USDA National Agroforestry Center

Inside Agroforestry

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NAC Director's Corner

A commentary on the status of agroforestry by Susan Stein, NAC Director

What motivates landowners, researchers, educators, planners, technology transfer specialists and others to engage in agroforestry? Why agroforestry? Why us? We all have stories, based on our backgrounds, experiences, and goals, and we at NAC find such stories to be a source of inspiration. We thought you might too.

As you will see, this issue contains a diversity of perspectives, approaches and experiences – from landowners, scientists, natural resources professionals, and others, on the adoption of agroforestry and other sustainable agriculture practices. You will also see a wide diversity of objectives for engaging in agroforestry, from maintaining/enhancing water quality, soil, wildlife, or crop/livestock production, to the advancement of social and environmental justice, to addressing climate adaptation and mitigation needs. And this by no means represents the entire spectrum of approaches and objectives for agroforestry engagement, nor the high interest that our readers have in sharing their stories. In fact, we received so many insightful and interesting articles for this issue that we decided to do two issues on this topic. So stay tuned…

My story? I first learned about the soil erosion and siltation occurring in the highlands of Africa when working there after college. So, I went to forestry school to learn how to work with farmers on planting trees to reduce soil erosion. If you have a story you'd like to share, please do! We'd love to hear it. Our contact information is available on the back of the newsletter. Meanwhile, we hope you enjoy the stories provided here.

Multifunctional Riparian Forest Buffers: A Tool for Merging Conservation and Production

Gary Bentrup, National Agroforestry Center
Katie Commender, Virginia Polytechnic Institute and State University

Riparian forest buffers offer numerous environmental benefits. They can help improve water quality by filtering non-point source pollution and stabilizing stream banks, enhance terrestrial and aquatic wildlife habitat, and even sequester carbon.

Although many landowners see the environmental benefits of riparian buffers, they are often wary of losing this profitable, arable land that they rely on for crop and/or livestock production. As a result, landowners are left with a difficult decision between conservation and production. Even if financial incentives are provided, such as cost share payments, landowners may remove their riparian forest buffer once their contract term is over and payments cease.

The NTFP Calculator is a simple Excel-based tool that explores the economic potential of growing six different woody plants in a conservation planting, such as a multifunctional riparian forest buffer. Species included are pawpaws, elderberries, hazelnuts, persimmons, dogwoods and willows, but additional species will be added in the future as economic data becomes available. The Calculator has default cost and revenue values for each NTFP based on existing market studies and interviews with growers throughout the U.S. However, users can easily adjust variables based on local knowledge and price points for a more accurate calculation.

Landowners often want to compare enterprise options. With this in mind, the Calculator was designed to offer a way to compare income potential from producing traditional crops or livestock with that from NTFPs in a buffer zone.

It is important to keep in mind that the Calculator only provides general estimates of income potential, and landowners will need to complete a more detailed enterprise budget to determine the economic viability of their proposed enterprise. The Calculator provides links to supplementary tools and resources for learning more about NTFPs and guides for developing an enterprise budget.

Additional resources on growing and marketing NTFPs can be found through the USDA National Agroforestry Center and Virginia Tech.

Buffer$ is another spreadsheet-based tool that can be used for evaluating the implementation costs of buffer establishment.

The development of this tool was supported in part by NRCS CIG grant (project number 69-33A7-14-001), in partnership with Appalachian Sustainable Development, Virginia Tech, NAC and U.S. Fish and Wildlife Service (USFWS), Partners for Fish and Wildlife (PFW) Program.

Photos from during and after planting a multifunctional buffer established on a former coal tipple site in St. Charles, VA. The site was transformed into a park and outdoor classroom. Photos by Katie Commender.

Can You Help Windbreak Researchers?

Craig Stange, NRCS North Dakota

In this age of precision agriculture why would a farmer plant a field windbreak? If you could grow another 680 bushels corn on a 34 acre, half mile long field, without extra fertilizer, would you be interested? Over 60 years of research across every continent but Antarctica shows that it is possible with field windbreaks. Over the life of a windbreak, from planting to removal, the average annual increase is 10% so for example:

(200 bu corn/ac yield) x *(10% increases)* x *(34 ac [area protected by 40' tall windbreak])* = *680 bu corn increased yield*

However, that crop yield research was done over 40 years ago. Much has changed in agriculture over those forty years. The question many farmers, conservationists and organizations are asking is, "Do windbreaks still help increase crop yields with modern farming techniques and hybrid crops?"

Conservationists in the Great Plains, Midwest, and Canadian Prairies wish to evaluate the effects of windbreaks on crop yield across whole fields managed with modern farming techniques, hybrids, fertility management, etc. The research concept is simple. Many producers utilize yield monitors. A fair number of these producers farm adjacent to windbreaks. When analyzed, the yield monitor data will reveal if crop yields change as distance from the windbreak increases.

Many producers have multiple years of yield data. Willing producers could provide all the data needed for this research project. Using this approach also allows the inclusion of crops not previously evaluated by the research. Multiple sets of data over a period of years from different locations and producers will improve the statistical reliability of the study.

Confidentiality is important. Only the researchers at North Dakota State University and Kansas State University will be able to match yield data to an individual. After the data is aggregated, no names will be discernable. Any reports will be reported by state, region, or crop, not by individual.

If a landowner is interested in sharing their data and they farm in Nebraska, Kansas or Oklahoma they should contact Charlie Barden. If they farm in the Northern Plains of the U.S. or Canada they should contact Craig Stange (contact information is below). Then someone will be in contact with the interested producer to gain permission, measure the windbreak height, and make note any unique features that may affect results. Thumb drives will be provided on which producer yield data can be stored for mailing to the appropriate university for analysis.

If windbreaks still increase crop yields within modern farming practices, then a study such as this may show producers the economic value of retaining existing windbreaks or establishing new windbreaks.

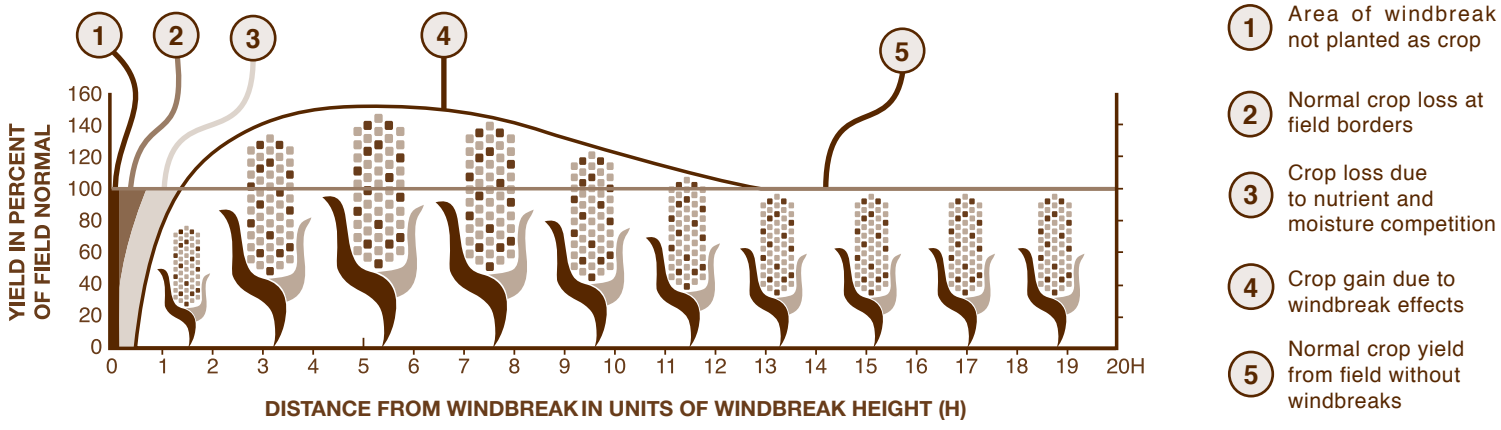
CONTACT US

For more information or to participate in this study:

Craig Stange
(701) 250-4330
craig.stange@nd.usda.gov

Charles Barden
(785) 532-1444
cbarden@ksu.edu

Increased Yields



Source: Compilation of data from 50 world wide studies 1934-1984; John Kort, 1988

Silvopasture Opportunity Provides Producer Benefits for Life's Transitions

John Fike, Virginia Polytechnic Institute and State University

As Mr. Milton Nappier began considering retirement, his thoughts turned to his old stomping grounds in Nelson County, Virginia, where he grew up. Having left Nelson County over 40 years ago to put himself through college and work for the Department of Defense, Mr. Nappier has always been interested in the land. He saw retirement as an opportunity to return to family and friends in rural Virginia, and to farm and to engage with nature once again.

As a beginning farmer with 25 acres of mostly wooded land that had become "a jungle", Mr. Nappier's first goal was to establish a plan for his property. In 2012, with the help of his brothers (who farm nearby) he began timber harvesting and establishing the infrastructure for his property with the idea that he would someday run goats on the farm. He had no idea, however, that his own personal "back-to-the-land" story would involve creating silvopastures and direct engagement with Virginia Tech and Virginia State Universities.

Landowner Milton Napier

In 2014, researchers at the two Virginia land grant universities received funding from Southern Sustainable Agriculture Research and Education (SARE) to conduct silvopasture research and expand related outreach. Part of the grant involved engaging farmers from historically underserved communities to better spread the message of how livestock and timber management can work together. It also offered support to implement and demonstrate silvopastures on a two-acre site.

> By improving the value of the land, adding infrastructure for farming, and creating opportunities for more valuable future timber harvests, he is creating a more valuable and workable asset for his children.

Mr. Nappier has addressed several challenges through his participation in the project. First, he was unfamiliar with agroforestry, so along with local extension agents and his potential university partners he toured area farms with on-going silvopasture efforts. Seeing those operations helped him realize what might be possible on his farm, although he remained somewhat skeptical. Still, he thought it would be an opportunity to help develop more pasture land.

The partnership really began when Adam Downing (Virginia Tech extension forester) and Martha Warring (Virginia Department of Forestry) marked the site for a thinning and harvest. The site, on a north slope, had a mixed hardwood timber stand with a number of small to mid-stage yellow poplar trees. The poplars, along with a few other species of interest to Mr. Nappier were left for the silvopasture.

The next challenge was to find a logger who would not only be willing to follow the specifications for the harvest but be willing to do it on a small acreage. Most loggers in the area were not interested in a small project in which a number of the better trees were to be left behind, even though he was having other timber harvested at the same time. Fortunately, a local logger was interested and did an excellent thinning with minimal damage. Even so, a few trees slated for harvest had to be left to avoid damage during felling. Mr. Nappier notes that the loggers were actually excited about something new and still come by to view their handiwork and the site's progress.

Clean-up after harvest was another challenge. Experience in Virginia suggests that if the harvest residuals are not excessive, mulching these materials can be an effective way to return nutrients to the system and also cover the ground to minimize erosion. Forages often have to be broadcast-seeded on such sites because of the rough surface. Although the mulched residues can temporarily tie up nitrogen as they decay, they help with forage establishment by creating micro-sites for new forage seedlings and by preventing erosion. Unfortunately, it can be difficult to find cost-effective mulching operations, and that was true in this case.

Forage grasses were broadcast in Fall 2015, and the stand is thickening. This winter, red clover and sericea lespedeza were frost seeded to thicken the stand, add nitrogen to the system, and to improve the forage nutritive value for the goats and sheep that have been purchased for the farm. Lespedeza is of particular interest due to its anthelminthic properties to reduce worm burdens for small ruminants. Mast and timber trees will also be added to the site in time.

Implementing this silvopasture has provided a number of learning experiences for Mr. Nappier. Along with learning about the integration of trees and forage-livestock

systems, it has helped him understand rotational grazing and better pasture management. He hopes to build on his experiences in future land management.

The experience has also provided Mr. Nappier the opportunity to be an educator. The farm is adjacent to a county road, and Mr. Nappier notes that many people traveling through the area now slow down (or stop and chat) to get a better look at the changes he is making. In addition to this casual training, Mr. Nappier has hosted farm tours and worked with extension agents and specialists to explain these efforts to visitors.

Although Mr. Nappier has just gotten started with silvopastures, he recognizes several potential benefits. For him, silvopasture provides greater use of and better opportunity to preserve natural resources. The end result has been aesthetically pleasing as well. As the project progresses he hopes to see two additional benefits: better long-term timber income and better transitioning for the next generation. Mr. Nappier notes that a land inheritance can often be a liability for the heirs. By improving the value of the land, adding infrastructure for farming, and creating opportunities for more valuable future timber harvests, he is creating a more valuable and workable asset for his children.

Milton Napier (left) and Adam Downing (right) discuss possibilities for Napier's land. Photos by John Fike.

Silvopasture From a Forester's Perspective

Adam Downing, Virginia Tech Area Extension

As an extension forester for nearly the past two decades, it's been fairly easy to engage private forest landowners who see forest management as their primary land-based activity. This has not been my experience with farmers, who generally view their "woods" as a secondary land-based resource. My impression is that, while farmers value and appreciate their forests, they believe their woods don't require the same kind of intensive inputs and management as other agricultural endeavors.

It is from this perspective that I began looking into various agroforestry practices. Could agroforestry be a tool to engage farm-based woodlot owners? In particular, could silvopasture be a "bridge" between livestock producers and better forestry practices?

I first became interested in agroforestry after learning about work by Cornell University concerning livestock in the woods. Like every other forester, my first reaction was the fundamental teaching that "cows are bad for forests". Like so many things in life, it's not that simple. The potential negative effects of livestock near trees can be avoided with proper livestock management.

Several years later, I have had the opportunity to engage with this silvopasture first-hand. I have seen a silvopasture system established in an open field and have created silvopastures out of existing woodlots. These experiences have required me, a forester, to turn some of my training around to not only keep long-term tree productivity and value in mind but to also incorporate annual components such as forage and livestock needs.

Before, I would enter a woodlot with an eye to regenerating the forest stand and allocating growth resources to woody cellulose (increased diameter growth). Now, I'm one of only a few foresters who know something about animal comfort and growing digestible cellulose (forage). Balancing these demands on a given piece of land is challenging and requires interdisciplinary knowledge and experience.

Finding the right balance between tree spacing that fosters forage growth and maintains tree vigor and form is difficult, especially in thinning an existing forest with inherent variability. For example, too much sudden sunlight on a tree's trunk is stressful. Depending on the severity of the stress it can result in epicormic branching (small whipping branch growth out of the previously "clear" tree trunk), which degrades value or, even worse, results in mortality. This is a big deal to me as a forester… but is losing a few trees a problem to a livestock producer who might largely value the cooling shade for his primary crop of livestock?

We are learning as we go and it's a privilege to work with innovative, creative and risk-taking landowners such as Mr. Nappier and an interdisciplinary team of forage, livestock, and forest professionals.

Certified-Organic Indigenous Agroforestry in the Sacramento Valley

Greg & Jennifer House, Coco Ranch

Located in Solano County, California, our 40-acre Coco Ranch apple orchard was planted by our family in 1998. The land previously had a green manure crop and, before that, conventional row crops. From the outset we managed the land organically, certifying it as USDA organic with California Certified Organic Farmers (CCOF). While our fruit trees are a commercial venture, the orchard ecosystem has multiple uses including fruit cropping, animal grazing, and the gathering of plants for teas, edibles and medicinals. We call this multi-cropping system "indigenous agroforestry," and have successfully certified this system to USDA Good Agricultural Practice standards for food safety for fresh market apple sales.

Our ecological and spiritual values

Our practices are based on the science of ecology but are also strongly informed by indigenous values. As Gene Logsden, author of *The Contrary Farmer* and many other books and articles, wrote many years ago, "Nature lives and grows at its own pace, and that is not the pace of our highly stimulated financial world." Rather than seeking to decouple and move away from nature, we seek to further develop our participation with nature, viewing ourselves as a part of nature. We stand with renowned ethnobotanist Gary Paul Nabhan in recognizing that the deep cultural knowledge developed by humans over the millennia offers wisdom for us living today.

An indigenous agroforestry both economic and science-based

Our approach follows the intent of the word on which "economics" is based. This term has its heritage in the Greek word *oikonomikos*. The ancient Greek word, in contrast to the current conception of economics, embodied a pre-industrial meaning – the sustainable management of the home. Oikos, means "house", and nemein, means "to manage". Oikos, notably, is also the root of the modern word "ecology".

Our approach is less dependent on purchased inputs than conventional modern agriculture. It also focuses on fostering an understanding of soil biology and fertility. In our agroforestry work we seek to restore cultural knowledge and develop appreciation of it so as to live our lives regeneratively with pleasure and satisfaction.

Returning to science, plant breeder and champion of crop biodiversity Jack R. Harlan stated: "Our only hope for achieving stability and sustainability in our managed ecosystems is to imitate natural ecosystems as much as possible." Indeed, we see our farm as a managed ecosystem that depends on our informed and considered participation in order to allow for that complex ecological balance that we, in graceful relationship, depend upon.

Benefits of our agroforestry program

With the managed inclusion of grazing geese and sheep in the orchard and no tillage for more than 15 years, we have seen plant biodiversity increase on the orchard floor, organic matter increase in the soil, and a visible layer of humus develop. We have not added fertilizers while growth and productivity have continued strong. Our apple yields are above California and national averages, while at the same time our input costs for pest control and fertility are lower. Because we are certified organic, we get market recognition and obtain a higher price for our apples than conventional apples.

Our developed biodiversity means there are a variety of plants on the farm year-round, feeding the livestock that nourish us and giving us ample opportunity to collect wild herbs and greens. We recently conducted a survey of orchard floor resident vegetation, cataloging 28 plant species, valued for a wide variety of reasons, from food to medicinals, bee forage to livestock forage to ecosystem support roles.

An indigenous heritage

Steve Gleissman, M. Kat Anderson, and other scholars have asserted that traditional ecological knowledge (TEK) can provide models and practices to support sustainable agricultural systems today. Indeed, the rich productive landscape that the Europeans found when they first arrived in California is understood to have been developed and maintained by the skillful land management practices of California's first peoples.

Anderson, in her interviews with California Native elders, reports that these elders today remember that their valued plant foods and medicines were not "naturally" productive continuously over many years, but required

Geese graze in an orchard. Photo by Greg House.

Understory species & their roles

	Food	Medicinal	Bee forage	Livestock forage	Nitrogen cycling	Non-nitrogen nutrient cycling	Soil structure benefits	Native California plant
Amsinckia menziesii	✓		✓	✓	✓			✓
Avena fatua	✓	✓	✓	✓	✓	✓	✓	
Brassica campestris	✓	✓	✓	✓	✓	✓	✓	
Brassica nigra	✓	✓	✓	✓	✓		✓	
Bromus mollis			✓	✓	✓	✓	✓	
Calandrinia ciliata	✓	✓	✓	✓				✓
Capsella bursa-pastoris	✓	✓	✓	✓				
Chenopodium album	✓	✓		✓	✓			
Claytonia perfoliata	✓	✓	✓	✓				
Elymus glaucus			✓	✓	✓	✓	✓	✓
Epilobium brachycarpum	✓	✓	✓	✓				✓
Erodium circularium			✓	✓				
Hordeum leporium			✓	✓	✓	✓	✓	
Lamium amplexicaule	✓	✓	✓	✓				
Lacuca serriola	✓	✓	✓	✓				
Lolium multiflorum			✓	✓	✓	✓	✓	
Medicago polymopha		✓	✓	✓	✓			
Nassella pulchra			✓	✓	✓	✓	✓	✓
Portulaca oleracea	✓	✓	✓	✓				
Raphanus sativas	✓	✓	✓	✓				
Rumex crispus	✓	✓		✓				
Silybum marianum	✓	✓	✓	✓				
Sonchus oleraceus	✓	✓	✓	✓		✓		
Stellaria media	✓	✓	✓	✓		✓		
Urtica dioica	✓	✓		✓			✓	

These species are valued for their food, medicinal, bee forage, livestock forage, and ecosystem support roles at Coco Ranch. This chart may be reproduced as long as you acknowledge our authorship: Greg & Jennifer House, Coco Ranch & House Agricultural Consultants, Davis, California; 2016.

human management – an informed participation with nature – to maintain their quality and quantity each year. They would visit with the plants, talk to them, and in short, have a relationship with them in which there was an exchange of giving between the humans and the plants. We can think of no better explanation of our practices, or why we do them, than this.

Why Plant a Community Food Forest?

Catherine Bukowski, Virginia Polytechnical Institute and State University

Community food forests are a unique agroforestry approach that has become increasingly popular in urban areas. The motivation behind them differs from on-farm agroforestry in that there is a stronger focus on social outcomes rather than financial profit or increased yields.

Also known as forest gardens, food forests are food production systems that use perennial plants combined with annuals in a multi-story cropping design. Vegetation layers are patterned on the structure and functions of young forest woodlands, with high biodiversity and maximum use of light and other resources.

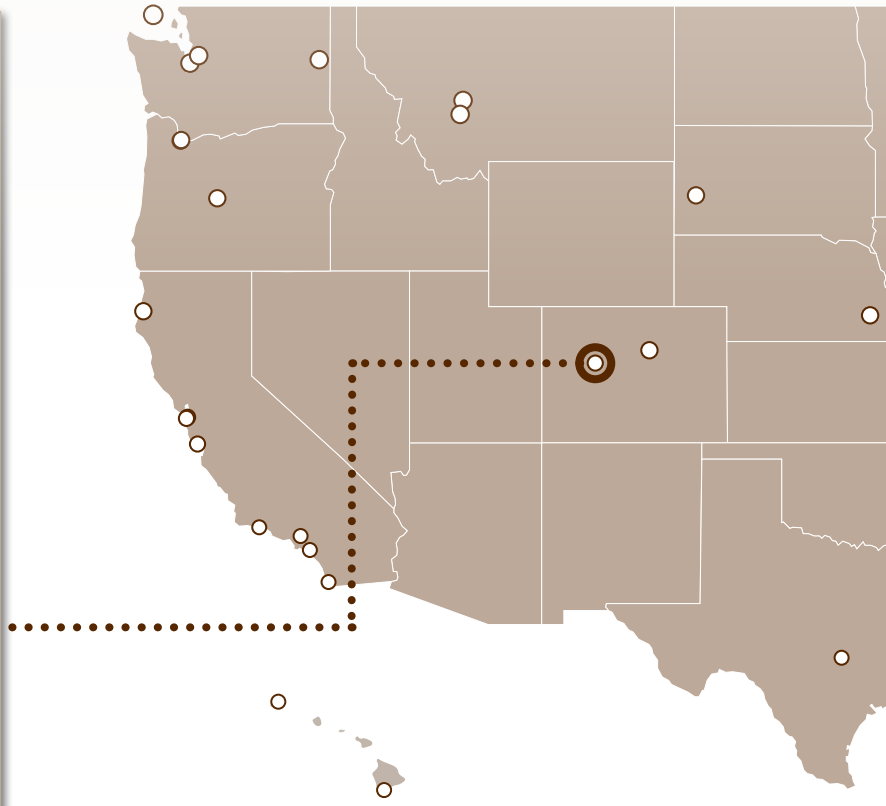
Food forests contain edible species selected to fill niche roles found in forest ecosystems. Over time, as natural succession occurs, these systems continue to function with minimal inputs and management, and increased outputs (such as fruit and nut production). The edible species are grown in mixed plant groupings called polycultures, established in patches so that the site resembles a young forest with micro-habitats. The concept of communally-established and managed food forests started to become popular in the United States around 2008 with interest increasing consistently each year. Why? Because there is an increasing need to find sustainable solutions to the need for urban food security, resilient communities, and productive public land with multi-functional uses.

Multiple factors have sparked the creation of community food forests, including interest in social, environmental and health justice. The motivation is also often based in a belief that everyone, regardless of socioeconomic status, should have access to affordable, fresh produce that is grown locally using chemical-free methods and climate-smart techniques.

Food forests support social justice in a number of ways. Most food forests are open to the public for free harvesting, especially ones located on public property managed by local agencies responsible for parks and recreation or public works. Partnerships are often formed between non-profit or community-based organizations, institutions and/or government agencies to secure land, organize volunteers, seek financial support and understand policies. Locations are often selected in proximity to ethnically-diverse neighborhoods and areas experiencing socio-economic challenges. Many community-based organizations hope that food forests

Community food forests in the U.S.

Children play at the demonstration food forest and connect with nature while parents talk with each other inside the Basalt Food Park in Basalt, CO. It was installed in Ponderosa Public park along with a seed-saving garden that supplies locally acclimated seed to the public library for community members to use at home. Fencing is necessary within the mountain town to keep bears and elk from damaging the edible vegetation. Photo by Catherine Bukowski.



will strengthen their community through the cross-cultural connections and social bonding that occur when people volunteer for a common cause. In short, people coming together to collaboratively plan a food forest is an act of place-making, which is a form of creating a public space that increases a community's well-being, health, and social cohesion.

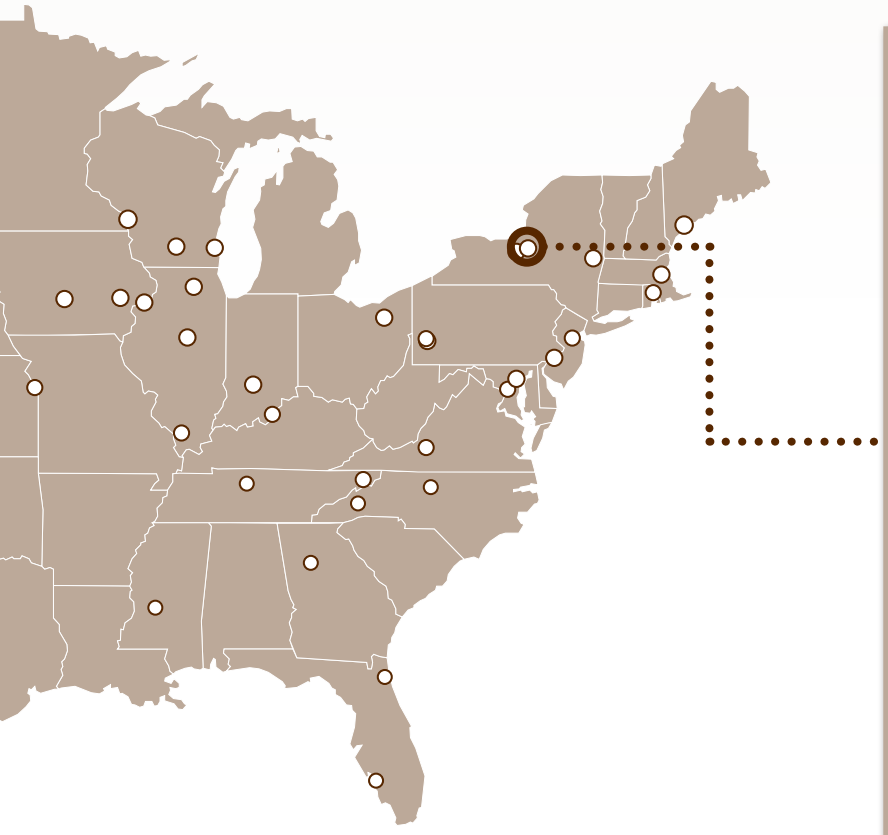
Food forests can help to address environmental justice issues. A participatory planning process can be used to engage all community members in providing input on site design and how the food forest will be used to serve their community. After establishment, food forests provide access to a natural setting for personal and community enjoyment. Food forests contribute to neighborhood aesthetics by providing shaded areas in which to relax as well as engage in recreational activities such as gardening or walking. Furthermore, they provide environmental services and benefits such as storm water management, biodiverse habitat (especially for birds and pollinators) and improve soil health.

Food forests can meet many other needs in addition to social and environmental justice. In some communities, people are planning food forests as a source of seed banking and preservation of genetic plant material for vegetative propagation. These sites become a repository of regionally appropriate, climate-acclimated seed and propagation material for families, homesteads and local farmers. Ultimately, the highest yields from community food forests come in the form of education. The sites are a tool for learning about ecology, sustainable food production, food literacy, civic engagement in community initiatives and an introduction to cultural practices such as foraging and gleaning of non-timber forest products.

Food forests can help to address environmental justice issues.

While not traditionally considered in urban planning of green spaces, foraging for wild edible and medicinal plants in forest ecosystems is a cultural practice used by many diverse populations and included in many food forests. There are many benefits to this. For example, gathering edible plants actively engages people with nature and requires the ability to identify specific plants while understanding their niche growing conditions. Native wild foods, such as many greens and herbs, are often overlooked for their nutritional value due to a lack of familiarity and food forests can safely introduce people to the benefits of these plants, their identification, and how to harvest them. Over time such experiences could change people's perceptions of acceptable food sources and their desirability in the landscape. Food forest sites also provide a location where people can learn about specialty crops, such as pawpaws, elderberry, aronia, and hazelnuts. This exposure may make them more likely to buy these products from farmers who grow them using agroforestry practices.

People may become involved with a food forest simply to meet other like-minded people, learn about perennial gardening or connect to a community after moving to a new location, but through participation they can learn how humans can play a valuable role in redesigning residential, farm and public spaces with productive ecological landscapes that offer multiple benefits including sustainable food sources and environmental services.



The sign at the Rahma Edible Forest Snack Garden explains the concept of mimicking the vegetation layers of a natural forest with perennial edible plants that have nutritious value. The sign was placed along an existing footpath community members would use to reach the gas station convenience store across the street. The food forest is located next to the Rahma Free Health Clinic in Syracuse, NY. Photo by Catherine Bukowski.

Ecosystem-based Adaptation: Cultivating Climate Resilience with Agroforestry

Laura Lengnick
Cultivating Resilience LLC

Ron Rossman at a Practical Farmers of Iowa field day. Photo by Practical Farmers of Iowa.

Like agricultural producers worldwide, farmers and ranchers in the United States face more variable and extreme weather that increasingly challenges their ability to manage crop and livestock production. More frequent heavy rainfalls complicate fieldwork and bring catastrophic flooding in the Midwest and Northeast, while producers in the Southwest are challenged by prolonged extreme drought. Crop and livestock pest populations are increasing throughout the country as winters warm and the growing seasons lengthen. Warmer winters, earlier spring warm ups, and more variable spring temperatures have complicated tree fruit production and increased the risk of total crop failure. Producers everywhere are struggling to manage more dry periods, more drought, and longer periods of high temperatures and heat wave, as competition for water intensifies in many regions. Interest in agroforestry is increasing in the U.S. as farmers and ranchers search for effective climate risk management strategies.

Ecosystem-based adaptation strategies restore, conserve, and manage ecosystem services to reduce the potential damages and take advantage of opportunities created by climate change. These cost effective and broadly applicable strategies often fulfill both mitigation and adaptation objectives. For example, shelterbelts moderate extremes of temperature and wind; restored riparian areas and wetlands contribute to a healthy regional hydrologic cycle and reduce inland flooding; and afforestation with native species facilitates the adaptation of woodlands to climate change. All of these practices also sequester carbon. While the benefits of ecosystem-based adaptation are widely recognized by the international development community, they have received less attention in the U.S.

Because sustainable agriculture and food systems are designed to produce multiple benefits along three dimensions - environmental, social and economic – many sustainable agriculture practices promote mitigation and adaptation. Production systems that reduce heat-trapping gas emissions and sequester carbon while enhancing adaptive capacity include conservation and no-till systems that use cover crops, diversified crop rotations, organic farming, rotational grazing, perennial production, agroforestry and farmscaping. Recent case study research offers some practical examples of how agroforestry practices are being used by leading sustainable producers to adapt to changing climate conditions across the U.S.

A field at Full Belly Farm with a hedgerow. Photo by Laura Lengnick.

Case study research shows agroforestry reduces climate risk

In the face of extreme and continuing drought, Full Belly Farm, a 400-acre diversified organic vegetable farm in Guinda, California has remained productive and profitable as many other growers in the Central Valley have idled land, invested in new wells, or exited farming. According to Paul Muller, co-owner and production manager of Full Belly Farm, the success of the production system under a changing climate is supported by the diverse mosaic of annual crops, forages, pastures and perennial orchards, hedgerows, and riparian areas that make up the farm's landscape. This extraordinary biological diversity promotes soil health, produces healthy, high-quality products, reduces the need for purchased

inputs such as fertilizers and pesticides, conserves water, and protects the farm from flooding.

Historic drought in the southern Great Plains in 2011 and 2012 led to massive destocking of beef cattle on ranches in Texas, yet Gary and Sue Price, owners and operators of the 77 Ranch in Blooming Grove, maintained their cowherd without the need for supplemental feed or water. Gary credits the success of the ranch under such extreme conditions to the high-quality natural resource base – soil, water, and biodiversity – cultivated by many years of planned grazing coupled with the exceptional drought tolerance of the restored and grazed oak savanna ecosystem that dominates the ranch landscape.

Bob Quinn owns and manages the 4,000-acre Quinn Farm and Ranch in Big Sandy, Montana, where he produces certified organic food grains in a full tillage, diversified, dryland production system. Winter warming in his region has got Bob thinking about some new fruit-growing possibilities on the farm and he has had some success growing sour cherries and other fruit trees in orchards protected by a shelterbelt.

The Rosmann Family Farm is a 700-acre certified organic crop and livestock farm located in the rolling prairie lands of west central Iowa near Harlan. Increasingly challenged by flooding rains, extreme temperature fluctuations, and higher weed pressures, Ron Rosmann works to enhance ecosystem services on the farm by managing for high quality soils and continually planting more trees, shrubs, and crops for pollinators, windbreaks, and wildlife habitat. Inspired by Mark Shepard's New Forest Farm in Wisconsin, Ron plans to add more perennial nut, fruit and berry crops on his farm, both as food and as forages for livestock.

USDA launches new climate smart program

In May of this year, the USDA launched a new comprehensive program, called the Building Blocks for Climate Smart Agriculture, that helps farmers, ranchers, and forest landowners respond to climate change with actions that reduce heat-trapping gas emissions, increase carbon storage, and generate clean renewable energy. The program is designed to mitigate about 2% percent of current U.S. emissions by 2025 - the equivalent of taking 25 million cars off the road. The USDA will offer incentives and technical assistance to farmers, ranchers and forest land owners to encourage actions that promote soil health, improve nutrient management, and conserve and enhance forest resources on private and public lands.

Additional Resources:

- *Resilient Agriculture: Cultivating Food Systems for a Changing Climate,* Laura Lengnick, 2015, New Society Publishers.
- *Carbon Sequestration Potential on Agricultural Lands: A Review of Current Science and Available Practices*, Daniel Kane, 2015, National Sustainable Agriculture Coalition.

Visit ***http://cultivatingresilience.com/*** *for more information.*

Some examples of the potential mitigation and adaptation benefits of sustainable agriculture practices and production systems are provided below.

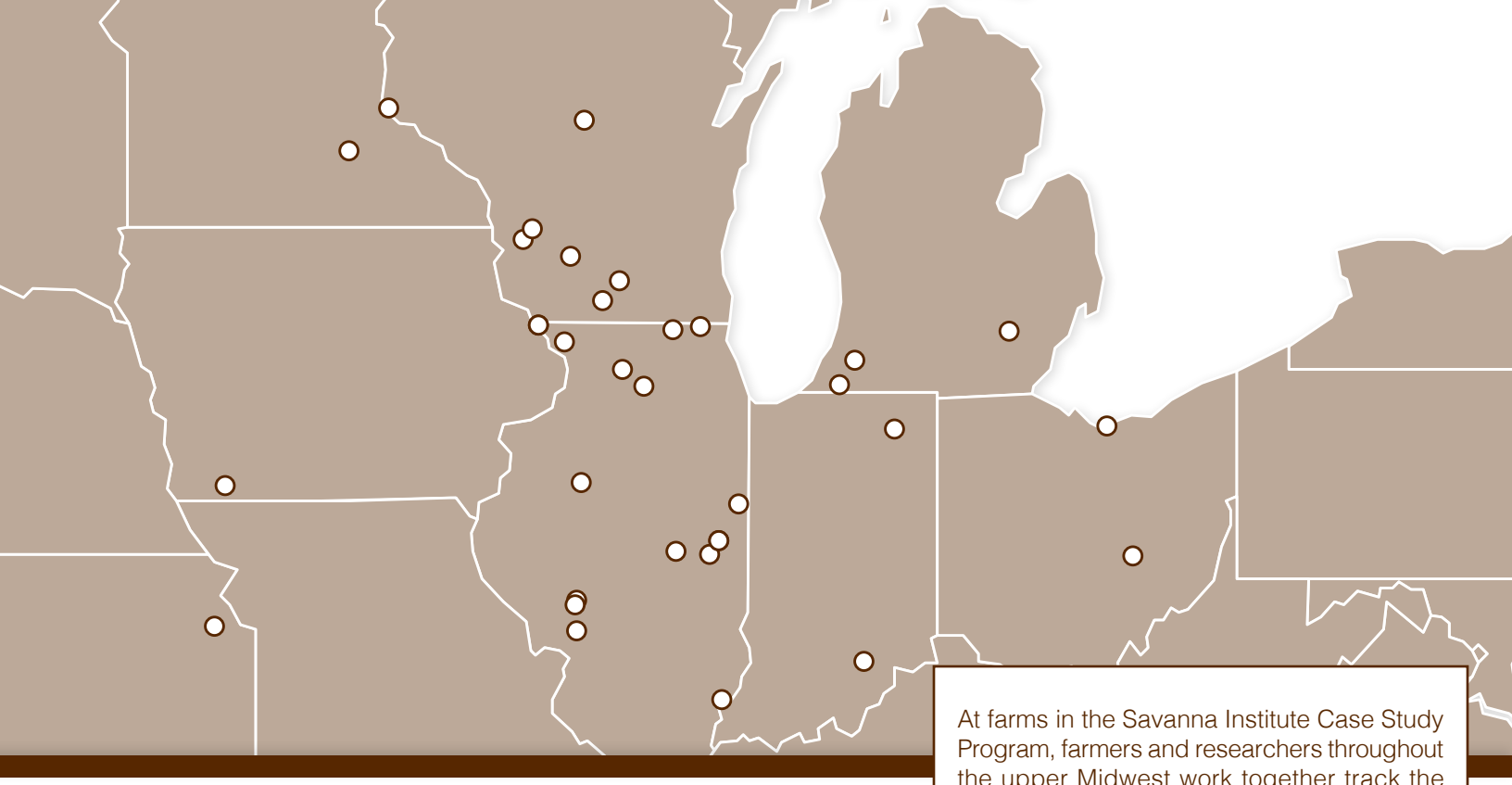
Replacing **synthetic fertilizers** with **nitrogen-fixing cover crops** can reduce carbon dioxide emissions by **50%**

Soils amended with **animal manures, composts**, and **cover crops** have greater **soil carbon sequestration** than soils amended with **synthetic fertilizers.**

Grassfed livestock **may require** up to **50%** less **fossil fuel energy inputs** compared to **conventional feedlot livestock** as well as lower methane and nitrous oxide emissions.

Riparian and hedgerow habitats with **woody vegetation** can store up to **20%** of **total farm carbon** on less than 6% of **total farm area.**

*Actual benefits are dependent on soil type, regional climate, and specific production practices
(Source: California Climate and Agriculture Network 2014)



At farms in the Savanna Institute Case Study Program, farmers and researchers throughout the upper Midwest work together track the economic and ecological performance of diverse perennial agricultural systems.

Why a Savanna Institute?

Keefe Keeley, The Savanna Institute and University of Wisconsin-Madison
Ronald Revord, The Savanna Institute and University of Illinois Urbana-Champaign

Agriculture connects to some of our greatest issues: biodiversity, climate change, soil and water quality, and environmental justice. At the Savanna Institute, we see opportunities for farms to be a part of transformative solutions. With this aim, we bring farmers and researchers together to develop agricultural systems that mimic an exceptionally productive ecosystem once common throughout the corn belts and bread baskets of the world: the savanna.

We propose that agricultural savannas can be intentionally designed and intensively managed to produce food, fuel, and fiber, all the while maintaining or even restoring our natural resources. This approach adapts diverse agroforestry practices, including alley and multi-story cropping, silvopasture, edible buffers, and forest farming. It also draws ideas and techniques from aligned disciplines that apply ecological science to managing complex landscapes for multiple objectives: forestry, range management, agroecology, integrated pest management, organics, permaculture, and others. Pivotally, ecosystem-mimicking agriculture aims to supplant some portion of annual crops grown in monoculture – which supply the bulk of the current diet and commodity demand – with perennial crops grown in polycultural systems that integrate livestock.

We propose that agricultural savannas can be intentionally designed and intensively managed to produce food, fuel, and fiber, all the while maintaining or even restoring soil, water, climate, and biodiversity resources.

While farmers may explore these possibilities to meet their own farm and life goals, markets also drive adoption of new crops and practices. Consumers increasingly demand food systems that restore ecosystems, and they are developing tastes for emerging crops that can be grown in agricultural savannas, including chestnuts, hazelnuts, elderberries, pawpaws, currants, pecans, and perennial grains. While farmers and scientists have pioneered cultivation and market development of these and other such perennial crops, they remain underutilized and underdeveloped. The Savanna Institute exists to help advance the research and education necessary to profitably grow and market these crops in integrated systems.

Our principal research effort, the Case Study Program, explores the potential of savanna-based farming systems to become ecologically sound, agriculturally productive, and economically viable. We work with farmers across the Midwest to study the conversion of their working farmland into commercial-scale agroforestry operations. Our research is cooperative and participatory: scientists and farmers work together to collect comprehensive data concerning the economic, ecological and social impacts of their efforts. We have standardized protocols

for farmers to record labor, expenses, yield, and other inputs and outputs included in assessing their farming system's performance. In addition, the Savanna Institute collects data directly via soil samples, time-lapse photography, pollinator surveys, and pest and pathogen monitoring. We also facilitate collaboration among scientists at other institutions and farmers who are keen to engage in more sophisticated research such as conducting crop variety trials, comparing agroecosystems' functions, and testing intensive management strategies for polycultures and silvopastures.

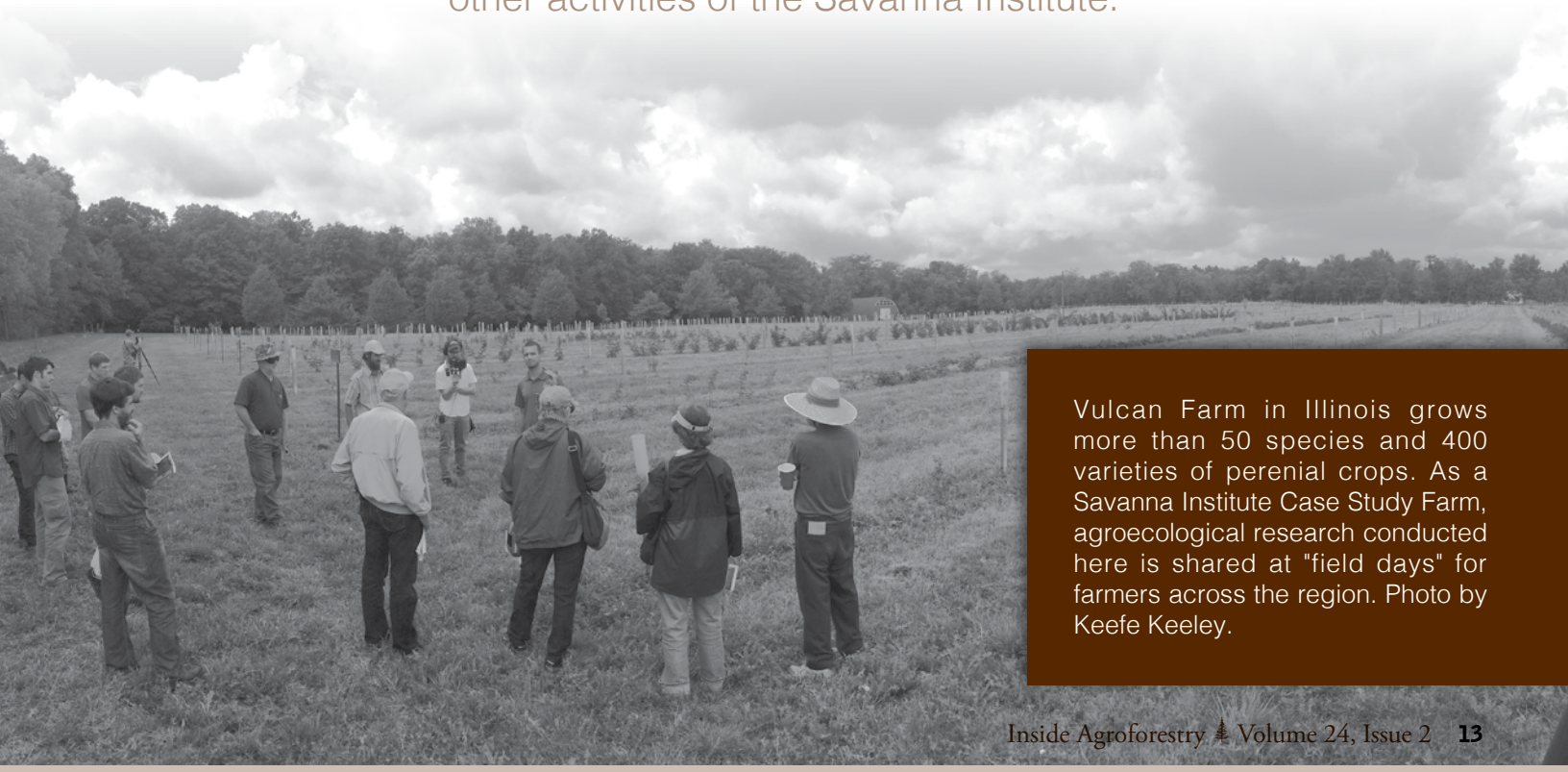
To extend our research, our mission includes education. Farmers learn best from other farmers, so we focus on enabling farmers to connect and share knowledge gained in experience and research. At on-farm field days and our annual gathering, farmers discuss what's working and what's not in their agroforestry enterprises. To further connect this geographically-dispersed community, we are preparing to podcast beginning farmers interviewing experienced farmers, and we are developing an interactive hub for farmers and collaborators throughout the food system called PerennialMap.org.

Our vision encompasses systemic change from field to fork, but our most significant victories come one diverse agroforestry planting at a time, and on each occasion that a successful farmer shares his or her knowledge with another. One such victory came with Steve and Kelly. After reading a shelf of books on restorative agriculture and purchasing a 38-acre farm near their suburban half-acre of permaculture, Steve applied to our Case Study Program. After talking through his intentions, helping him identify key next steps, and discussing risks and uncertainty, we connected Steve with Peter of Savanna Gardens, one of the experienced farmers in our network who offers consulting services in farm design. Peter worked with Steve and Kelly over the fall and winter to develop a comprehensive multi-stage plan to plant, manage, and market 30 species of perennial crops and integrated livestock. In the spring, One Seed Farm planted their first 10 acres into polycultures based

This young polyculture of Chinese chestnut, paw paw, and aronia is one of a number of integrated plantings at Red Fern Farm in Iowa. Photo by Tobia Carter.

around chestnuts, hazelnuts, serviceberries, currants, elderberry, and seaberry. Since then, Steve and Kelly have managed the young planting, kept their day jobs, and joined the groundswell of ecological innovation in agriculture. As Steve put it, "We know how important it is to repair our own land, but that is not the greatest part of our mission. We want to spread the word. This is to be a learning farm. If we can make our savanna-based model work, we can teach others. New and old farmers alike may be inspired to work with nature instead of constantly fighting it. We want to be part of the critical mass that reforms broken agriculture in our country and helps fix the staggering failures of our food system. The case study program will serve as a vehicle to share what we are doing and help us collaborate with like-minded farmers."

Visit **www.savannainstitute.org** to learn more about the Case Study Program and other activities of the Savanna Institute.



Vulcan Farm in Illinois grows more than 50 species and 400 varieties of perenial crops. As a Savanna Institute Case Study Farm, agroecological research conducted here is shared at "field days" for farmers across the region. Photo by Keefe Keeley.

Volunteers planted hundreds of native trees and shrubs along the tributary channel. The tubes help protect the seedlings from wildlife and reduces the effects of drought. Photos by the Long Tom Watershed Council.

Laughing Stock Farm Improves Watershed Health and Habitat alongside Livestock Stewardship

Katie MacKendrick, Long Tom Watershed Council
Kate MacFarland, USDA National Agroforestry Center

With the help of the Long Tom Watershed Council and others, Paul Atkinson has improved a tributary on his farm by restoring its historic hydrology and planting a native riparian forest buffer. Located in Oregon's southern Willamette Valley, Laughing Stock Farm has been in Paul's family for 52 years. Along with the experience that comes from many years on the farm, Paul's parents instilled a love for the land and taught him how best to care for the land over time. Paul raises layer hens, turkeys, cattle, and hogs and grows a wide variety of crops and trees. Paul has also undertaken a variety of projects to improve the habitat for native animals and plants. As he sees it, he raises multiple species of farm animals and crops and should support multiple species of wild animals and plants as well. Paul clearly recognizes the connection between his farm and the larger surrounding area. He has worked with the Long Tom Watershed Council (LTWC) since its inception in 1997, when he became a founding member. Since then, he has supported the Council's mission in a variety of ways including through a six-year water quality monitoring program.

The Long Tom Watershed Council (LTWC) is a local nonprofit based in Eugene, Oregon, which works with interested landowners to enhance fish and wildlife habitat voluntarily. The LTWC's mission is to improve water quality and watershed condition in the Long Tom River basin through education, coordination, consultation, and cooperation among all interests, using the collective wisdom and voluntary action of our community members.

In 2007, Paul partnered with the Long Tom Watershed Council to do something he had contemplated for several years – restore 1,400 feet of a Coyote Creek tributary. The tributary had been straightened in the early 1900s to facilitate agricultural activities and provides important habitat for resident cutthroat trout, sculpin, and other native fish and amphibians living in it and in Coyote Creek. Working on this project helped Paul to address his strong moral and religious commitments to habitat enhancement and the resulting benefits to wildlife.

Funded by Paul and a grant from the Oregon Watershed Enhancement Board, the project aimed to improve fish passage, restore instream habitat, improve water quality, and enhance riparian vegetation. To accomplish this, the project needed to address several problems. First, an undersized culvert at the upstream end of the site had created high-velocity stream flows that caused erosion and were a barrier to fish passage. In addition, the straightening of the tributary had led to accelerated stream flow, channel incision, and had reduced the amount of habitat for fish. Nonnative, invasive blackberry became established along the stream, which outcompeted native trees and shrubs. Because of the steep, eroding stream banks, it was difficult to control the blackberry.

The Council worked with Paul to reconstruct the stream channel with river rock and log weirs, and to remove blackberry, while planting native trees and shrubs. The Council replaced the original 18" culvert with a much larger 66"x 51" corrugated metal pipe arch filled with two feet of river rock to provide a continuous stream bed through the culvert. The first 230 feet of existing channel downstream of the culvert was raised by adding river rock and 10 log weirs. Then, 1,150 feet of new meandering channel were excavated across the landowner's pasture and the excavated material was placed in the abandoned channel segment along the driveway (see photos). Council volunteers from Lane Community College and the University of Oregon donated many hours of time planting

hundreds of live willow stakes and a diverse mix of native trees and shrubs. Over time the trees and shrubs have become established and are keeping the channel from eroding.

The channel cross-section is now wider and shallower, erosion has decreased, the stream is reconnected with its floodplain, and now there is habitat for important aquatic life. An unexpected impact of the project has been the benefits to Paul's livestock. The creek restoration has enhanced the sub-irrigation of the nearby pastureland as well as the forage production.

The tributary project was only one component of the long-term restoration work Paul is doing on his farm. He is also working on a savanna restoration project. He became interested because oak savanna is a vanishing ecosystem in the Willamette Valley, but he also sees benefits for his livestock as the climate changes. This project will allow him to more easily rotationally graze his livestock while also providing them with shade. Paul will begin planting oak, fruit, and nut trees in fence rows and will rotationally graze between the rows. He also plans to create areas in his pasture, perhaps between the trees, as patches with native prairie plants.

Paul has worked hard to combine habitat enhancement and conservation work with his farming and sees this work as important to caring for the land over the long term. Balancing the values of a working landscape while managing projects for the benefit of fish and wildlife is a specialty of watershed councils, and successes are dependent upon farmers like Paul.

Before the project, the existing channel was deeply incised and lined with non-native Himalayan blackberry.

After the project, the blackberry were removed and replaced with native trees and shrubs.

In this section, the channel was reconstructed with stream rock and log weirs.

IN BRIEF...

A periodic summary of agroforestry-related journal articles

John Weedon, Connecticut Farmland Trust

Speak not of cows in the woods

Researchers conducted two focus groups with resource professionals and one group with farmers regarding attitudes towards silvopasture. The farmers said they typically didn't ask professionals for advice on woodland grazing because they expected to be told to stop. The professionals reported they rarely offer advice because they feared providing it would be taken as a practice endorsement. Yet, both farmers and professionals agreed separately on the multiple benefits of silvopasture and recognized the need for local research and demonstration farms. The researchers speculated this consensus was due to participants hailing from the same area and the anonymity of focus groups.

Take home Message: Because "cows in the woods" is considered taboo, self-imposed constraints hinder conversations about silvopasture between farmers and resource professionals.

Mayerfeld D, Rickenbach M, Rissman A. 2016. Overcoming history: attitudes of resource professionals and farmers toward silvopasture in southwest Wisconsin. Agroforest Syst. Online:30 April 2016.

One size doesn't fit all

Environmental advantages of riparian buffers are well-known, but many producers believe buffers come at the expense of profits. Researchers presented buffer systems with combined production and conservation benefits to streamside owners to help understand why they may or may not be likely to establish buffers. Owners were segmented into three groups: producers who used streams to water cattle; producers who used alternate water sources; and non-producers. Streamside characteristics varied among the groups with percentage of erodible soil differing the most. Groups responded differently to the importance they gave various management outcomes, buffer effectiveness, and potential benefits of multifunctional buffer systems.

Take Home Message: Because of the heterogeneous reactions by different groups to multifunctional buffers in the study, targeting by ownership and stream characteristics may improve buffer promotion.

Trozzo KE, Munsell JF, Chamberlain JL, Aust WM. 2014. Potential adoption of agroforestry riparian buffers based on landowner and streamside characteristics. J Soil Water Conserv. 69(2):140-150.

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Upcoming Events

August 26-28, 2016
Forest Farming in South Appalachia
Mountain City, TN
http://www.appalachianforestfarmers.org

August 29-31, 2016
Minnesota Agroforestry Institute
Spicer, MN
www.regonline.com/Register/Checkin.aspx?EventID=1838137

September 20-22, 2016
National Small Farm Conference
Virginia Beach, VA
http://bit.ly/1QgwYYw

For more upcoming events, visit our website calendar: *http://nac.unl.edu/events*

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Phone: 402-437-5178;
Fax: 402-437-5712.

- **Susan Stein,** NAC Director
- **Michele Schoeneberger,** FS Research Lead (ext. 4021)
- **Richard Straight,** FS Lead Agroforester (ext. 4024)
- **Vacant** - NRCS Lead Agroforester
- **Kate MacFarland,** FS Assistant Agroforester (ext. 4012)
- **Joseph Banegas,** Information Assistant/ "Inside Agroforestry" Designer (ext. 4014)

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NAC Mission

The USDA National Agroforestry Center (NAC) is a partnership of the Forest Service (Research & Development and State & Private Forestry) and the Natural Resources Conservation Service. NAC's staff is located at the University of Nebraska, Lincoln, NE. NAC's purpose is to accelerate the development and application of agroforestry technologies to attain more economically, environmentally, and socially sustainable land use systems by working with a national network of partners and cooperators to conduct research, develop technologies and tools, establish demonstrations, and provide useful information to natural resource professionals.

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