Climate Adaptation Resources for Northern New England Farmers: Part 1 - Livestock Enterprises

March 29, 2022

The University of Vermont

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USDA Northeast Climate Hub
U.S. DEPARTMENT OF AGRICULTURE

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U.S. DEPARTMENT OF AGRICULTURE

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Today's Presentation

- Project Overview- Developing climate adaptation resources for small and medium Northeast farms (Meredith)
- Silvopasture Overview (Kate)
  - What it is, definitions
  - Benefits and Challenges
  - Examples and how to
- Project Tools and Resources (Carolyn)
  - Economic calculator- the cost of implementation
  - Visualizing silvopasture
  - Additional resources and website

Project Overview

Phase 1: Farmer (n=33) and Technical Advisor (n=16) Interviews

Phase 2: Farmer Focus Groups (n=28)

Phase 3: Tool Development with Feedback and Refining

Two Tools

- Economic Tool
- Visualizations

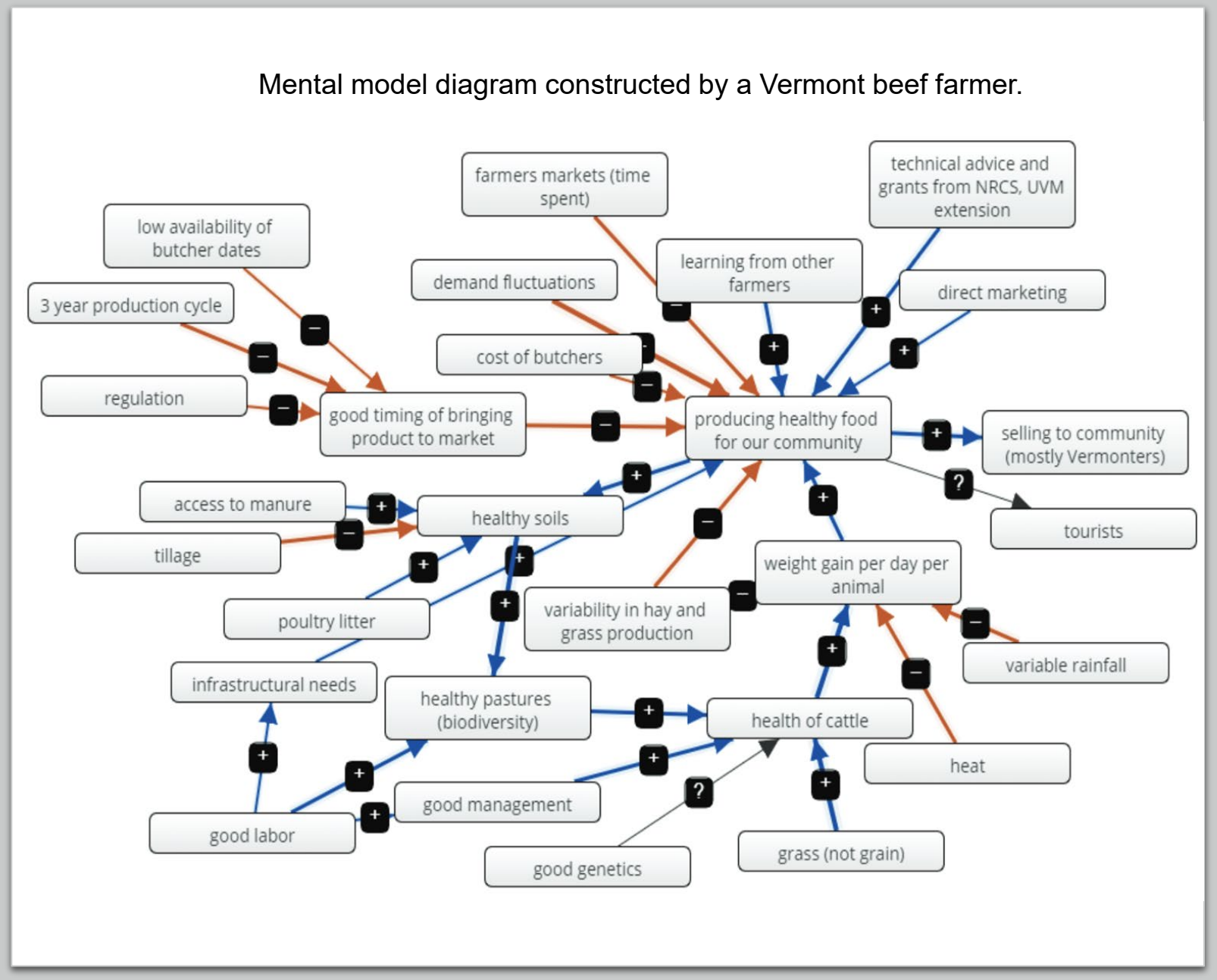
Three Practices

- Silvopasture
- Irrigation
- Tarping

Interviews

- Mental models are the ways in which people imagine the relationships between parts in their mind
- In-depth interviews, including mental model development with farmers and technical advisors about their farm

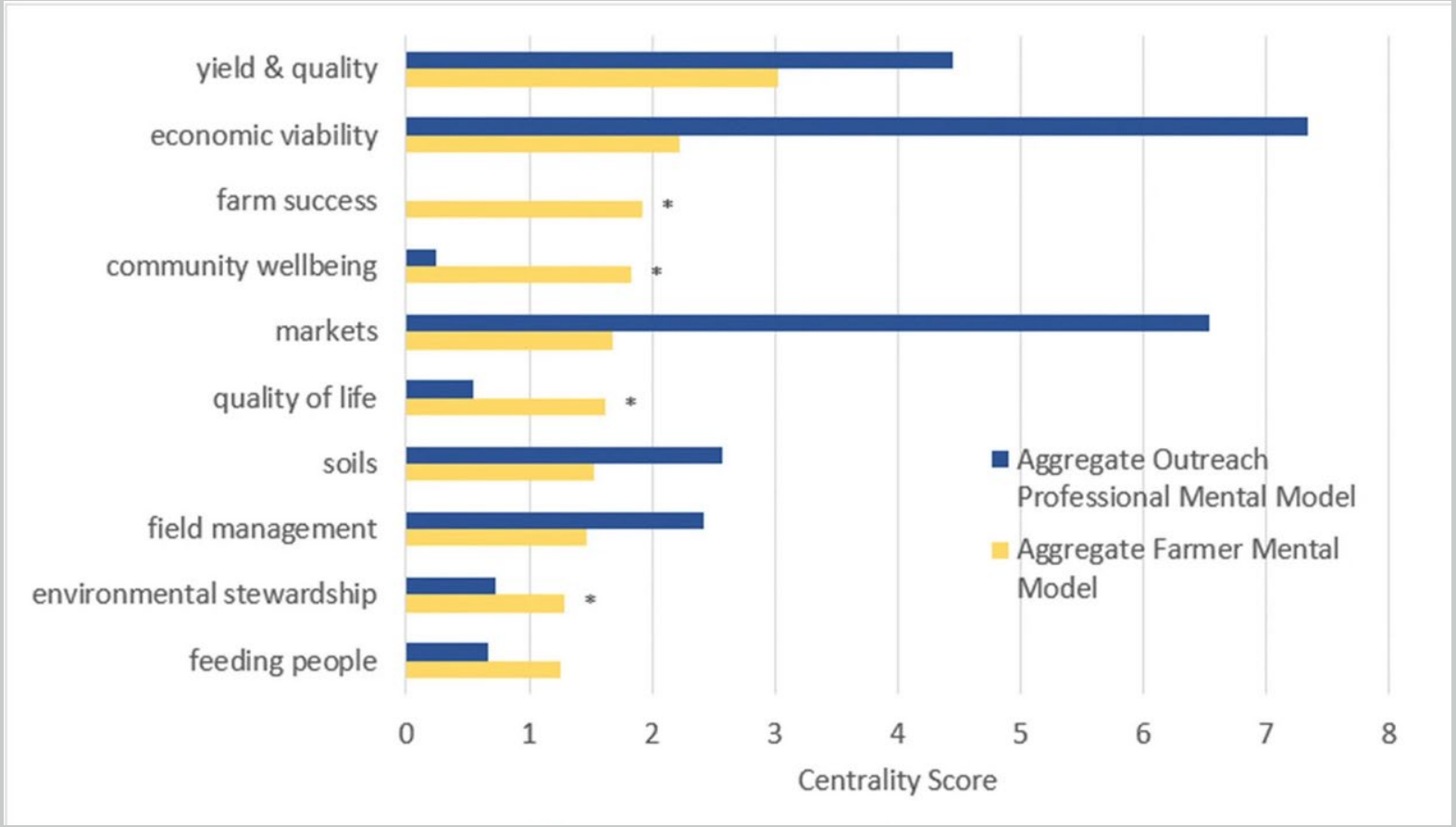
Mental model diagram constructed by a Vermont beef farmer.



Johnson, D., et al. 2019. https://womeninag.extension.org/wp-content/uploads/2020/01/Farmer-Advisor-Mental-Models-Brief_1_2020.pdf

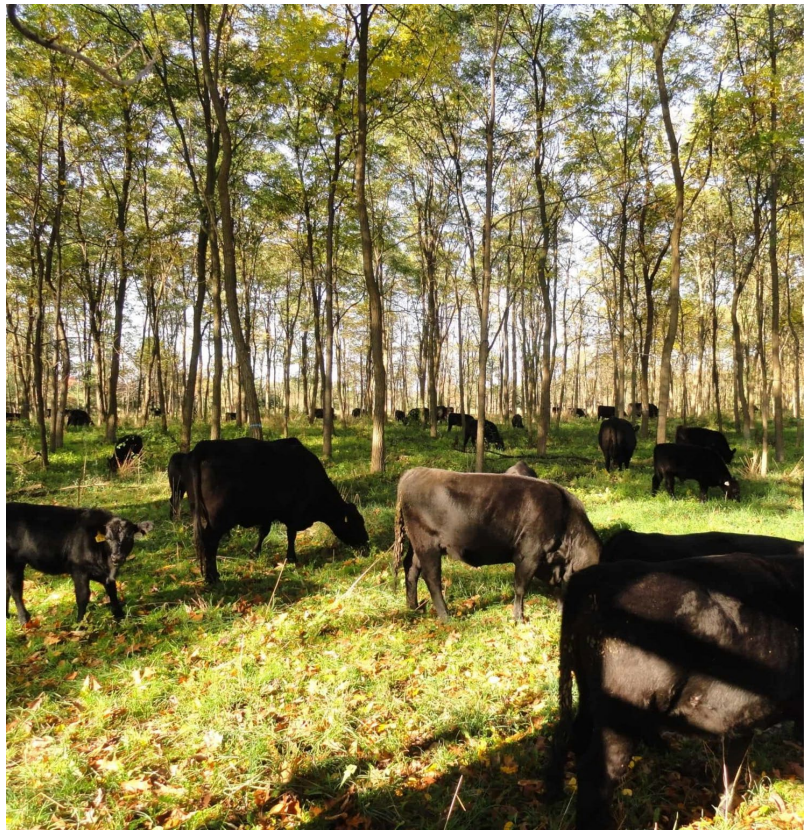
Interviews & Focus Groups

- Farmers more likely to identify farm success, community wellbeing, quality of life and environmental stewardship
- Outreach professionals more likely to focus on finance and economics
- Focus groups identified practices and piloted tools iteratively with farmers



How central key concepts were to farmers versus outreach professionals in mental models

Clements, R.S., *et al.* Climate change in the context of whole-farming systems: opportunities for improved outreach. *Climatic Change* **166,** 40 (2021). https://doi.org/10.1007/s10584-021-03101-4



Climate Change Adaptation Practices

Silvopasture & Climate Adaptation

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USDA United States Department of Agriculture
National Agroforestry Center

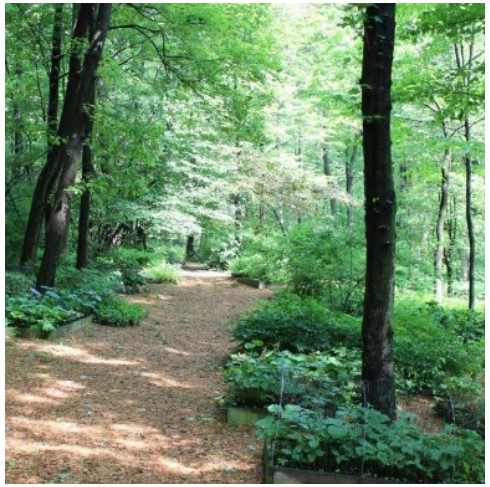
Today's presentation:

- What is silvopasture?
- Benefits and challenges
- How are people using silvopasture?
- Next steps towards silvopasture

What is agroforestry?

Agroforestry is the intentional integration of trees and shrubs into crop and animal farming systems to create environmental, economic, and social benefits.

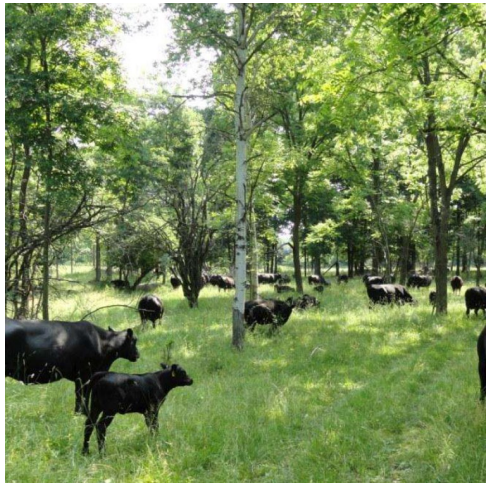
Alley cropping



Forest farming

Riparian buffers

Windbreaks



Silvopasture

Agroforestry practices can complement other climate adaptation practices

Crop rotation

Forest farming

Rotational grazing

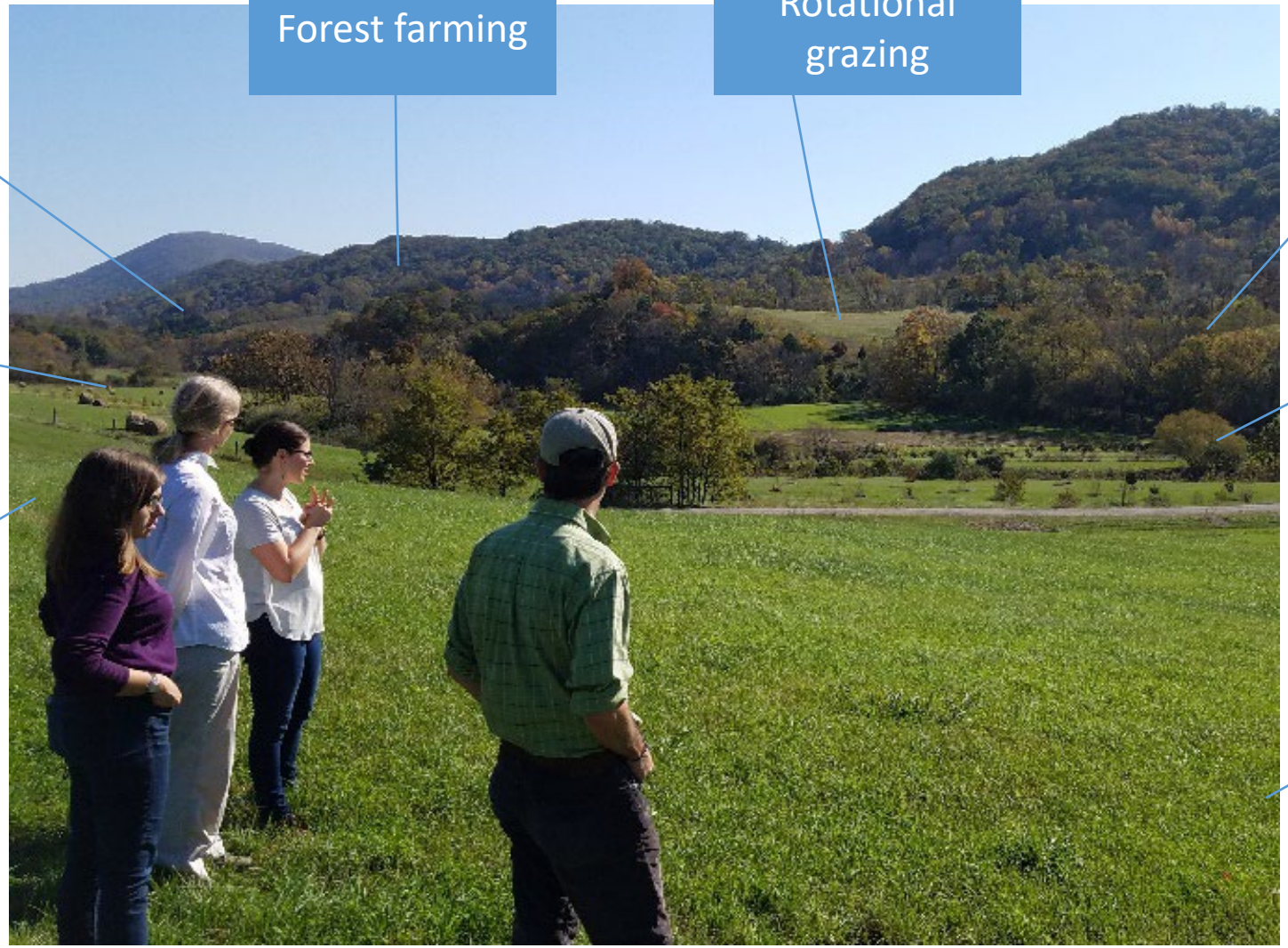
No till

Silvopasture

Multifunctional riparian buffer

Cover cropping

Alley cropping



Courtesy photo by John Munsell, Virginia Tech

Definitions

Silvopasture is the intentional integration of trees and grazing livestock operations on the same unit of land.

These systems are intensively managed for tree products, livestock, and forage, providing both short- and long-term income sources.

Silvopasture research at black locust/black walnut silvopasture system at Virginia Tech's Kentland Research Farm. Courtesy photo by John Munsell, Virginia Tech.

What Silvopasturing is Not

- Single trees in pastures
- Turning livestock into the woods

Why not? Problems with root compaction, girdling, soil degradation, parasite problems

Courtesy photos by Joe Orefice, Yale University

Courtesy photo by Dusty Walter, University of Missouri

Cattle bunching around a single tree in a pasture in Wyoming. USDA National Agroforestry Center photo.

Characteristics of Silvopasture

Two definitive characteristics of silvopastures are:

1. The management of the livestock type, timing, and impact maintains forage and tree health and maintains rooting zones that stabilize soil in silvopastures.

2. Trees are actively cultivated in silvopasture systems and stem density is controlled to encourage forage and tree vigor.

Long rest periods: in the northeast, often livestock are only in a silvopasture for a few days (1-7) over the course of a growing season.

Beef cattle in an apple silvopasture on North Branch Farm in New York. Courtesy photo by Joe Orefice, Yale University

Silvopasture Benefits

…may not all be realized

- **Improved animal performance**
- Improved animal health
- Diversified farm products and income
- **Balance seasonal forage grown and increased forage availability during droughts**
- Cost-effective vegetation control
- Creation of high-value wildlife habitat
- Improved soil health
- **Improved water retention and quality**
- Carbon sequestration
- Beneficial farm aesthetics

Climate Risk: Hot Summers & Extreme Weather Events

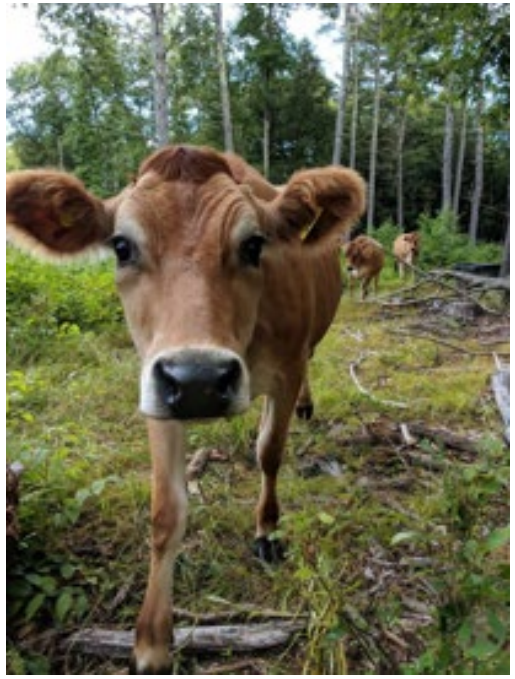
Adaptation: Improved Animal Performance with Shade & Protection

Cows begin to experience heat stress at much lower temperatures than humans. In general, mild heat stress starts around 72°F with 50% humidity.

Reduced heat and cold stress improves:

- Animal condition
- Milk production
- Breeding efficiency
- Feed intake
- Weight gain
- Nutrient distribution

Hogs in a hazelnut silvopasture in Oregon. *Courtesy photo by Taylor Larson, My Brothers' Farm.*

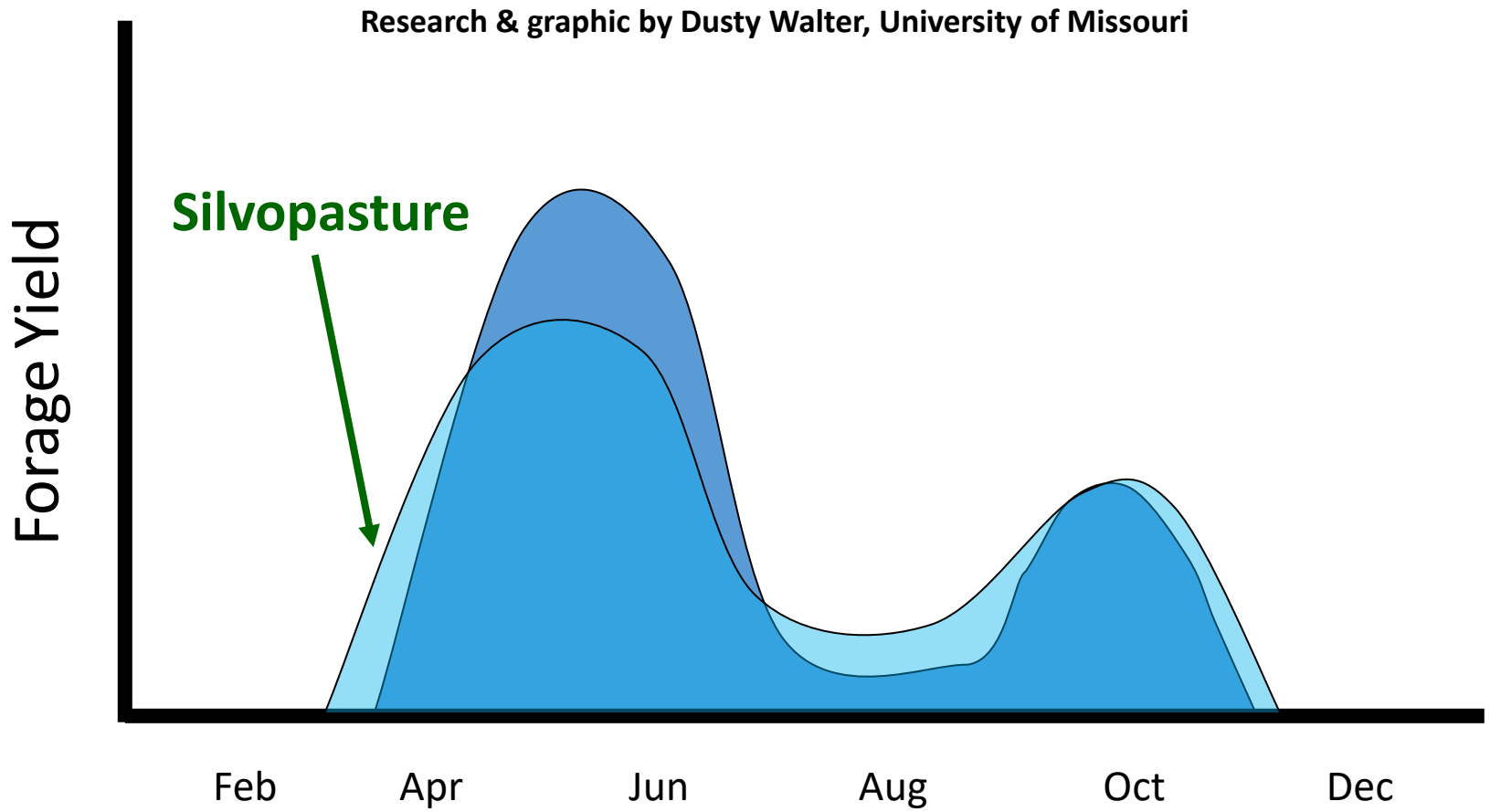


Dairy cattle entering newly established silvopasture at the University of New Hampshire Organic Dairy Research Farm. *USDA National Agroforestry Center photo by Matt Smith.*

Climate Risk: Hot, Droughty Summers

Climate Adaptation: Forage Availability

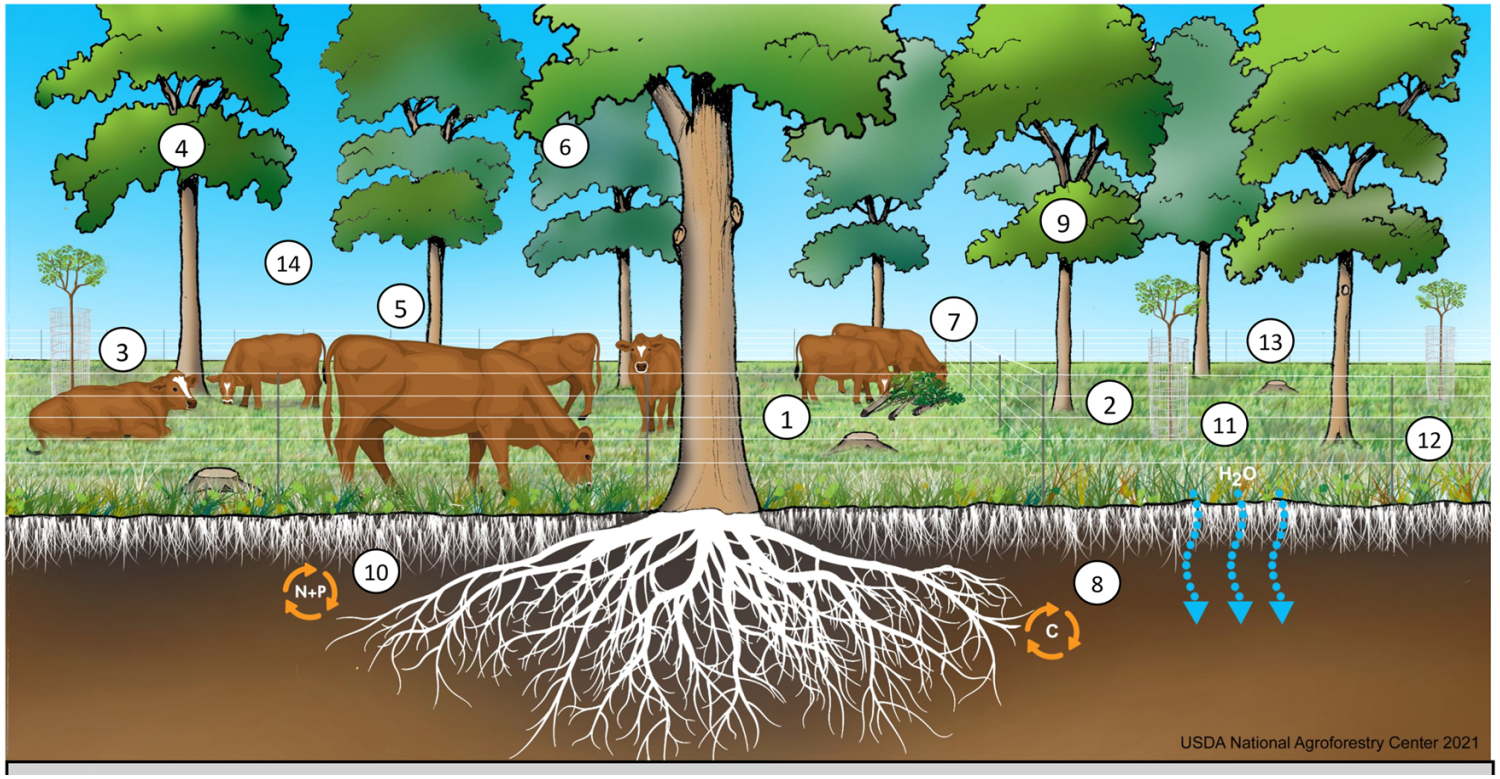
- Throughout the season & during droughts
  - Forages start growth earlier in spring, continue later in fall
  - Forage yields higher in heat of summer



Climate Risk: High-intensity Rain Events

Climate Adaptation: Improved water quality & infiltration

- Water retention: infiltration rates are similar or slightly higher in silvopasture than open pastures but lower than forests
- Water quality: can enhance nutrient recycling and reduce phosphorus loss and nitrate leaching when compared to open pasture



Silvopasture Challenges

…may be mitigated through management or design

- Managers' lack of silvopasture management experience and knowledge
- Silvopasture establishment and maintenance costs, time, and labor
- Livestock exposure to toxic plants, predators, parasites, diseases, physical hazards, hunters
- Reduced mobility of farm equipment in grazing areas
- Decreased water retention and quality if poorly designed or poorly managed
- Implementation of silvopasture may impact farms' Current Use designation and enrollment

Dickinson College Farm Silvopasture Demonstration. NRCS photo by Dan Dostie.

Establishment Pathways Reported by Farmers

- Planting trees into a pasture or field
- Wooded pasture edge to silvopasture by thinning
- Orchard to silvopasture by integrating livestock

Field to Silvopasture
USDA National Agroforestry Center photo.

Wooded Pasture Edge to Silvopasture
Courtesy photo by Brian Tomazi

Orchard to Silvopasture
Licensed photo by AdobeStock

Establishment Pathways Reported by Farmers

- Forest to silvopasture by thinning trees and establishing forage

Courtesy photos by Brett Chedzoy, Angus Glen Farms



- Pine plantation to silvopasture by thinning trees or thinning multiple adjacent rows to create alleys, followed by forage establishment

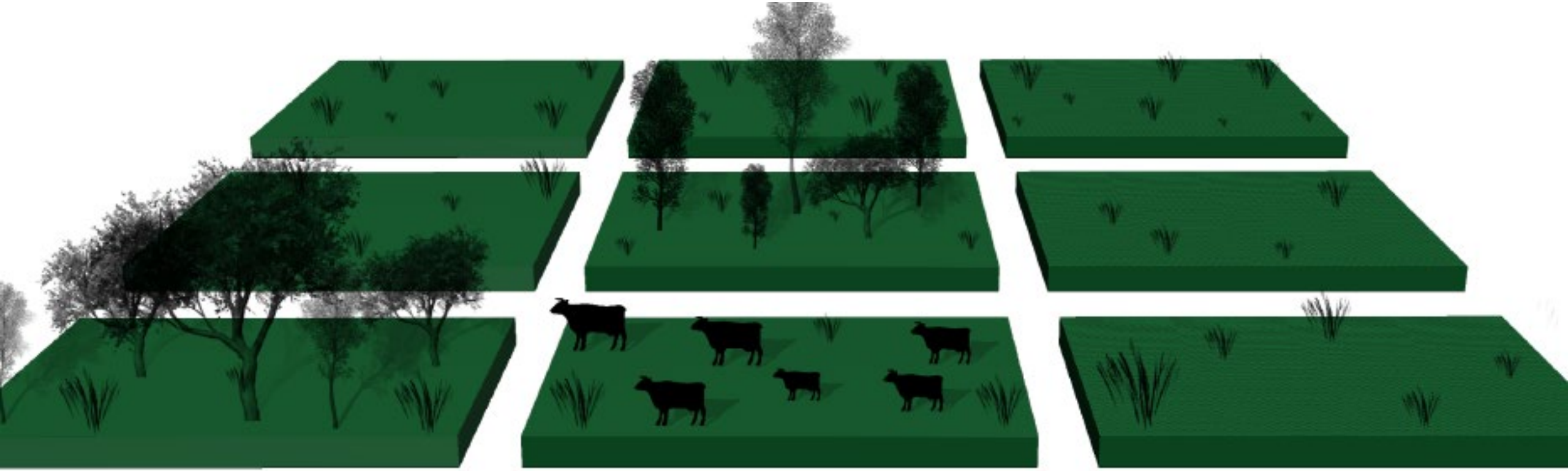


USDA Forest Service photo

Photos by John Fike, Virginia Tech

How does silvopasture fit into your operation?

A synthesis of surveys of silvopasture adoption found that 96% of farmers with silvopastures have a combination of some silvopastures and some pastures without trees (Smith et al. 2022)



USDA Forest Service Graphic by Josh Bundy

Common Components of Northern New England Silvopastures

Tree Species	Tree Products	Livestock Species	Forages
Oaks	Firewood	Cattle (beef, dairy)	Red clover
Maples	Sawtimber	Goats (meat, dairy)	White clover
Fruit trees	Fence posts	Sheep (meat, fiber)	Orchardgrass
Eastern white pine	Fruit	Chicken (meat, eggs)	Bentgrasses
Hickories	Nuts	Turkeys	Bluegrasses
Eastern hemlock	Sap	Ducks	Fescues
Commercial nut trees	Tree nurseries & plant materials	Pigs	Timothy
Black locust	Scion wood	Horses	Ryegrasses

Silvopasture Examples

Field edge silvopasture: The overstory is comprised of eastern white pine and the understory is a mixture of cool season grasses and sedges. When livestock are introduced, in this case dairy goats and beef cattle, paddocks are created to include both open field and silvopasture.

Photo by Joe Orefice, Yale University.

Use livestock to utilize fruit or nuts: This system uses hazelnuts to provide shade and cover for poultry, as well as nuts for the poultry to eat.

Courtesy photo by Reginaldo Haslett-Marroquin, Main Street Project.

Silvopasture Examples

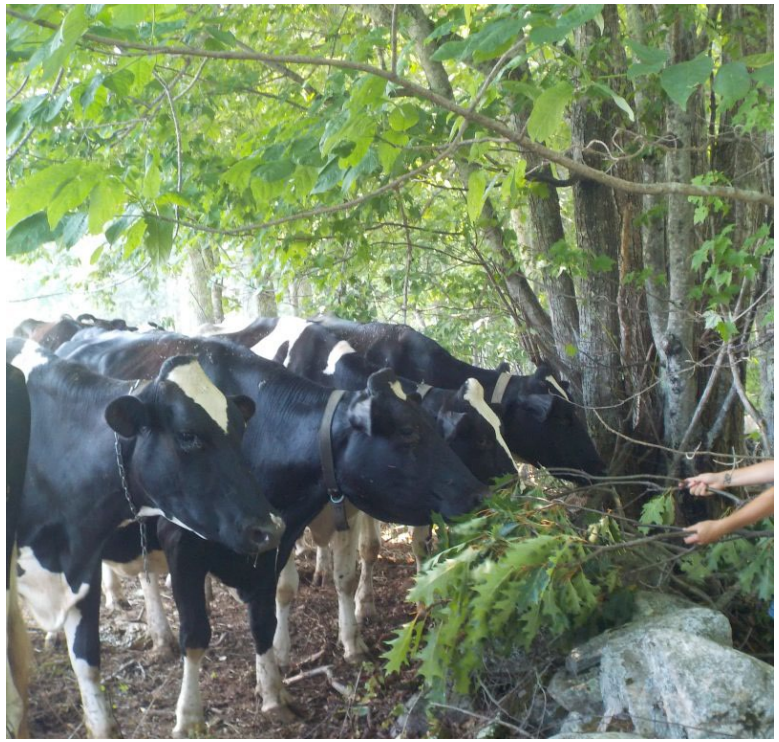
Thanks to Joe Orefice for giving permission to share photos and examples from *Photo Guide to Northeast United States Silvopasture*:

https://cpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/d/5957/files/2015/03/Photo-Guide-to-NE-US-Silvopasture-2m9ggax.pdf

Variable density oak and maple silvopasture converted from a forest, irregular tree spacing with residual trees.

Hardwood Plantation Silvopasture: Black locust silvopasture with some black walnut, established from an open field about 20 years ago. It was commercially thinned twice for black locust fence posts and rotationally grazed with beef cattle, and occasionally meat goats, for the past ten years.

Silvopasture Examples



Tree fodder: Increasingly, research is being done on the health, nutrition, and other benefits of tree fodders, including appropriate species for the northeast and management requirements.

Courtesy photo by Shana Hansen, 3 Streams Farm, Belfast, ME

Orchards: This apple orchard silvopasture has been periodically grazed by sheep. The orchardgrass in the foreground is one component of a cool season grass and legume forage layer. The USDA organic standard prohibits livestock grazing within 90 days prior to harvesting fruit and the Food Safety and Modernization Act has restrictions related to livestock manure on farms of a certain scale. This makes silvopasture in orchards more complex and timing very important.

Courtesy photo by Joe Orefice, Yale University.

Silvopasture Steps

Rotational grazing is a pre-requisite to silvopasture.

1. Gather a team of people with the right expertise
2. Assess the site
3. Select trees appropriate to site conditions
4. Make sure these trees also meet manager goals: produce a light shade, produce desired products (nuts, timber, syrup), high value, deeply rooted
5. Determine planting configuration: shade management, mowing, fencing, product growth and harvest
6. Weed control: mechanical, herbicide, mulch
7. Protect trees from grazing

Courtesy photo by Joe Orefice, Yale University

Courtesy photo by Charlotte Clifford-Rathert, Lincoln University

Site Requirements

- **Site quality**: site capable of growing agricultural crops and/or quality timber.
- **Access**: Relatively easy to reach the location with materials, equipment and livestock.
- **Erosion concerns**: Site can tolerate managed grazing during heavy rainfalls with negligible long-term impacts.
- **Hazards**: No significant risks such as deep gullies, flood-prone streams, etc.
- **Terrain/"fence-ablity"**: Site can be enclosed with secure fence with minimal clearing and excavation.
- **Water**: Potable water is readily available on location for livestock.
- **Size/shape/location**: Area is adjacent to existing grazing operation, large enough to justify the investment in developing it, and the shape allows for efficient fencing.

Manager Requirements

- Already comfortable practicing rotational grazing
- Has the time/labor available to move animals often
- Comfortable working with a system that changes over time
- Willing to work without a recipe
- Has a team: foresters need grazing knowledge and vice versa
- Likes working with & learning from others

Jacob Marty, a sixth generation farmer, in Illinois transitioned 250 acres of conventional grain production to rotational grazing. In 2016, a pilot silvopasture planting of 1,000 redbuds, apple, pear, chestnut, and other fruit and nut trees was created on 8 acres. Courtesy photo by Jacob Marty.

Questions?

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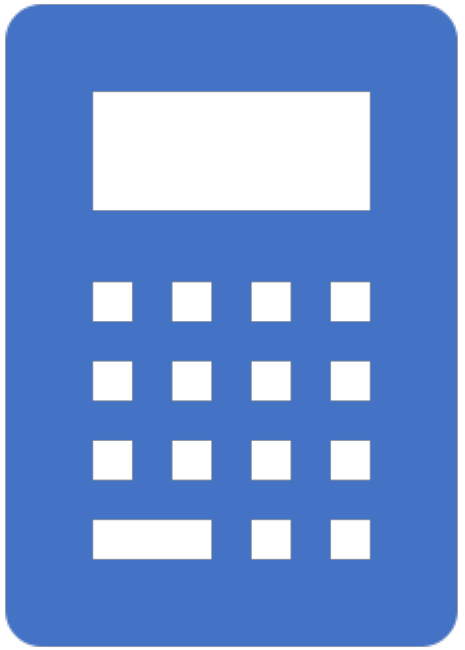
Additional Resources

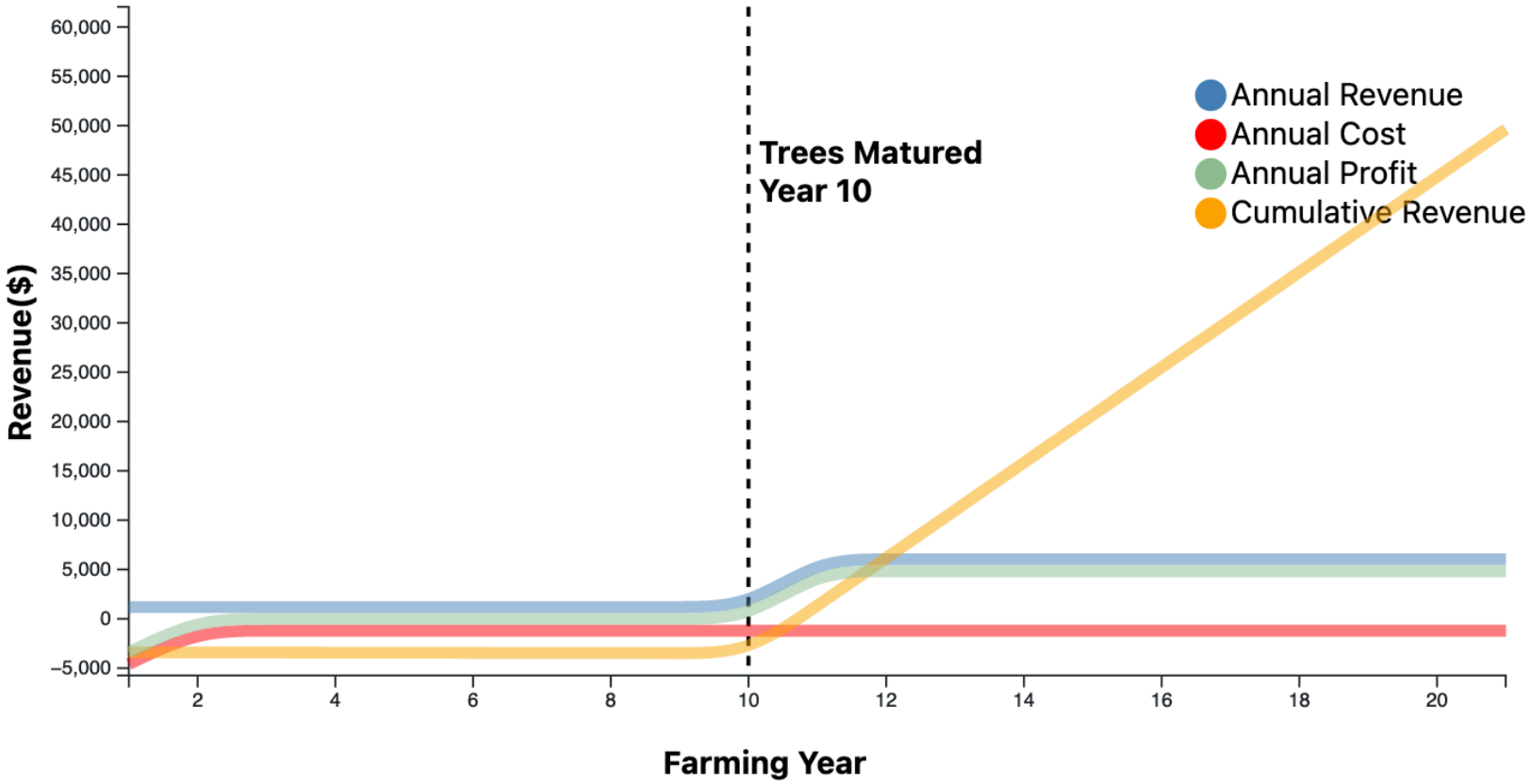
- www.nefarmclimate.com
- Three tools
  - Economic calculator
  - Visualizations
  - Practice overview and resources

Economic Tool

- Farmer suggested - “mortgage calculator”
- Assists farmers and their advisors in understanding the general costs, revenues and profits associated with implementing different climate adaptation practices
- Can input farm-specific data
- To be used with other tools and technical information and advisors



Economic Tool - Silvopasture



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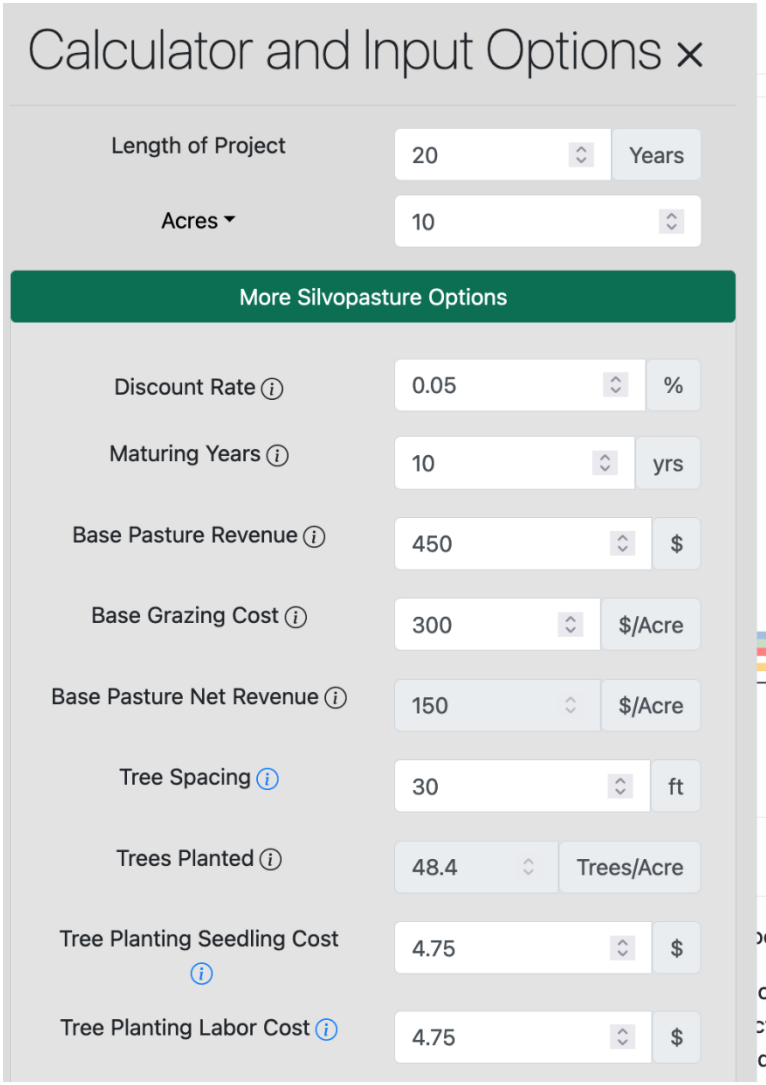
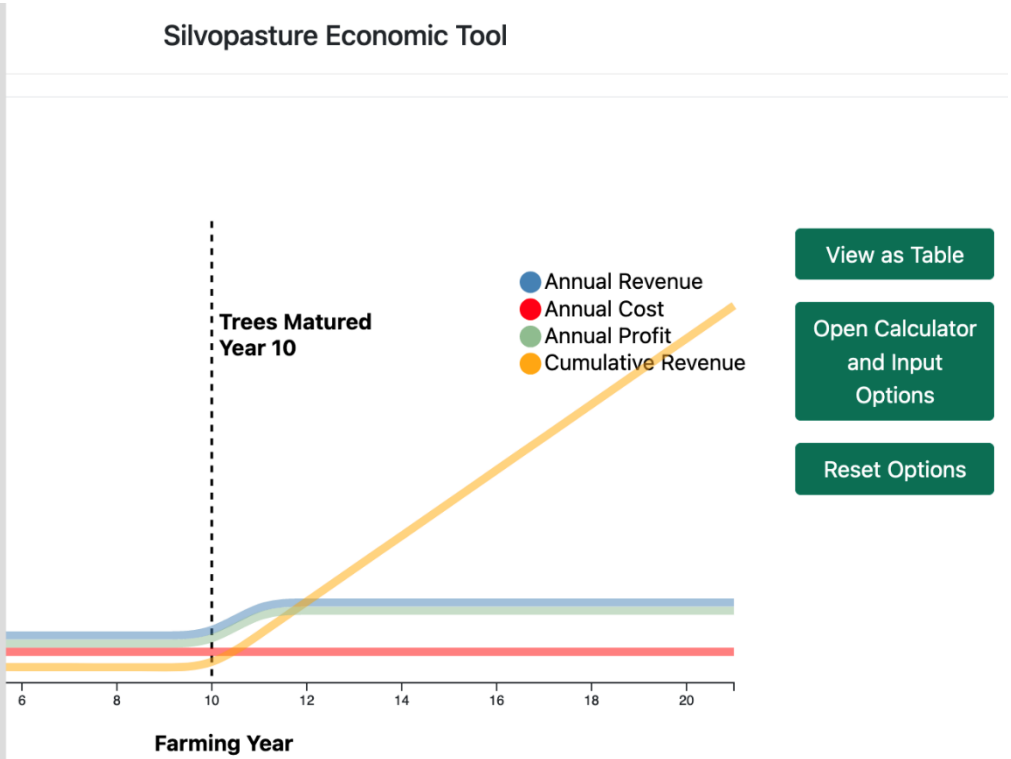
Open Calculator and Input Options

Reset Options

Economic Tool - Silvopasture





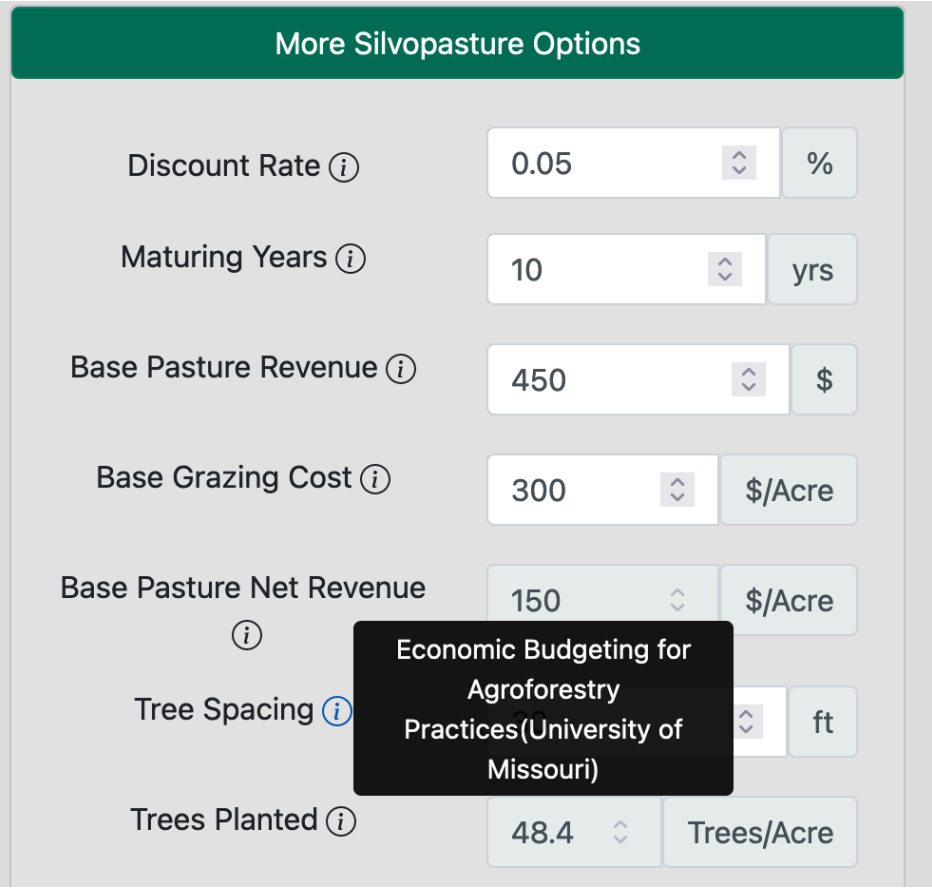
Using this tool

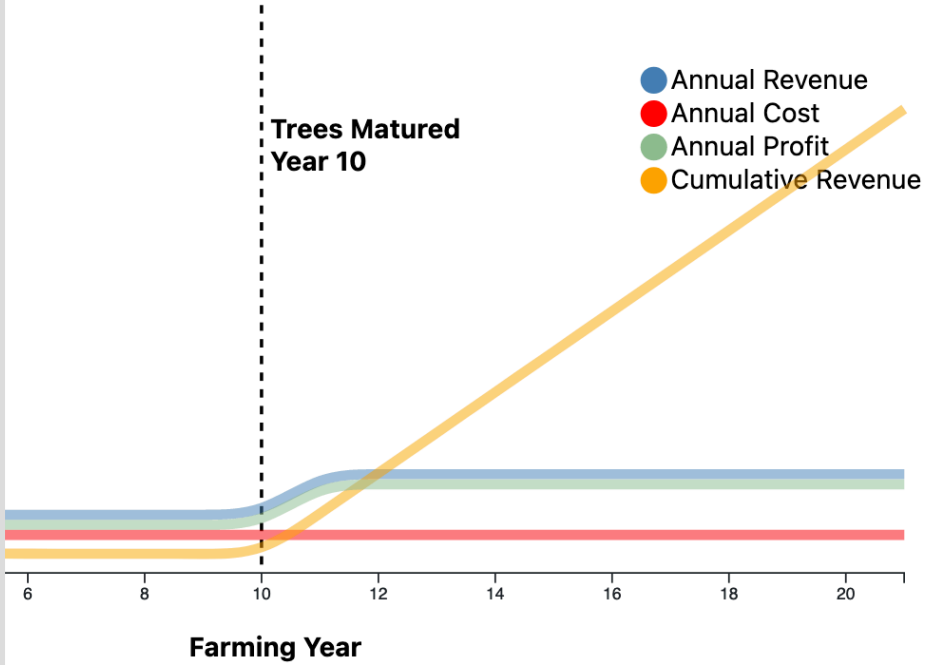
…pen Calculator and Input Options".

…ons for each metric, or enter information specific to your operation, such as your …ct length, your costs and revenue for the base pasture, tree planting costs, trees per …d tree crop yield.

www.nefarmclimate.com

Economic Tool - Silvopasture





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Open Calculator and Input Options

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www.nefarmclimate.com

Economic Tool - Silvopasture

Component	Per Acre	Total Area
PV Benefit	$3,789.86	$37,898.55
PV Cost	-$1,830.59	-$18,305.94
NPV ⓘ	$1,959.26	$19,592.61
Benefit-Cost Ratio ⓘ	2.07	2.07

View as Graph

Open Calculator and Input Options

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Year	Revenue	Cost	Value	Cumulative
1	$1,200.00	-$4,598.00	-$3,398.00	-$3,398.00
2	$1,200.00	-$1,210.00	-$10.00	-$3,408.00
3	$1,200.00	-$1,210.00	-$10.00	-$3,418.00
4	$1,200.00	-$1,210.00	-$10.00	-$3,428.00
5	$1,200.00	-$1,210.00	-$10.00	-$3,438.00
6	$1,200.00	-$1,210.00	-$10.00	-$3,448.00
7	$1,200.00	-$1,210.00	-$10.00	-$3,458.00
8	$1,200.00	-$1,210.00	-$10.00	-$3,468.00
9	$1,200.00	-$1,210.00	-$10.00	-$3,478.00
10	$1,200.00	-$1,210.00	-$10.00	-$3,488.00
11	$6,040.00	-$1,210.00	$4,830.00	$1,342.00
12	$6,040.00	-$1,210.00	$4,830.00	$6,172.00
13	$6,040.00	-$1,210.00	$4,830.00	$11,002.00
14	$6,040.00	-$1,210.00	$4,830.00	$15,832.00
15	$6,040.00	-$1,210.00	$4,830.00	$20,662.00

Visualization Tool

- Picture how the implementation of silvopasture and other practices appear in the context of a real New England farm
- Different stages of practice implementation
- Aerial and on the ground visuals

Cattle graze in a pasture on a New England farm. Livestock density is average for a small to medium size farm.

Trees intended for future timber harvest are planted at 17-21 basal density in the pasture. Example trees: Black Walnut.

Mature trees in the pasture 15-20 years after planting. Cattle graze among the trees, some of which are selectively harvested.

Visualization Tool - Silvopasture

Perspective view of apple orchard in sheep pasture

Sheep and cattle graze in adjacent pastures on a New England farm.

Visualization Tool - Silvopasture

Perspective view of apple orchard in sheep pasture

Apple saplings are planted 15-20 feet apart in the sheep pasture.

Visualization Tool - Silvopasture

Perspective view of apple orchard in sheep pasture

Mature apple trees in the pasture 5-15 years after planting.

Additional Resources

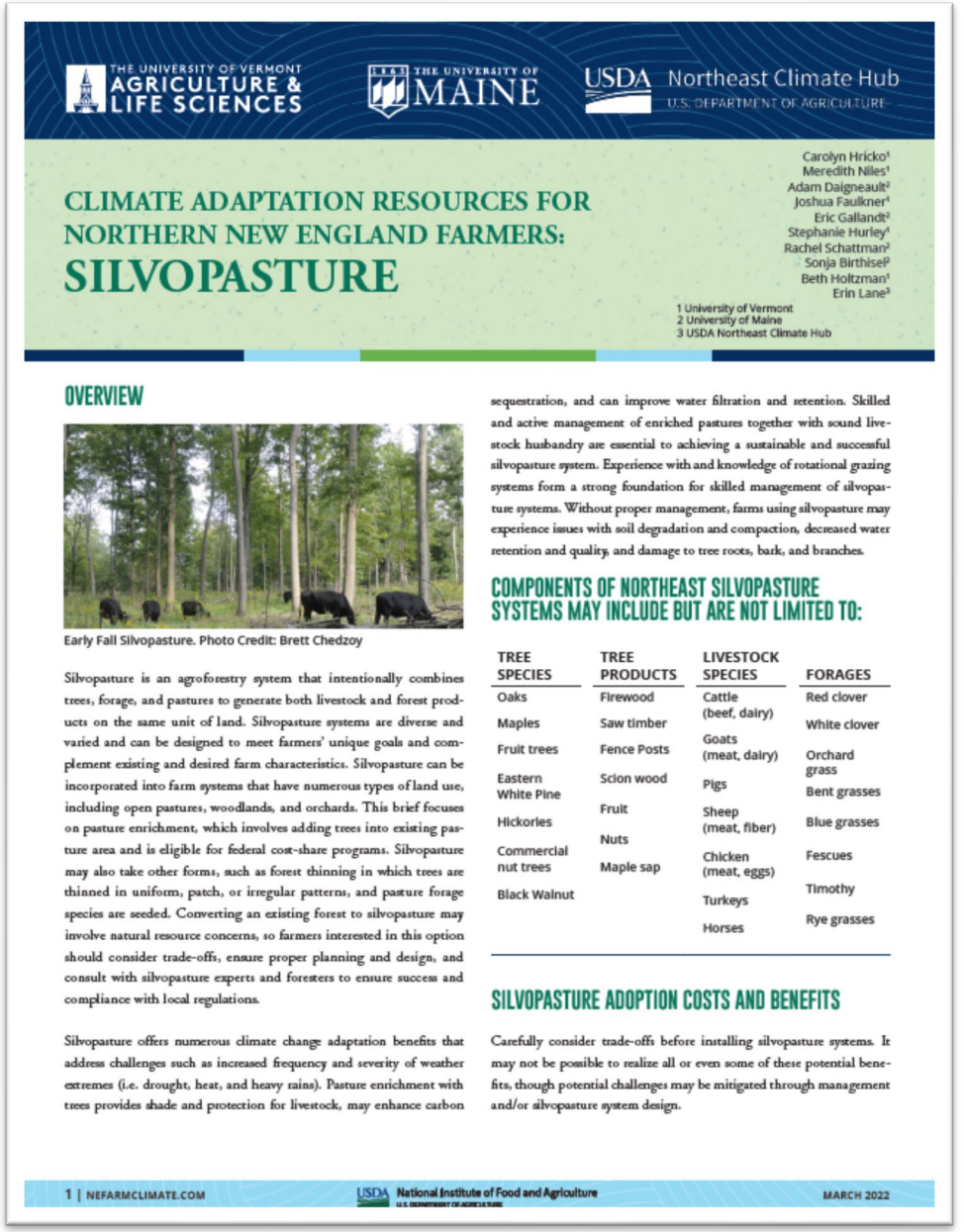
- Background on adaptation practices
- Documented benefits and costs
- Additional resources

Common Components of Silvopasture

Components of Northeast Silvopasture systems may include but are not limited to these elements

Tree Species	Forest Products	Livestock Species	Forages
Oaks	Firewood	Cattle (beef, dairy)	Red Clover
Maples	Sawtimber	Goats (meat, dairy)	White Clover
Fruit Trees	Fence Posts	Pigs	Orchardgrass
Eastern White Pine	Scion Wood	Sheep (meat, fiber)	Bentgrasses
Hickories	Fruit	Chicken (meat, eggs)	Bluegrasses
Eastern Hemlock	Nuts	Turkeys	Fescues
Commercial Nut Trees	Maple Sap	Horses	Timothy
Black Locust	Tree Nursery		Ryegrasses

www.nefarmclimate.com



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CLIMATE ADAPTATION RESOURCES FOR NORTHERN NEW ENGLAND FARMERS:

SILVOPASTURE

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1 University of Vermont
2 University of Maine
3 USDA Northeast Climate Hub

OVERVIEW

Early Fall Silvopasture. Photo Credit: Brett Chedzoy

Silvopasture is an agroforestry system that intentionally combines trees, forage, and pastures to generate both livestock and forest products on the same unit of land. Silvopasture systems are diverse and varied and can be designed to meet farmers' unique goals and complement existing and desired farm characteristics. Silvopasture can be incorporated into farm systems that have numerous types of land use, including open pastures, woodlands, and orchards. This brief focuses on pasture enrichment, which involves adding trees into existing pasture area and is eligible for federal cost-share programs. Silvopasture may also take other forms, such as forest thinning in which trees are thinned in uniform, patch, or irregular patterns, and pasture forage species are seeded. Converting an existing forest to silvopasture may involve natural resource concerns, so farmers interested in this option should consider trade-offs, ensure proper planning and design, and consult with silvopasture experts and foresters to ensure success and compliance with local regulations.

Silvopasture offers numerous climate change adaptation benefits that address challenges such as increased frequency and severity of weather extremes (i.e. drought, heat, and heavy rains). Pasture enrichment with trees provides shade and protection for livestock, may enhance carbon sequestration, and can improve water filtration and retention. Skilled and active management of enriched pastures together with sound livestock husbandry are essential to achieving a sustainable and successful silvopasture system. Experience with and knowledge of rotational grazing systems form a strong foundation for skilled management of silvopasture systems. Without proper management, farms using silvopasture may experience issues with soil degradation and compaction, decreased water retention and quality, and damage to tree roots, bark, and branches.

COMPONENTS OF NORTHEAST SILVOPASTURE SYSTEMS MAY INCLUDE BUT ARE NOT LIMITED TO:

TREE SPECIES	TREE PRODUCTS	LIVESTOCK SPECIES	FORAGES
Oaks	Firewood	Cattle (beef, dairy)	Red clover
Maples	Saw timber	Goats (meat, dairy)	White clover
Fruit trees	Fence Posts	Pigs	Orchard grass
Eastern White Pine	Scion wood	Sheep (meat, fiber)	Bent grasses
Hickories	Fruit	Chicken (meat, eggs)	Blue grasses
Commercial nut trees	Nuts	Turkeys	Fescues
Black Walnut	Maple sap	Horses	Timothy
			Rye grasses

SILVOPASTURE ADOPTION COSTS AND BENEFITS

Carefully consider trade-offs before installing silvopasture systems. It may not be possible to realize all or even some of these potential benefits, though potential challenges may be mitigated through management and/or silvopasture system design.

Acknowledgements

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  - **USDA Northeast Climate Hub:** Erin Lane
- Website Design
  - Tim Harrold, University of Vermont
- Visualizations
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