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Big River Chestnuts

Scaling-up Tree Crops to Strengthen the Local Food Economy

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Featured Practices

Alley Cropping
Silvopasture
Windbreaks

Key Themes

Scaling Agroforestry
Nut Processing
Market Development
Tree Crop Genetics

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This case study is part of a series highlighting farms across the Northeast implementing agroforestry as a strategy for building resilience. All farmers featured were participants in the Climate Adaptation and Mitigation Fellowship (CAMF). Discover more agroforestry case studies like this on their website: www.adaptationfellows.net

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Farm Overview

Big River Chestnuts (BRC) began in 2018 on 7.5 acres of land alongside the Connecticut River in Sunderland, Massachusetts. Over the years BRC has scaled up, adding an additional 55 acres in alley cropping systems on properties in nearby Easthampton and South Deerfield. From the beginning, agroforestry has been central to the farm's production system and mission.

As one of the first large-scale producers of chestnuts in the region, farmer Jono Neiger and his team at BRC are heavily involved in developing chestnut processing capacity and the chestnut market in the Northeast.

Locations	Sunderland, MA South Deerfield, MA Easthampton, MA	**Product**	Chestnuts
		Land	75 Acres

Chestnuts release from the burr when they are ready for harvest. Photo by Kate Holcomb, USDA Northeast Climate Hub.

Background

Jono spent much of his career as an ecologist, doing field research and working on restoration projects. With many years of experience in land management, he has a deep understanding of soil ecology, water management, and trees, although he had no previous experience farming. His work as an ecologist sparked a desire to help develop ecological farming models using permaculture and perennial cropping systems.

Chestnuts seemed particularly promising. As a food crop, they offer high nutritive value. Economically, domestic production is far behind demand. From a production perspective, the trees do well in diversified systems. Once established, chestnuts are prolific producers and can continue generating a crop for generations. Jono observed a lack of on-the-ground examples of agroforestry in the Northeast and was inspried to start BRC as an innovative proof of concept.

Photo of Jono Neiger, Photo used with Permission.

> " What was lacking were on the ground sites, because I would talk to farmers year after year and they would listen politely and then they'd say - ***what are you talking about? Does it it make any money?*** "
>
> Jono Neiger, Farmer/Owner

The Connecticut River Valley has been in agricultural production for over a thousand years. The valley once had deep, rich soil, but much of it has been heavily used and depleted. For instance, on the largest BRC property in South Deerfield, the land was most recently used for commercial corn production. The large equipment caused severe soil compaction.

Weather Risks & Impacts

Jono has observed changes in weather patterns in the region in recent years, such as more intense storms, more frequent droughts, more periods of high rainfall, and less predictable frost dates. These environmental disruptions can be extremely challenging for farmers, creating increased management burdens and potentially causing massive crop loss.

The farm is susceptible to many of these extreme weather events. For example, a late freeze in May 2023 (year six for the farm) took out the entire chestnut crop at BRC when it damaged new growth on the trees. At that time, the expected harvest was minimal anyway. If this were to happen in the future, when BRC is counting on higher revenue from chestnut sales, it could be catastrophic for the business. However, creating a system that is resilient in the face of changing conditions was central to BRC from the start. These risks are continually informing the design and management of BRC.

Temperatures in Massachusetts have risen nearly 3.5 degrees Fahrenheit since the beginning of the 20th century and are expected to continue to increase.[1] Extreme precipitation events increased 123% from 1950-2021, and are projected to more than double by the end of the century.[2]

Using Agroforestry

Big River Chestnuts is built around tree cropping systems and perennial agriculture. Agroforestry practices are folded into their operations in multiple ways. Agroforestry is the intentional integration of trees and shrubs into crop and animal farming systems to create environmental, economic, and social benefits.

Alley Cropping

Planting crops between rows of trees.

Silvopasture

Deliberate integration of trees and grazing livestock operations on the same land to achieve multiple ecological, social, and production benefits.

Windbreaks

Sometimes known as 'shelterbelts' or 'hedgerows', windbreaks shelter crops, animals, buildings, and soil from wind, snow, dust, and odors. These areas can also support wildlife and provide another source of income.

At BRC, the alleys between rows of chestnuts have been used for both alley cropping and silvopasture. In some alleys, Jono grows berries. Both chicken and sheep have been rotationally grazed in the meadow between tree rows as well. In the future, BRC may also use alleys to grow perennial grain, annual vegetables, and more. Use of the alleys will evolve over time as the trees grow and the ecology of the system changes.

Hedgerows at BRC support wildlife and contribute to soil improvement. They include trees that can be trimmed (through coppicing or pollarding) and used as cut-and-carry fodder for the livestock.

Goals

Jono's goal for BRC is to be a large-scale, profitable, and productive chestnut alley cropping system, while also serving as a demonstration site for others to learn about agroforestry.

> " From the beginning, it's all about the trees. And then, what are all the other cool things we can add on top of that in different ways over different time periods? "
>
> Jono Neiger, Farmer/Owner

The Big River Chestnuts farm in Sunderland, Massachusetts. This location is home to the farmstand, tours and events, and processing equipment. Photo by Jono Neiger, used with permission.

Design

Chestnut trees were planted in rows in a north-south orientation with 40' between rows, and 20-30' between trees within the row. Jono chose this spacing with the intention to selectively thin as needed as the trees grow larger.

Chestnuts are BRC's primary long-term crop, but they can take about ten years to reach substantial production. In the meantime, Jono and his team have thought a lot about designing succession into the farm plan. Berries, which began producing in year two, have acted as an intermediate crop as they wait for the chestnuts to come into production.

BRC has also incorporated animals through silvopasture. The first year, broiler chickens grazed the alleys and provided the farm with an immediate sellable output. In recent years, BRC has collaborated with sheep graziers, who use the alleys as part of their rotational grazing system. For about two-to-four months of the year, a flock of about 50 Finnsheep move daily through the alleys between trees. They graze on pasture as well as fodder from coppiced trees. The pasture is made up of existing vegetation, along with various perennials and annuals that BRC has sown. They have noticed that some plant species that were dominant in the past, such as Canada thistle, have declined as conditions have changed in the alleys. The farmers use electronet to create long, narrow runs, so trees and berries are protected from grazing. As this partnership develops, BRC is learning how to manage what forage is planted in the alleys, to best meet the needs of the tree crops as well as the animals.

> " We're not trying for perfection just from the start. It doesn't have to be perfect... Recognize that you're going to need to shift and adapt. "
>
> Jono Neiger, Farmer/Owner

Map of

Big River Chestnuts

(home farm)

- Farm Store
- Tree Lines
- Small Fruit and Perennial Crops
- Stream Restoration
- Connecticut River
- Riparian Forest Buffer
- Hedgerow

Addressing Risk from Extreme Weather

Although the farm faces risks from erratic and extreme weather, Jono believes their system is well designed to adapt, starting with the choice to focus on tree crops.

> " Trees are more resilient... fundamentally, these perennial crops, trees and shrubs, they have a natural buffering effect on the land. So if you have a drought, they are rooting deeply; you have a flood, they're not going to get washed away, generally, they're going to capture and hold water. "
>
> Jono Neiger, Farmer/Owner

Agroforestry systems may have resilience benefits; however, they are not immune to risks of drought, flooding, early or late frosts, new pests and disease, and other potential weather risks facing agriculture in the Northeast. Jono approaches this uncertainty with a strategy of diversity—not only diversification of crop types, but diversity more broadly: of cropping system, site, plant age, genetics, and more.

For example, another late spring cold snap could threaten the chestnut harvest as it did in 2023. The diversity within the chestnut plantings could offer some resilience benefits. Older, taller trees may be out of the cold air pocket; varying genetics may have greater frost tolerance, or slightly different flowering times; and each BRC location may be affected differently by the same weather event. In this way, the negative impact of an extreme weather event can be mitigated. The same principle can apply for other risks, such as drought, flooding, or pests and disease.

Agroforestry, Soil Health, and Resilience:

The Natural Resources Conservation Service (NRCS) defines soil health as "the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans."[3] Healthy soils are more resilient to some weather risks, such as drought, extreme precipitation, and changes in pest and disease pressure from shifting climate patterns.

NRCS lists Five Soil Health Principles, all of which can be supported by agroforestry:

- Use plant diversity to increase diversity in the soil
- Manage soils more by disturbing them less
- Keep plants growing throughout the year to feed the soil
- Keep the soil covered as much as possible
- Integrate livestock to recycle nutrients and increase plant diversity

Over time, agroforestry practices such as alley cropping and silvopasture can lead to improved infiltration, better water retention, reduced erosion, and improved soil fertility as compared to annual cropping systems or open pasture.[4, 5, 6]

BRC owner Jono Neiger inspects a planting at a forest garden in nearby Conway, MA, where he used perennial plantings to help control erosion on a steep slope. Photo used with permission.

Species Selection

Many tree crop genetics, including chestnuts, are in development, and growers continue to experiment with new varieties. BRC trials a range of chestnut varieties and assesses which genetics display positive traits: for example, trees that come into production quickly, produce high quality nuts, prove well-adapted for the local climate, etc. They can then adjust by culling trees with negative traits or planting more trees with positive traits as needed.

Chestnut nursery stock can be propogated from cuttings of desireable trees, or planted from seed (called "seedlings"). The chestnuts at BRC were mostly grown from seedlings. The nuts were collected from select mother trees in improved orchards. The majority are Chinese hybrids, meaning that they have primarily Chinese genetics (for blight resistance), with complex mixes of the other species, including Japanese, American, European, and Chinquapin genetics.

Other crops include black currant, aronia, American elderberry, American persimmon, mulberry, hybrid hazelnuts, and heartnuts. There are also small quantities of honey locust, walnuts, oaks, apples, willows, and other trees and shrubs used for fodder.

In addition to chestnuts, BRC grows a variety of other trees and shrubs, including American persimmon. These are sold direct-to-consumer at the weekly on-farm market. Photo by Kate Holcomb, USDA Northeast Climate Hub.

Management

As the farm progresses from the establishment phase into production, the management needs and strategies at BRC are shifting and changing.

Young trees are protected with trees tubes for rodent deterrence. As they mature, the tubes are removed, and the trunks are painted to protect from sunscald. The alleys between the tree rows are mowed short during the harvest to allow for the farmers to more easily collect the nuts as they fall to the ground. During the rest of the year, the meadow is allowed to grow tall for pollinator habitat and grazing for sheep. Photo by Kate Holcomb, USDA Northeast Climate Hub.

Establishment

Before planting, fields needed to be prepared in various ways, depending on the site; for example, cover cropping, subsoiling, and inoculation with beneficial mycorrhizae. These processes help reduce compaction, build organic matter, improve water infiltration, and increase nutrient cycling to create more productive and resilient soils.

Once trees are planted, they may need irrigation for the first several years while they grow deep roots and get established. Jono waters the trees directly from tanks on trailers or trucks (berries have drip irrigation in the alleys). In 2024, BRC received funding for a mobile sprinkler irrigation system, which will be installed in the coming year.

Pests & Disease

The primary pest pressure that BRC faces is from voles, rabbits and beavers. Voles and rabbits will eat the bark around the base of the tree, which can cause a young tree to die. BRC protects young trees during establishment with materials like hardware cloth and tree tubes. Management practices, such as mowing closely around saplings, make the area less hospitable for voles and rabbits. Trees are less susceptible to small mammal pressure as they grow; however, beavers on the property remain problematic for trees of all ages. The trees closest to the river are protected by beaver cages.

Other occasional pests include ambrosia beetles, gall wasps, Japanese beetles, leaf hoppers, and weevils. Although not certified organic, BRC follows organic standards and does not spray for weevils. Weevil larvae hatch in the nut kernel and will then burrow into the soil to overwinter. Therefore, it is very important to get all the nuts out of the field at harvest to disrupt the weevil lifecycle.

Hardware cloth protects a young tree from rodents and rabbits (left). Vole damage on trees at BRC. If the bark is eaten all the way around the base of a young tree, the tree may die (middle and right). Photos by Jono Neiger, used with permission.

Ongoing Management

As the trees grow, their tubes are removed and trunks are painted with dilute latex paint to prevent damage from sunscald, which can cause bark damage in the wintertime. The team prunes trees for various reasons, including shaping the trees for access, so that they are easier for management and harvest. Trees that show signs of disease, poor growth, or other undesirable traits are culled. They occasionally use a foliar spray for adding microbial inoculants and mineral nutrients. For most of the season, the meadow in the alleys is allowed to grow tall to act as pollinator habitat, encourage soil microbial activity, and provide fodder for the sheep. In the fall, the alleys are mowed short for the chestnut harvest.

Harvest

Chestnut harvest season begins in late September and lasts into November. When ready, chestnuts release from their burrs and fall to the ground. Nuts are collected manually using a hand tool called a nut wizard that picks up nuts as it is rolled along the ground. BRC plans to mechanize harvest as production increases.

Owner Jono Neiger and Assistant Manager Ellena Baum harvest chestnuts using a “nut wizard,” a hand tool that picks up nuts as it is rolled along the ground (left). Freshly harvested chestnuts (right). Photos by Kate Holcomb, USDA Northeast Climate Hub.

Post-Harvest

After harvest, chestnuts must be refrigerated right away to preserve freshness. Next, to process the nuts and prepare them for sale, they are given a hot water treatment at 120°F for 20 minutes, which kills the chestnut weevil. They are then left to cure in cold storage for 7 to 10 days to develop the starches and flavor of the nut before they go to market.

Markets

BRC is still in the early stages of developing their markets as they work toward full production. Currently, they sell chestnuts at their farmstand from October-December. Before their trees were producing, they brought in chestnuts from other growers to build the market and learn about consumer interest. Now that production has increased, they primarily sell their own nuts, and in the future, they will expand to wholesale customers as well. Berries and other fruits are also grown at BRC and sold at their farmstand. Occasionally they will sell these crops in small quantities at local markets.

Economics

BRC's start-up costs (the land and initial implementation costs such as plant materials, fencing, irrigation, and equipment) were funded primarily through family loans. These will be repaid as income begins to exceed operating expenses. Non-production-related income such as contract farming, tours, and events help to cover a small amount of the yearly operating costs, and will continue going forward. Currently (in year 8), they are just starting to pay back the initial investment. They project that yearly operating costs will be fully covered around year 10, and that the investment will be paid back around year 15.

Retail prices for chestnuts can range from $5-15 per pound. BRC typically charges $7-9 per pound, depending on nut size. Wholesale prices are $3-5 per pound, with an expectation that the price will decrease as regional supply grows. At full production, a chestnut orchard can expect to produce at least 1000 pounds per acre, with even higher production potential with new genetics. This means that the farm can project annual income of around $5,000 per acre — a total of $375,000 from the farm's 75 acres.

Operationally, the biggest cost by far has been labor. During the growing season, the farm is supported by four or five full- and part-time employees. This work is anticipated to become more stable throughout the year as the farm scales up.

A roasted chestnut, ready to be eaten. Photo by Kate Holcomb, USDA Northeast Climate Hub.

Funding

BRC has received or been a partner on several grants to support their work:

Granting Agency	Program	Project	Amount
Sustainable Agriculture Research and Education (**SARE**)	**Partnership Grant**	**Measuring Soil Health and Carbon Sequestration in an Emerging Chestnut Agroforestry System** (2018)	$18,700
USDA Natural Resources Conservation Service (**NRCS**)	Environmental Quality Incentives Program (**EQIP**)	a) Installing a hedgerow on the Sunderland property (2020), b) Soil health practices on all properties, including cover cropping, soil carbon amendment (biochar), and mulching (ongoing)	$78,000
NRCS	Agricultural Management Assistance (**AMA**)	Acquiring and installing a moveable sprinkler system for irrigation on the Sunderland property (ongoing)	$63,000
Massachusetts Department of Agricultural Resources (**MDAR**)	Resilient Food Systems Infrastructure (**RFSI**) Program	Funding chestnut processing equipment (ongoing)	$85,000
SARE	**Farmer grant**	Collaborating on developing: **The Farmer to Farmer Agroforestry Guidebook for the Northeast** (ongoing)	$30,000

Reflections

The public has reacted positively to Big River Chestnuts and their work. People enjoy visiting the farm and having the opportunity to interact with a food production system that is prioritizing climate resilience. This enthusiasm is also evident in sales.

> " We sell out - it's actually good food, too... There's a solid market, and there's excitement about the way we're producing. "
>
> Jono Neiger, Farmer/Owner

Visitors to the annual Chestnut Festival at Big River Chestnuts on a tour with owner Jono Neiger. Photo by Kate Holcomb, USDA Northeast Climate Hub.

Jono expects that improvements such as increased soil organic carbon are likely to develop with time as the system matures.[5, 6] In the meantime, there is evidence of early improvements. Testing has shown increased soil biology, decreased compactness, and increased water infiltration time.[7] For an in-depth look at the soil health evolution in the first few years of BRC, see the farm's 2022 SARE report: **Measuring Soil Health and Carbon Sequestration in an Emerging Chestnut Agroforestry System**.

> " Farming is complex, and agroforestry is complex on top of that. "
>
> Jono Neiger, Farmer/Owner

It can be challenging to balance the benefits of diversification with the demands of managing multiple crops. Each crop requires specialized knowledge and attention. Although diversity can be an effective strategy for mitigating risk, it can add a large management burden.

Additional challenges arise from being a leader in a developing industry. Standard best practices may not exist yet, markets are underdeveloped, and regulations may not always cleanly apply. For example, the farm has not been able to maintain organic certification while practicing silvopasture. Although BRC uses organic practices, organic certification requires excluding animals from the field for a period of time that is not feasible for the farm (typically 90 or 120 days, depending on the circumstances).

Going forward, Jono sees opportunity for local university researchers and Extension to get more involved. There is a need for more research related to tree crops and other perennial crops. Greater understanding around perennial systems' pest and disease cycles, soil nutritional needs, harvest methods, and food safety is needed.

Future Plans and Considerations

BRC is continuing to scale up, and will soon have over 75 acres of chestnuts planted. In addition, their network of nearby growers has added approximately 25 more acres. As the trees mature, BRC expects production to increase exponentially. By 2033, they project more than 50,000 lbs. of chestnuts from those 100 acres. By 2037, that will likely be over 100,000 lbs. or higher (see Figure 1).

With that level of production in mind, Jono plans on eventually shifting away from people-power to more automated systems for management, harvest, and processing. The upgraded processing equipment BRC is currently installing will be able to handle approximately 50,000-75,000 pounds of chestnuts each season. That capacity will serve producers in the immediate vicinity, and will also be a part of a constellation of processing hubs for chestnuts and other tree crops in the region. Other farmers in Jono's regional network have plans for larger-scale production facilities, such as at **Breadtree Farms** in New York's Hudson Valley, which is building a facility that can process over one million pounds of chestnuts annually.

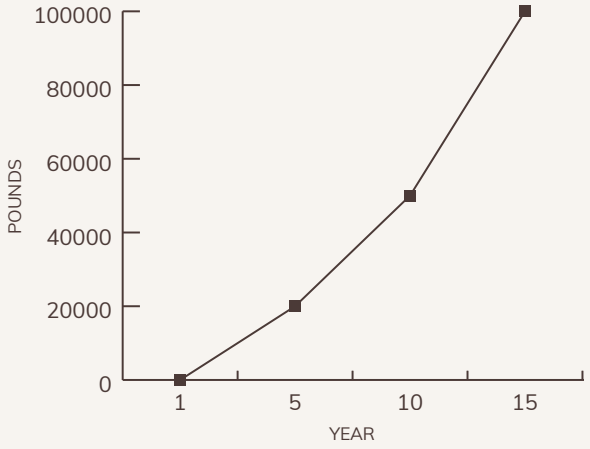

Figure 1: Projected Chestnut Production

Over the first 20 years of growing chestnuts at Big River Chestnuts and their surrounding network of growers, production is expected to grow exponentially. On 100 acres, Jono projects that they will reach 50,000 pounds of chestnuts by 2033 (year 10 of their projections), and will double to 100,000 pounds in 2037.

Advice from the Farmer

Based on nearly a decade of operating BRC, Jono can offer some advice for anyone interested in implementing similar agroforestry systems:

- Visit farms and see agroforestry in action! Ask questions and connect with others in the network.
- Be clear about your goals and let that lead your planning.
- Think successionally. Tree crops can take a long time to reach production; over the years, will there be varied income streams?
- Consider using diversity as a learning approach. Start with a range of crops and species, and then determine: What does the land grow well? What do you enjoy growing? What does well in the market? Look for what ends up working well, and adjust and expand from there.

Additional Resources

USDA National Agroforestry Center
Silvopasture

Webpage

USDA National Agroforestry Center
Windbreaks

Webpage

University of Missouri Center for Agroforestry
Growing and Marketing Chinese Chestnuts

Practice Guide

USDA Forest Service | Northern Research Station
Changing Hydrology in Agriculture and Agroforestry

Webinar

USDA National Agroforestry Center
Alley Cropping

Webpage

USDA Northeast Climate Hub
How can agroforestry support climate change mitigation in the Northeast?

Webpage

Savanna Institute
Food Safety in Silvopasture Guide

Practice Guide

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