalecoguy.org/we-need-to-see-the-whole-board-to-stop-climate-change-98be66412281>

[New Report Reveals Top 10 Insights in Climate Science in 2020 | UNFCCC](https://www.unfccc.org/news/new-report-reveals-top-10-insights-in-climate-science-in-2020)

<http://teebweb.org/>

<https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/air/quality/?cid=stelprdb1044982>

[https://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs141p2\\_002437.pdf](https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs141p2_002437.pdf)

<https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/air/?cid=stelprdb1044982>

<http://landsmart.org/programs-services/landsmart-carbon-farm-plans/>

<https://www.realorganicproject.org/>

<https://www.carbonbrief.org/analysis-the-climate-papers-most-featured-in-the-media-in-2020>

[https://climate.nasa.gov/news/3057/land-ecosystems-are-becoming-less-efficient-at-absorbing-carbon-dioxide/?fbclid=IwAR0mAplDuOwwRV-0OplvVW0Mm\\_FFuMKUTE12CO-wR3pU\\_JEWxaLaSS1iXE](https://climate.nasa.gov/news/3057/land-ecosystems-are-becoming-less-efficient-at-absorbing-carbon-dioxide/?fbclid=IwAR0mAplDuOwwRV-0OplvVW0Mm_FFuMKUTE12CO-wR3pU_JEWxaLaSS1iXE)

<https://www.motherjones.com/environment/2020/07/indigo-agriculture-carbon-farming-sequestration-agriculture-climate-change-emissions-soil-health/>

<https://apnews.com/article/un-calls-end-war-nature-go-carbon-free-d144cda34053abbd0758e22d9ff8f7c6>

<https://treesonfarmsforbiodiversity.com/>

<https://www.fs.usda.gov/nac/practices/index.shtml>

<https://www.pnas.org/content/117/52/33351> Crop wild relatives of the United States require urgent conservation action.

[https://usfs.maps.arcgis.com/apps/MapJournal/index.html?appid=4d1f6e2200cf432bb2cc2c1584f6f9f6&fbclid=IwAR1BOeYe2SfrUWa4EpJQtgTjq7-iwoWKKRYRI9j07IaSvxdnVvLTa1nv4\\_o#map](https://usfs.maps.arcgis.com/apps/MapJournal/index.html?appid=4d1f6e2200cf432bb2cc2c1584f6f9f6&fbclid=IwAR1BOeYe2SfrUWa4EpJQtgTjq7-iwoWKKRYRI9j07IaSvxdnVvLTa1nv4_o#map)

<https://civileats.com/2020/08/19/perennial-vegetables-are-a-solution-in-the-fight-against-hunger-and-climate-change/>

[jonnyhigham.co.uk/FOTG/index.php](http://jonnyhigham.co.uk/FOTG/index.php) a iOS and Android mobile app capable of determining velocity fields in the field.

<https://www.thelancet.com/commissions/EAT> Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems.

<https://www.nytimes.com/interactive/2019/04/02/climate/pricing-carbon-emissions.html>

<https://www.worldagroforestry.org/blog/2020/09/04/nutri-scapes-recipe-better-nutrition>

<https://www.fs.usda.gov/nac/resources/webinar-library/index.php>

<https://www.climate-kic.org/opinion/trees-as-infrastructure-pt-2/>

<https://www.reuters.com/article/us-usa-cities-trees-trfn-idUSKBN20E1A1>

<https://bioneers.org/forest-wisdom/>

<https://civileats.com/2020/09/24/are-carbon-markets-for-farmers-worth-the-hype/>

<https://www.smithsonianmag.com/science-nature/385-million-year-old-fossils-reveal-worlds-oldest-forest-had-modern-tree-roots-180973810/>

<https://aeclinic.org/publicationpages/2019/11/20/technosilvicultural-reclamation-for-environmental-emission-sequestration>

[https://usfs.maps.arcgis.com/apps/MapJournal/index.html?appid=4d1f6e2200cf432bb2cc2c1584f6f9f6&fbclid=IwAR1BOeYe2SfrUWa4EpJQtgTjq7-iwoWKKRYRI9j07IaSvxdnVvLTa1nv4\\_o#map](https://usfs.maps.arcgis.com/apps/MapJournal/index.html?appid=4d1f6e2200cf432bb2cc2c1584f6f9f6&fbclid=IwAR1BOeYe2SfrUWa4EpJQtgTjq7-iwoWKKRYRI9j07IaSvxdnVvLTa1nv4_o#map)

<https://www.fs.usda.gov/nac/assets/documents/agroforestrynotes/an44g14.pdf>

<https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/air/quality/?cid=stelprdb1044982>

<https://www.fs.usda.gov/nac/practices/index.shtml>

<https://www.carboncycle.org/carbon-farming/>

<https://www.wired.com/story/carbon-farming-could-make-us-agriculture-truly-green/>

[https://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs141p2\\_002437.pdf](https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs141p2_002437.pdf)

<https://www.globalagriculture.org/report-topics/industrial-agriculture-and-small-scale-farming.html>

<https://www.nber.org/papers/w26331>

<https://www.canberratimes.com.au/story/7120389/why-our-farmers-need-a-carbon-training-program/>

<http://teebweb.org/our-work/agrifood/understanding-teebagrifood/systems-thinking-approach/>

[https://bridgingthegap.org/wp-content/uploads/2020/08/ENERGYSTAR\\_Small\\_Business\\_AWB\\_Bridging-the-Gap.pdf](https://bridgingthegap.org/wp-content/uploads/2020/08/ENERGYSTAR_Small_Business_AWB_Bridging-the-Gap.pdf)

[https://www.ted.com/talks/kate\\_raworth\\_a\\_healthy\\_economy\\_should\\_be\\_designed\\_to\\_thrive\\_not\\_grow](https://www.ted.com/talks/kate_raworth_a_healthy_economy_should_be_designed_to_thrive_not_grow)