



United States Department of Agriculture



Agroforestry:

USDA Reports to America,
Fiscal Years 2011–2012—In-Brief



USDA SUPPORTS AGROFORESTRY

Agroforestry is the right tree in the right place for the right reasons:

- Diversified income
- Cleaner air and water
- Productive soils
- Wildlife habitat (including pollinators)
- Bioenergy
- Resilience to climate change

Introduction

In the 1970s, Mack Evans planted loblolly pine on his newly purchased land in Jakin, GA, intending to someday generate income from timber. Twenty years later, he was making a decent income thinning his pine stand every few years, but he was having trouble managing the weedy vegetation around the trees, and he wanted to do more with his land.

Browsing the Internet for ideas, Evans came across a U.S. Department of Agriculture (USDA) Web site that mentioned agroforestry, a system where landowners combine trees with crops and livestock. One particular type of agroforestry struck a chord with Evans: silvopasture. “Silvo” means forest, and “pasture” refers to grazing lands. This practice is a way for producers to combine trees and livestock on the same piece of land.

Evans had recently purchased his first herd of cattle. By integrating them into his existing pine forest, he realized he could raise two cash crops on the same acreage. Even better, the system would make both cattle and pine more productive. The cattle could graze on forage planted around the trees, controlling weeds while fertilizing the trees. Meanwhile, the trees would provide shade and shelter for the animals, a particular benefit in the Southeastern United States.

Evans went for it.

With the help of the Natural Resources Conservation Service (NRCS), Evans now operates 43 acres of silvopasture and plans to convert an additional 90 acres. The native grasses he planted beneath his pines provide forage for the cattle. And, his trees grow more quickly.

Evans is now sharing his excitement and techniques with other farmers in the area through demonstrations and field days.

Agroforestry is catching on among farmers, ranchers, and forest owners of all sizes because it can enhance productivity, bring environmental benefits, and increase profitability regardless of the scale of operation. While agroforestry practices offer financially strapped landowners an opportunity to hold onto their lands and way of life, owners of larger tracts of land also use agroforestry to diversify their income streams. By bringing together financial resources, technical assistance, and science, USDA is speeding the adoption of agroforestry across the country, helping farmers to hold onto their working lands.

Read on to learn about the many faces of agroforestry and how USDA can help you put trees to work on your land, whether you are a row-crop producer in Iowa, a forest owner in Georgia, a permaculturalist in Minnesota, or a rancher in Montana. For more information, see the expanded version of this report, entitled *Agroforestry: USDA Reports to America, Fiscal Years 2011–2012—Comprehensive Version* (hereafter referred to as the Comprehensive Report).

AGROFORESTRY 101

**Agroforestry =
Trees + Crops and/or Livestock**

**Agroforestry is
Intentional—Interactive—
Integrated—Intensive**

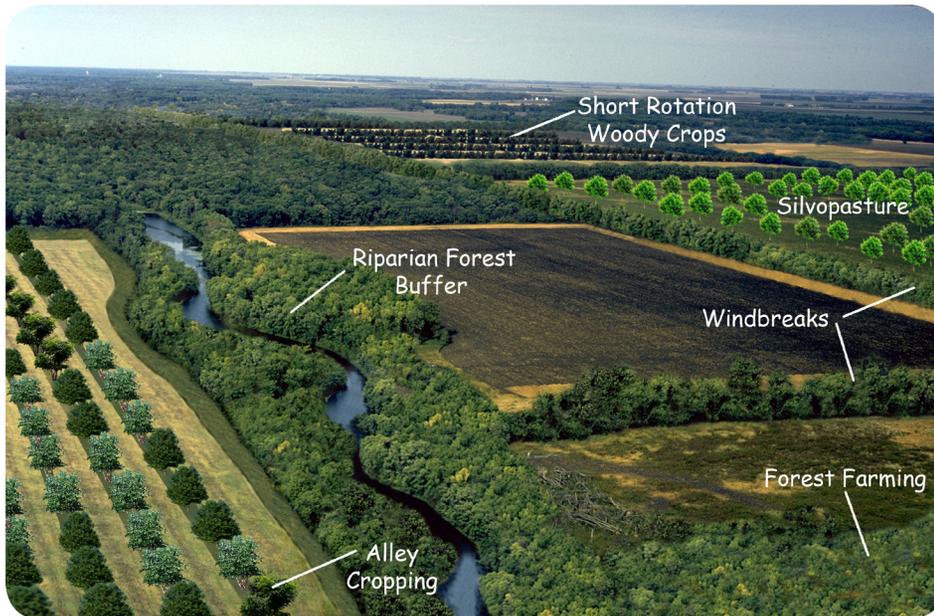
**Agroforestry makes it possible to
meet multiple objectives with one
piece of land.**



Pine and cattle silvopasture on Evans' farm. Photo courtesy of Mack Evans.

What Does Agroforestry Look Like?

There are five widely recognized types of agroforestry in the United States, all of which provide both economic and environmental benefits to farmers, ranchers, and communities:



This image of agroforestry practices across a landscape was designed by USDA National Agroforestry Center scientists using CanVis software.

- **Silvopasture** combines trees with livestock and their pasture. The trees provide timber, fruit, or nuts, as well as shade and shelter for livestock. Silvopastures reduce stress on the animals from the hot summer sun, cold winter winds, or drenching downpours and increase production of grasses and other forage for the animals.
- **Alley cropping** means planting crops between rows of trees to provide income while the trees mature. The system can be designed to produce fruits, vegetables, grains, flowers, herbs, bioenergy feedstocks, and more.
- **Forest farming** is where producers grow food, botanical, or decorative crops under a forest canopy that is managed to provide ideal shade levels, and perhaps nuts or timber products. Forest farming is also called **multistory cropping**.

- **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. They are also known as **shelterbelts, hedgerows, or living snow fences**.

- **Riparian forest buffers** are natural or re-established areas of trees, shrubs, and grasses that grow along rivers and streams. These buffers can help filter farm runoff while the roots stabilize the banks of streams, rivers, lakes, and ponds to prevent erosion. These areas can also support wildlife habitat connectivity and potentially provide additional income if planted with food, bioenergy, or other crops.

Agroforestry: One Strategy, Many Benefits

Mack Evans discovered the economic benefits of agroforestry when he began experimenting with silvopasture. There are many other reasons why a landowner might adopt agroforestry practices:

1. **Bioenergy production.** On his 110-acre Wisconsin farm, Mark Shepard grows hazelnuts in a silvopasture system with pigs, cattle, sheep, and chickens. Animals that he runs through his fields eat the nuts missed during



Alley cropping of corn between rows of cherrybark oak and loblolly pine in North Carolina. Scientists are comparing yields, profits, greenhouse gas emissions, and carbon sequestration across different farming systems, including alley cropping and silvopasture. Photo courtesy of Fred Cabbage.

harvest. While Shepard currently sells his hazelnuts as a food product, he is working with the University of Wisconsin Cooperative Extension, entrepreneurs, and other farmers in the area to develop a hazelnut biofuel industry. The U.S. military is interested in the fuel because hazelnuts produce twice as much oil as soybeans per acre (Xu and others 2007). There is also potential to provide energy from hazelnut husks and wood.

Researchers across the United States are experimenting with various types of alley-cropping bioenergy systems such as pine, cottonwood, or hybrid poplar with switchgrass and willows with a mix of native grasses.

2. Resilience to climate change. University of Florida researchers studied sites around the world and found that agroforestry systems store significantly more carbon in deeper layers of soil compared to treeless farms. They also found that soil carbon levels increase with denser tree cover and greater species diversity (Kumar and Nair 2011; Nair and Garrity 2012).

North Carolina State University researchers recommend alley cropping for farmers who expect to experience higher levels of flooding and drought due to climate change. During 3 years of their 4-year research study, floods and droughts reduced corn and soybean yields to near-failure levels but had little impact on trees (Cubbage and others 2012).

3. Clean and abundant water. Farmers across the United States work with USDA to plant native trees, shrubs, and grasses on the edges of streams and rivers. Called riparian buffers, the vegetation enhances water quality by helping to filter out nutrients and pollutants and prevent stream bank erosion. In the Pacific Northwest, farmers are using these trees to cool the water, enabling salmon and steelhead trout to spawn upstream and migrate back to the ocean. Researchers at Virginia Polytechnic Institute and State University and elsewhere are taking riparian buffers a step further by developing edible versions using fruit and nut trees native to their area.

4. Economic revitalization of rural communities. In east Texas, the culture, economy, and history of the Alabama-Coushatta American Indian Tribe are interwoven with the longleaf pine tree. Its needles have been used for generations to craft intricate handmade baskets. But longleaf pine forests have diminished over the years, and a local source of revenue has gone with them. In an effort to restore the trees, the tribe planted 240,000 longleaf pine seedlings on 400 acres of reservation land through USDA's Longleaf Pine Initiative. This will allow the tribe to continue using needles from these trees to make attractive and culturally significant handicrafts that are also a source of income.



A member of the Alabama-Coushatta Tribe harvests longleaf pine needles.



Basket made of longleaf pine needles. Photos courtesy of Beverly Moseley.

CASE STUDY: Economics

Ohio Landowners Going Nuts for Agroforestry

Southeast Ohio is not yet a hotbed for nut production, but thanks to Kurt Belser and Marie DeMange, that may soon change. Belser and DeMange produce hickory nuts, chestnuts, black walnuts, and hazelnuts, which are amenable to the growing conditions in the Midwest.

They started by harvesting the hickory nuts and walnuts growing in pastures, on fence lines, and along streams of several nearby landowners. As Belser and DeMange started making money off the nuts, the landowners became interested in entering the world of nut production themselves. Their ears perked up even more when Belser told them that nut trees can provide them about \$300 of additional income per tree each year, surpassing local timber values.

Far from ruining Belser and DeMange's plan for a unique enterprise, however, the landowners' interest in nut production fits right into it. Over the long term, Belser and DeMange aim to process the nuts grown by others nearby into flours, butters, and baked goods.

Their neighbors' new-found interest in nut production provided the perfect opportunity for Belser to teach them about agroforestry techniques he learned from the Center for Agroforestry at the University of Missouri—techniques like silvopasture and

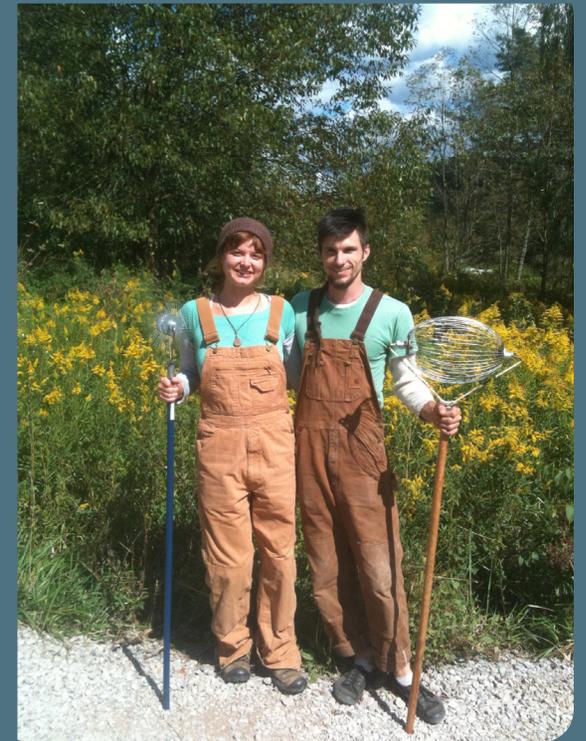


Half of the walnut harvest from one tree. Photo courtesy of Kurt Belser.

windbreaks, which support livestock production, or riparian buffers that protect streambanks from erosion. With Belser's guidance, several landowners have already started planting nut trees on their properties and grafting on the best available cultivars.

Inspired by the interested landowners around them, Belser, DeMange, and two other farmers in the area applied for and received a USDA Sustainable Agriculture Research and Education (SARE) grant of \$22,493 to develop a prototype for regional-scale nut processing. Their primary goal is to keep the land in the hands of rural landowners, so Belser and DeMange are intent on making the economics work for everyone by creating a values-based supply chain. The grant enables them to experiment with different processing equipment, business models, and a variety of recipes, products, and markets—options they would not be able to try otherwise.

For others interested in applying for SARE grants, Belser is quick to note that he and DeMange were not successful with their first proposal. After not receiving the funding, they received a smaller grant from the Northern Nut Growers Association. That grant enabled them to do background work that better prepared them to apply for a USDA grant a second time—and succeed.



Two walnut harvesters in company uniform. Photo courtesy of Kurt Belser.

Agroforestry: What Does USDA Bring to the Table?

Less than 1 percent of USDA's budget¹ went to agroforestry in fiscal years (FY) 2011–12, which amounts to almost \$333 million over the 2 years. The majority of the funds (more than \$316 million) helped landowners across the country install riparian buffers and windbreaks on their land through the Conservation Reserve Program (CRP) and other USDA conservation programs.

Although agroforestry may be a small part of USDA's budget, the Department's work in this area is significant. In June 2011, USDA Deputy Secretary Kathleen Merrigan released the *USDA Agroforestry Strategic Framework*² to create a road map for advancing the science, practice, and application of agroforestry. Historically, USDA's agroforestry efforts have been mostly associated with the USDA National Agroforestry Center, which has a small staff. The new *Strategic Framework* strengthens coordination on agroforestry across the Department.

Five USDA agencies and two partners—the National Association of Conservation Districts and National Association of State Foresters—developed the *Strategic Framework* in consultation with stakeholders from around the country. Now,

¹ Budget figures derived from fiscal years 2011 and 2012 total obligations in the 2014 *USDA Budget Explanatory Notes*.

² Hereafter, the USDA Agroforestry Strategic Framework, FY 2011–16, will be referred to as the *Strategic Framework*.



Roy Barnett, an Alabama producer, discusses establishing silvopasture on his land with USDA natural resource professionals and forestry experts from Alabama. After his initial success with the practice, he is now converting two additional tracts of land to silvopasture. See case study on p. 13. Photo courtesy of Sutton Gibbs.

USDA's agroforestry work is coordinated through an Agroforestry Executive Steering Committee comprised of senior executives from eight USDA agencies.

The *Strategic Framework* outlines three overarching goals to increase agroforestry throughout the United States:

Goal 1—ADOPTION. Under this goal, USDA aims to increase use of agroforestry by landowners, managers, tribes, and communities.

Goal 2—SCIENCE. Under this goal, USDA aims to advance understanding of agroforestry and develop tools to expand its use.

Goal 3—INTEGRATION. Under this goal, USDA aims to integrate agroforestry into the way it does business.

How is USDA meeting these goals? And what do these efforts mean for landowners interested or engaged in agroforestry? Read on to find out!³

ADOPTION (increase use of agroforestry)

Through a variety of efforts, USDA encourages landowners, managers, tribes, and communities to adopt agroforestry practices that result in more diverse economic opportunities and products; enhance water, soil, and air quality; and create rural wealth.

Current Levels of Agroforestry Adoption. No national inventory or survey has regularly measured the extent to which specific agroforestry practices are used across the country.⁴ To properly target Federal, State, and local resources and to identify potential barriers to adoption, however, it is vital to know this information.

For that reason, USDA included the first-ever agroforestry question in the 2012 Census of Agriculture, the results of which are expected in 2014. This new question asks producers whether they practice alley cropping or silvopasture.

To estimate the levels of agroforestry adoption without this information, USDA has to rely on the number of acres of agroforestry that landowners established with USDA technical and financial assistance.⁵ To learn about which programs can be used to plan and install agroforestry and other conservation practices, see the "Adoption Resources" box on page 7.

³ To find out more, see: *Agroforestry: USDA Reports to America, Fiscal Years 2011–2012—Comprehensive Version*.

⁴ Previous Censuses of Agriculture have asked producers to report the amount of woodland grazed, but it is not clear how much of this may be a silvopasture, which involves managing the trees, livestock, and forages together in a system that is integrated, intensive, intentional, and interactive.

⁵ USDA's Farm Service Agency (FSA) and Natural Resources Conservation Service (NRCS) administer conservation programs that provide technical and financial assistance to help landowners apply agroforestry practices. These are currently the only sources of data on how much agroforestry has been applied across the Nation.

Agroforestry Potential in the United States

Land Use	Acres With Potential for Agroforestry*	Potentially Relevant Agroforestry Practice	Agroforestry Acres Applied With USDA Assistance, FY 2008-12**
Cropland	372 million	Windbreaks, riparian forest buffers, alley cropping	336,000 (<1%)
Pasture and grazed forest land	179 million	Silvopasture establishment	2,000 (<1%)
Ungrazed forest land	363 million	Multistory cropping (forest farming)	500 (<1%)

*These are estimates of privately owned acreage where agroforestry could physically be applied, by land use, as of 2007. The amount of land on which landowners would actually find it profitable to adopt agroforestry may be much lower. Estimates are based on data used to develop land use estimates in Nickerson, C. et al. 2011. Major uses of land in the United States, 2007. EIB-89. U.S. Department of Agriculture, Economics Research Service. Main data sources are National Agricultural Statistics Service's Census of Agriculture, Natural Resources Conservation Service's National Resources Inventory, and the Forest Service's Forest Resources of the United States.

** FY = fiscal year. Estimates of FY 2008–12 agroforestry practices applied (acres) with USDA assistance include all Farm Service Agency and Natural Resources Conservation Service program reporting in the ProTracts and Integrated Data for Enterprise Analysis (IDEA) databases.

Over the past 5 years,⁶ USDA assisted landowners—both financially and through technical guidance—to establish about 336,000 acres of windbreaks, riparian forest buffers, and alley cropping, which accounts for less than 1 percent of cropland in the United States.

During that same period, USDA helped landowners apply about 2,000 acres of silvopasture, which is an even smaller fraction of the amount of pasture and grazed forest land in the United States that may support this practice.

Combined, the acres on which USDA has helped apply agroforestry practices are 1 percent or less of land that may be capable of supporting such practices (see table above).

Including Agroforestry in USDA Conservation Programs. Two USDA agencies, the NRCS and the Farm Service Agency (FSA), administer conservation programs that help landowners plan and implement agroforestry, among other practices. For example, in Idaho, the Kootenai Tribe had lost 50,000 acres of floodplain to agricultural fields, so the tribe entered into a Cooperative Conservation Partnership Initiative agreement with NRCS to help producers restore wooded ecosystems along 55 miles of the Kootenai River. Both NRCS and partners provided funds for the project, which was a great success.

⁶ Fiscal years (FY) 2008–12

These types of efforts can have a significant impact around working lands. For example, FSA estimates that the 877,000 acres of riparian buffers enrolled in the CRP in 2012 prevented 59 million tons of sediment, 116 million pounds of nitrogen, and 26 million pounds of phosphorus from entering waterways. While useful across the country, it is notable that 55 percent of these buffers are in either the Corn Belt or Mississippi Delta States, improving water quality for the many communities along the Mississippi River to the Gulf Coast.



Shiitake mushroom inoculation workshop. Photo courtesy of Allen Matthews.

Holding workshops. USDA

agencies have expanded learning partnerships with forestry and agricultural extension professionals, including State departments of agriculture and forestry, land-grant universities, tribal organizations, conservation districts, and others to share knowledge about agroforestry and its benefits. USDA supported nearly 100 agroforestry workshops in FY 2011–12 and provided agroforestry presentations at nearly 80 conferences and events. These educational opportunities reached audiences interested in three main topics: applying agroforestry on their land; teaching others about agroforestry; and improving the science behind agroforestry.



Forest farming: Shiitake mushroom log inoculation (left) and fruiting (right) in the Northeast. Photos courtesy of Allen Matthews and Ken Mudge.

ADOPTION RESOURCES

Want to use agroforestry on your land?
Check out the following resources.

To develop a conservation plan for your land or apply for **technical and financial assistance** to implement agroforestry practices, contact the Natural Resources Conservation Service (NRCS) by visiting its local office* or Web site. Key programs include the Environmental Quality Incentives Program and the Conservation Stewardship Program.

Some NRCS programs require forest management plans. The Forest Service supports States through USDA's Forest Stewardship Program to provide technical assistance for landowners who want a management plan. Contact your **State's department of forestry** for assistance.

If you want to install riparian forest buffers and windbreaks on working farmland, the Farm Service Agency (FSA) provides financial assistance to landowners willing to keep land out of production in order to implement conservation practices. Explore the Conservation Reserve Program and visit your local FSA office* or Web site.

Find an agroforestry demonstration site near you and plan a visit. For more information on agroforestry demonstration sites, review the Comprehensive Report.

* To find your local FSA, Rural Development, or NRCS office, visit <http://offices.sc.egov.usda.gov>.

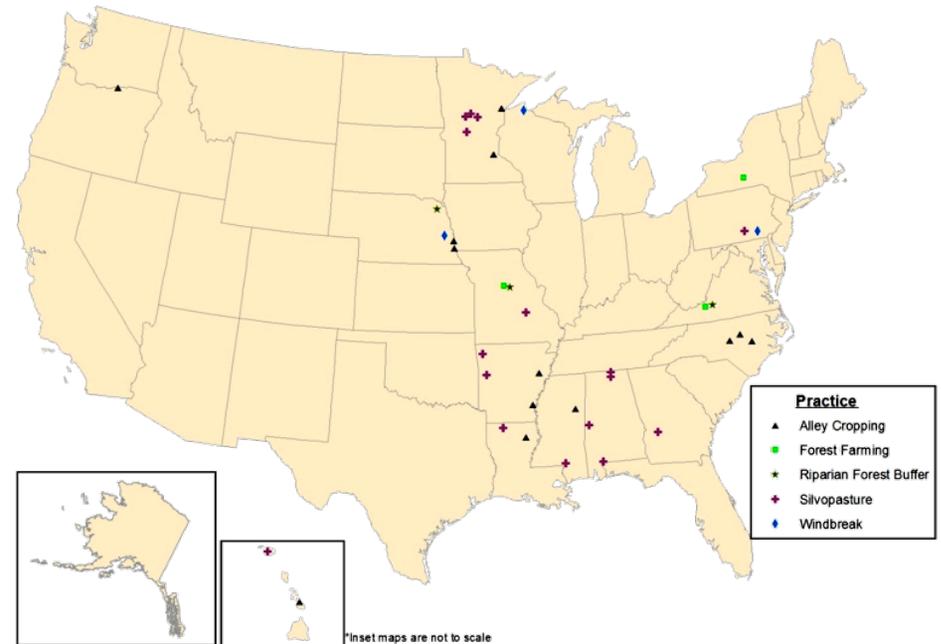
For example, with USDA support, land-grant universities, Cooperative Extension agents, and others held workshops on silvopasture across the **Southeast**, where this practice in particular holds great potential. Many acres of land in the region are already in either pine plantation or cattle pasture, and cattle often experience heat stress in the summer months—some of which could be alleviated by a shady tree canopy. Using USDA's Renewable Resources Extension Act funds and partnering with NRCS and their State departments of forestry, agriculture, and natural resources, universities in Georgia, Alabama, and North Carolina held workshops for farmers and woodland owners.

Further north, with the help of a USDA Sustainable Agriculture Research and Education grant, Cornell and Chatham University professors provided a series of workshops on forest-grown mushroom log production to more than 400 people from

8 States in the Northeast. They taught the basics of shiitake mushroom farming, from cutting and inoculating the logs, to inducing mushroom “fruiting,” to managing a business and marketing the shiitakes. Of these initial participants, the professors selected 23 who planned to scale up to commercial production to take part in a mushroom cultivation experiment. These entrepreneurs kept records of their expenses, labor, yield, and income for 2 years to provide real-world data for a best management practices guide on shiitake production in the Northeast.

Demonstration sites. Demonstration sites help landowners and others explore the benefits of agroforestry firsthand and consider how practices could be adopted on their own property. USDA has supported at least 40 agroforestry demonstration sites, 18 of which were started or planned in FY 2011–12. For example, South Dakota State University used a Specialty Crop Block Grant from USDA to demonstrate the feasibility of producing maple syrup in existing windbreaks and native woodlands. The university has educated at least 30 rural landowners through the demonstration plot, inspiring at least 5 to begin commercial maple syrup production themselves. For more information on these demonstration sites, read the Comprehensive Report.

Agroforestry Demonstration Sites



Communities of practice. Communities of practice are groups of experts who collaborate around a specific topic. The online arm of the Cooperative Extension System, called eXtension, hosts Internet-based spaces where communities of practice share resources and answer questions from any interested member of the public.

EDUCATION and EXTENSION RESOURCES

Want to help others adopt agroforestry?

Apply for a research, education, or extension grant from the U.S. Department of Agriculture. Grants are available from the National Institute of Food and Agriculture. These include the Beginning Farmer and Rancher Development Program and the Sustainable Agriculture Research and Education program, among others. Also, State Departments of Agriculture provide Specialty Crop Block Grants for research, promotion, and education.

Create an eXtension community of practice around alley cropping, tribal agroforestry, or silvopasture to share information and learn from others.

Have an idea about how an innovative agroforestry practice can help producers in your region conserve natural resources? Apply for a Conservation Innovation Grant at either the national or State level. For more information, visit your local Natural Resources Conservation Service office or Web site.



Nut grafting workshop. Photo courtesy of Kurt Belser.

If you are in your State's **Cooperative Extension System** and interested in hosting agroforestry workshops or training sessions, read the Comprehensive Report, section 1.2, to learn how others in Cooperative Extension are using capacity funds to teach about agroforestry.

CASE STUDY: Water Conservation

Riparian Zones: Tasty Enough To Eat?

As a certified technical service provider of the Northwest Natural Resource Group, Kirk Hanson designs riparian zones—trees and shrubs strategically placed along streams and rivers—and other agroforestry practices that not only enhance water quality, but also produce harvestable products. The approach helps landowners make enough income to stay on their land despite increasing land values and interested real estate developers.

For example, Hanson recently worked with a landowner to restore a 70-acre clearcut that had become an alder thicket after being left unmanaged for 15 years. Using the U.S. Department of Agriculture's (USDA's) Environmental Quality Incentives Program, they thinned the alder and planted an understory of native conifers, as well as trees and shrubs that produce nuts and berries. The diversity of trees provides habitat for many different wild animals while enhancing air quality, sequestering carbon, and doing much more. Just as important, Hanson created forest-farming opportunities for the landowner by providing the raw material to create wreaths, garlands, cedar boughs, nut products, and berry jams and jellies.

Hanson also worked with John Henrikson of Wild Thyme Farm in Washington to restore the riparian forest along Garrard Creek, a salmon-bearing stream that drains into the Chehalis River. USDA's Conservation Reserve Enhancement Program provided financial assistance to establish the riparian forest buffer with several different native tree species that help conserve soil, protect the riparian area from sediment erosion, and shade the stream to increase salmon habitat. The conservation program's contract requires landowners to keep their land out of agricultural production for 10 to 15 years. During



Riparian forest buffer on Wild Thyme Farm surviving an inundation. Photo courtesy of John Henrikson.

those years, however, incidental harvest of natural products, such as berries and nuts, may be permitted.

Once the contract expires, the farm owner will be able to harvest a wide range of tree/forest products, including berries and nuts, craft wood, and timber. The design of this agroforestry plantation was intended to ensure that the owners would have income in the short, medium, and long term, enabling them to stay on the land and to continue to provide salmon habitat.

In the future, Hanson hopes to teach others how to create these multifaceted designs. There is great opportunity for this type of work in the areas of western Washington and Oregon where Hanson lives, and he has seen the number of people applying for funding increase substantially. In 2012, Hanson and his colleagues secured funds from the USDA's Sustainable Agriculture Research and Education professional development program to train other forestry consultants to become technical service providers.

The Forest Farming Community of Practice is the first online agroforestry community on eXtension. The community includes forest farmers, university faculty, private business owners, and government personnel who share best practices, pose questions, and find answers about forest farming. The community produces articles and Webinars and answers questions from the public. In its first year, the online agroforestry community has attracted 1,500 visitors. Additional eXtension communities of practice are needed for other agroforestry practices (e.g., silvopasture, riparian and upland buffers, tribal agroforestry, and alley cropping).

Additionally, in 2004, several 1890 Land-Grant Universities partnered with USDA to form the 1890 Agroforestry Consortium. The 1890 Land-Grant Universities are a subset of all land-grant universities, which are colleges and universities given funds or tracts of land by Congress to teach practical agricultural, military, and engineering sciences. In 1890, Congress required that States either prove that race was not a criterion for admission to their land-grant universities or else establish separate universities for people of color. This resulted in the creation of the 1890 land-grant universities. The 1890 Agroforestry Consortium facilitates collaboration on agroforestry-related teaching, outreach, and research activities. Since that time, several have secured additional grants to develop their programs in silvopasture, forest farming, and alley cropping. For more information on this consortium, review the Comprehensive Report.

RESEARCH

Want to research agroforestry systems?

The U.S. Department of Agriculture (USDA) provides grants for research (as well as education, and extension) through the National Institute of Food and Agriculture. USDA's grant programs include the following:

- Agriculture and Food Research Initiative
- Specialty Crop Research Initiative
- Sustainable Agriculture Research and Education (SARE)

Looking for collaborators?

USDA scientists are interested in agroforestry topics. To learn more about who is doing what, check out *Agroforestry: USDA Reports to America, Fiscal Years 2011–2012—Comprehensive Version*.

To find scientists' contact information, visit their institutions' Web sites below:

- Agricultural Research Service: <http://www.ars.usda.gov>
- Forest Service: <http://www.fs.fed.us/research>
- Economic Research Service: <http://www.ers.usda.gov>

Scientists at many land-grant universities are also working on agroforestry issues. Find all land-grant universities at http://www.nifa.usda.gov/qlinks/partners/state_partners.html#maps.

SCIENCE (advance understanding of agroforestry and develop tools to expand its use)

We already know about some of agroforestry's benefits, but there is much more yet to learn—both about its impacts on the environment and rural economies, as well as how to best capture the synergies that occur when we mix trees, crops, and livestock.

To help landowners, managers, tribes, and communities maximize agroforestry's benefits for their local conditions, USDA develops, supports, and extends research and science-based tools. In 2011–12, USDA supported 69 research projects that resulted in nearly 200 peer-reviewed agroforestry publications.

Agroforestry research is focused on four key questions:

1. How do agroforestry practices affect **environmental goals** (also called ecosystem services), such as climate change mitigation, clean and abundant water supplies, healthy soils, pest and disease prevention, and more?
2. How do agroforestry practices affect **landowner profitability and rural economies**?
3. How should agroforestry **practices and systems** be developed to best address specific needs of a region—whether those needs are economic, environmental, or social?
4. How do **nutrients, water, and energy** cycle through agroforestry systems, compared to other natural, agricultural, and forested systems?



Forest farmer Dave Carmen teaches about false unicorn, a medicinal plant grown in West Virginia. Photo courtesy of Catherine Bukowski. Find out more at http://www.extension.org/forest_farming.



Alley cropping with chestnuts. Photo courtesy of Steve Shifely.

College and university researchers, extension agents, producers, natural resource professionals, and nonprofit organizations are carrying out this research with USDA funding, as are USDA scientists working in research stations across the country. These scientists aim to enhance both scientific and public understanding of agroforestry and to develop knowledge and tools that improve the performance of these practices, wherever they are applied.

Research highlights:

USDA is actively engaged in doing and sharing agroforestry research at the local and national levels, as well as internationally.

For example, in July 2012, the USDA National Agroforestry Center co-hosted a United States and Canada Great Plains Windbreak Renovation and Innovation Conference at the International Peace Garden on the Manitoba-North Dakota border. More than 80 scientists, natural resource professionals, and landowners from 11 States and 3 Provinces shared their expertise in renovating windbreaks, some of which were first established to slow soil erosion during the Dust Bowl era.

AVAILABLE TOOLS

Want to get started now?

- **Agroforestry Overview:** Includes emerging opportunities, bioenergy, carbon credits, business recommendations, and more (http://www.agmrc.org/media/cms/agrofor_A18CE08578D41.pdf).
- **Conservation Buffer Guide:** A synthesis of findings from 1,400 publications on how to design your buffer (<http://nac.unl.edu/buffers/index.html>).
- **Profitable Farms and Woodlands:** A practical guide to assist under-served farmers and woodland owners in the Southeastern United States (http://nac.unl.edu/documents/morepublications/profitable_farms.pdf).
- **Agroforestry Technical Notes:** Information in a useful “how to” format on topics from erosion control to exotic mushrooms to wild turkey silvopasture (<http://nac.unl.edu/publications/agroforestrynotes.htm>).
- **Non-Timber Forest Product Factsheets:** Information for small woodland owners (<http://www.ntfinfo.us/publications/>).
- **Elderberry Financial Decision Support Tool:** A tool to assist with elderberry production and business decisions (<http://www.centerforagroforestry.org/profit/elderberryfinance.php>).
- **Pacific Island Agroforestry Information:** Information about agroforestry in the Pacific Islands (http://www.winrock.org/fnrm/factnet/factpub/AIS_list.html).
- **Silvopasture Online Course:** Course that teaches site preparation and canopy, cattle, and forage management (<http://silvopasture.org/>). The user can receive 3.0 credit hours from the Society of American Foresters.

At the regional level, USDA and university researchers focus on different agroforestry systems in different parts of the country:

- **Pine silvopasture systems** in Alabama, Georgia, and Tennessee
- **Hardwood silvopasture systems** in North Carolina, Missouri, Louisiana, New York, Arkansas, Hawaii, and Minnesota
- **Alley cropping** in North Carolina, Georgia, Virginia, Tennessee, and Hawaii
- **Forest-grown mushrooms** in Missouri and New York
- **Forest farming of understory plants** in Maine, Virginia, Georgia, and Massachusetts
- **Windbreaks** in Nebraska, South Dakota, California, Iowa, North Dakota, and Ohio

CASE STUDY: Climate Change

Agroforestry Research Partnerships: From North Carolina to the World

Are agroforestry systems more productive, profitable, and beneficial for the environment than other agricultural and forestry systems?

Can agroforestry make agriculture more resilient in the face of climate change and uncertain markets?

Alan Franzluebbbers, a research ecologist with the Agricultural Research Service, and Michele Schoeneberger, a Forest Service research soil scientist with the U.S. Department of Agriculture (USDA) National Agroforestry Center, are partnering with scientists from North Carolina, Canada, and around the world to address these questions and more. In a time of shrinking budgets, this partnership maximizes limited funds and brings scientific experts together to address critical questions about the future of agriculture.

In 2007, Paul Mueller, Fred Cabbage, and other scientists at the Center for Environmental Farming Systems in North Carolina had the foresight to establish a 17-acre agroforestry research and demonstration project with the support of USDA. They designed it to evaluate an alley-cropping system of corn and soybeans in rotation between rows of loblolly pines, longleaf pines, and cherry bark oaks. After measuring production and economic returns from these different tree-crop combinations, they found that alley-cropping systems could prosper and provide reasonable returns on poor agricultural sites in North Carolina. Especially notable was the fact that the trees did fine under drought and flood conditions, while the crops nearly failed.

Beyond its regional significance, the project will also contribute to international research through the Global Research Alliance on Agricultural Greenhouse Gases, an international platform for research in 31 member countries. Franzluebbbers' and Schoeneberger's work to measure greenhouse gas emissions and the flow of nitrogen through agroforestry systems enables the United States to collaborate internationally in new ways, while also helping producers maximize carbon sequestration in the soil. Both globally and locally, the project has great promise.

MARKETING RESOURCES

Are you developing and marketing agroforestry products?

Are you interested in making jams, sausages, wreaths, or other value-added products from your agroforest? U.S. Department of Agriculture (USDA), Rural Development programs, such as Value-Added Producer Grants, can provide both planning assistance and working capital funds. To find out more, visit your local Rural Development office and Web site.

To educate consumers about agroforestry and market agroforestry products at a larger scale, apply to your State's department of agriculture for a Specialty Crop Block Grant.

To scale up your small business, check out Small Business Innovation Research grants from the National Institute of Food and Agriculture.



Hazelnuts ready for shipping at New Forest Farm in Wisconsin. Photo courtesy of Mark Shepard.



Forest farming products, like these log-grown shiitake mushrooms, add diversity to this farmer's business. Photo courtesy of Allen Matthews.

- **Bioenergy production in agroforestry systems** in Louisiana, Minnesota, Mississippi, Arkansas, Washington, Virginia, and Nebraska
- **Riparian buffers** in Nebraska, Missouri, Oregon, Virginia, Illinois, Georgia, and Arizona

Work is also taking place at the local level. For example, with a USDA Sustainable Agriculture Research and Education grant, farmers at Bug Hill Farm in Massachusetts are collaborating with fruit specialists from the University of Massachusetts to monitor organic berry crops that are grown in New England woodland soils. Meanwhile, USDA scientists from the Agricultural Research Service in Booneville and Fayetteville, AR, are working with partners and landowners to investigate the use of silvopasture with small ruminants and free-range poultry, where animals graze in the shade and feed on tree fodder.

- **Economic Research:** For landowners to adopt agroforestry systems and for bank and farm credit agencies to finance agroforestry operations, they must know whether they can be profitable. Economists at Virginia State University have partnered with the Forest Service to analyze the finances of alley cropping and silvopasture operations of various sizes and stages of development. The goal is to provide useful information for producers so their business plans are viable and to also help lenders better understand agroforestry businesses.

- **Agroforestry Tools and Resources.** Using research results published in peer-reviewed journals, USDA employees, extension agents, and others create science-based tools to help landowners, natural resource professionals, and others plan and design multifunctional agroforestry projects; improve climate change resilience; protect and create habitat for wildlife, aquatic species, and pollinators; and meet the needs of small and limited-resource landowners. See the sidebar on the previous page for a selection of these resources.

INTEGRATION (integrate agroforestry into the way USDA does business)

We've seen how USDA is enhancing public understanding of agroforestry, encouraging its adoption, and supporting cutting-edge research to improve these systems. USDA also aims to ensure that agroforestry becomes a well-used tool in each agency's toolbox across USDA. Whether the goal is environmental, economic, or production driven, agroforestry has something to offer.

CASE STUDY: Food Production

A Pioneering Producer and a Supportive Agency: A Match Made in Agroforestry Paradise

A few years ago, Alabama resident Roy Barnett invited a couple of U.S. Department of Agriculture (USDA) natural resource professionals to visit his farm and discuss how best to manage the pine trees on his 1,240 acres of land. Little did he know that this visit would start him on the path toward being a silvopasture pioneer.

At the time of the visit, Barnett had about 650 acres of loblolly pine, a 350-acre pasture for cattle, 90 acres of hardwoods, and a few ponds for fishing. After discussing Barnett's goals, Natural Resources Conservation Service (NRCS) Forester Tim Albritton suggested that he consider silvopasture. By creating silvopastures on his land, he would be able to increase the grazing acreage for his cattle while maintaining the tree canopy and timber income.



Cattle enjoying the shady silvopasture on Roy Barnett's farm.
Photo courtesy of Sutton Gibbs.

Barnett worked with NRCS District Conservationist Sutton Gibbs to establish a conservation plan for the property and set off at a quick pace. He enrolled in USDA's Environmental Quality Incentives Program and began to thin the tree stand, manage the understory, establish warm season grasses beneath the trees as forage for the cattle, and build fences to assist in rotating the cattle through paddocks and prevent overgrazing.

After 3 years, Barnett has increased the number of cattle he manages to 25 cow-calf pairs and is ready to turn new tracts of land into silvopastures.

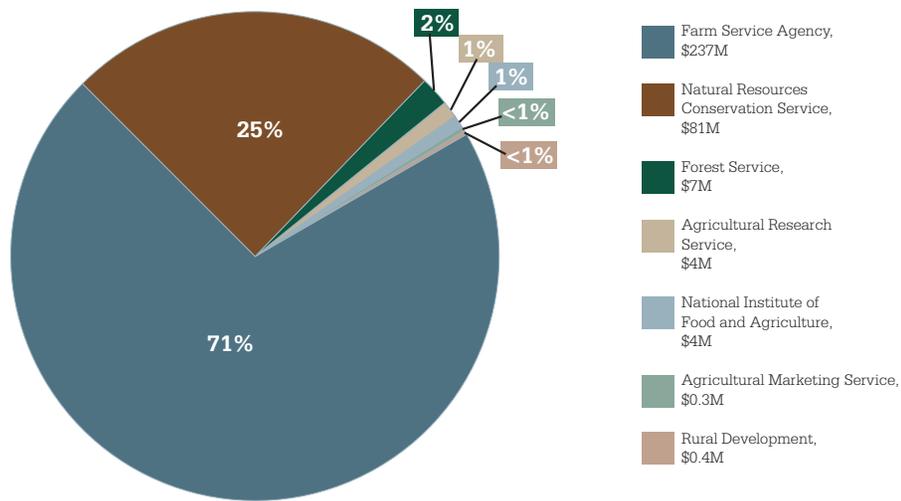
One of the additional tracts that Barnett plans to convert has 70 acres of pine trees that he established with the aid of USDA's Conservation Reserve Program (CRP) several years ago. Producers cannot use land under CRP contract as pasture for their animals, so Barnett will wait until the contract expires to rotate his cattle beneath the trees. In the meantime, he will be able to prepare the land.

Transitioning former CRP land to silvopasture after the contract expires will enable Barnett to keep trees on the land for a longer period of time, increasing the trees' value while also reducing erosion, increasing water infiltration, and providing a buffer for the cattle from the sun and wind.

Additionally, on a tract of open pasture, Barnett plans to use USDA's Longleaf Pine Initiative (funded under the Wildlife Habitat Incentive Program) to plant and manage long-leaf pine seedlings. He will space the trees far enough apart initially to allow forage to grow between them so that he can use the area as silvopasture in the future. This effort is possible thanks to a partnership between USDA, the U.S. Department of the Interior, and the U.S. Department of Defense. The partnership is aimed at restoring some of the 90 million acres of southeastern North America once blanketed by biodiverse longleaf pine ecosystems—of which only 3 percent remain.

Barnett's willingness to try new ideas is helping spread the word about silvopasture. Albritton has been able to use Barnett's farm as a demonstration site for other producers around the region.

Agroforestry Obligations by USDA Agencies, FY 2011-12



To achieve the goal of integrating agroforestry, USDA has made changes to its policies, programs, and activities. Specifically, USDA has:

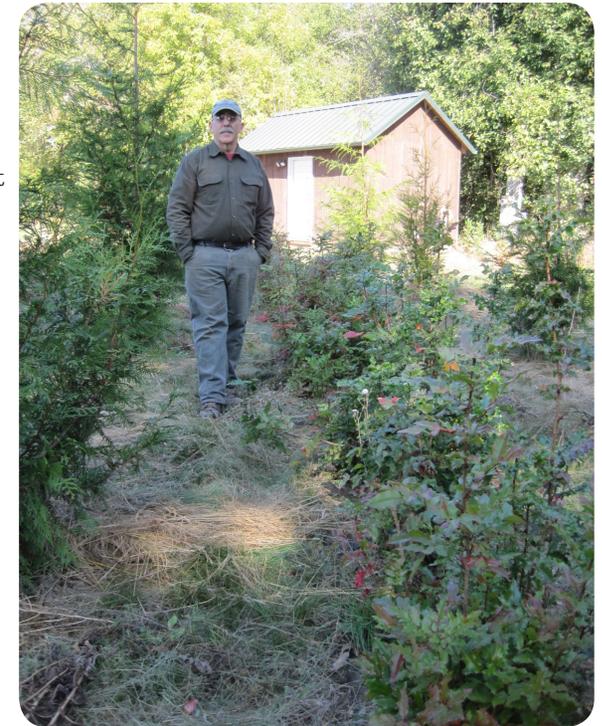
- **Established an Agroforestry Executive Steering Committee** and an Interagency Agroforestry Team (IAT) to implement the *Strategic Framework*. Comprised of representatives from eight USDA agencies, the committee is able to work across the Department to set priorities to meet *Strategic Framework* goals while the IAT helps the committee carry out its work.
- **Surveyed all USDA agencies** to better understand which programs currently support or could support agroforestry. Although the share of resources currently used for agroforestry is not large (as the graphic above illustrates), agroforestry cuts across many USDA agencies whose combined impact is significant and could increase in the years to come.
- **Developed a USDA Departmental Regulation**, signed by Secretary Vilsack in 2013, that establishes agroforestry policy across USDA.
- **Included agroforestry in USDA agencies' strategic plans and programs.** For example, NRCS and FSA established agroforestry practice standards, meaning that many conservation program participants are now able to apply in their State to receive support for adopting a range of

agroforestry practices. Once these practice standards are written at the national level, they must also be adopted within each State. Additionally, the National Institute of Food and Agriculture has included agroforestry in some of its requests for proposals for research and extension, including the Renewable Resources Extension Act National Focus Fund projects.

- **Included the first-ever Agroforestry Question** in the 2012 Census of Agriculture (as mentioned above). Knowing about the producers who are practicing alley cropping and silvopasture across the country will help USDA and its State and local partners identify potential barriers to adoption, benchmark progress, and focus resources over the years to come.

- **Provided input for the Agroforestry Policy Guidelines** developed by the United Nations Food and Agriculture Organization (FAO) in 2013.

Going forward, USDA expects to add new members to the Agroforestry Executive Steering Committee and will continue to work across agencies to communicate the benefits that agroforestry can bring to landowners, the environment, and rural communities. One key next step will be providing educational opportunities for USDA employees to learn more about what agroforestry is and how it can be better supported to fulfill their agency's mission and the Department's goals.



Oregon alley-cropping system using native Oregon grape, salal, and mixed conifers. Photo courtesy of Paul Sansone.

CASE STUDY: Bioenergy

Agroforestry = Energy, Water, and Jobs

Since its launch in 1996, the Center for Integrated Natural Resources and Agricultural Management (CINRAM) at the University of Minnesota has worked with public and private partners to develop innovative solutions to water and land use problems.

One of these tools is agroforestry—a solution with the potential to simultaneously generate income, enhance water quality, and, as it turns out, produce bioenergy.

It all began when several partners began to research the impacts of agroforestry on water quality and storage in the Minnesota River Basin with a 2002 grant from what is now the National Institute of Food and Agriculture.

Over the years, CINRAM has established research and demonstration plots of woody and perennial biomass crops in an alley cropping, agroforestry



Alley cropping of hybrid poplar and native grasses for bioenergy on a Minnesota research plot. Photo courtesy of Josh Gamble.

design to provide feedstock for bioenergy while also allowing scientists to evaluate the impact on water quality.

The alley-cropping systems alternate rows of trees and perennial grasses at three different locations along waterways. Two plots are on land in an area of south-central Minnesota dominated by corn and soybeans, which makes them important demonstration sites for interested farmers in the area. The third planting is managed by the Metropolitan Council at the Empire Sewage Treatment plant on a site where bio-solids were applied.

Since the initial establishment of the plantings, scientists have noticed that the trees and grasses have been able to survive and thrive even when covered continuously by water for 7 to 36 days. Perhaps such systems have more resilience to flooding.

As the research has evolved, more farmers in south-central Minnesota are expressing interest about getting involved, and so are other businesses nearby.

One such business is Koda Energy, LLC, an innovative combined heat and power plant that burns agricultural byproducts, wood waste, and dedicated energy crops to generate electricity and heat through steam. The energy is then used by the Shakopee Mdewakanton Sioux Community which is a co-owner of the business. CINRAM is helping Koda explore the logistics, options, and potential environmental benefits of supplying perennial feedstocks to the facility.

With CINRAM's 15-year history partnering to develop agroforestry systems, it is leading the way toward a future in which rural economies are reinvigorated even as they sustain and improve the environment—and a future in which an agroforestry farm is valued for the energy it produces as well as the water it protects and the floods it prevents downstream.

Conclusion

Agroforestry is not a new concept. Indigenous communities in the United States and around the world have been practicing it for many generations. While some call it agroforestry, others call it their traditional or cultural management of natural resources. Many of these systems still exist in tropical regions of the world, but agroforestry has been, can be—and is being—practiced in temperate regions, as well, with great success. With formalized agricultural and forestry sectors in the United States, many of us see farms and forests as distinct and different places in our minds, but there does not need to be a hard line between them. When intentionally and intensively managed, agroforestry holds much promise for farmers and woodland owners who wish to diversify their income streams, conserve natural resources, and support their communities. USDA is here to help.



Harvesting wild organic blueberries on Sealaska Native Corporation land near Kake, AK. Photos courtesy of Brian Kleinhenz.

Your Feedback

Do you practice agroforestry? If so, what practice? How many acres? When did you start? What is your story?

If not, what would you like more information about?

How has USDA helped or hindered your agroforestry efforts?

Do you have any additional comments?

USDA established an email address agroforestry@usda.gov where you can respond to the above questions and send us comments about this report and USDA's role in agroforestry. We look forward to hearing from you and learning about how you put agroforestry to work on your farm, on your college campus, and in your community.

Thank you!



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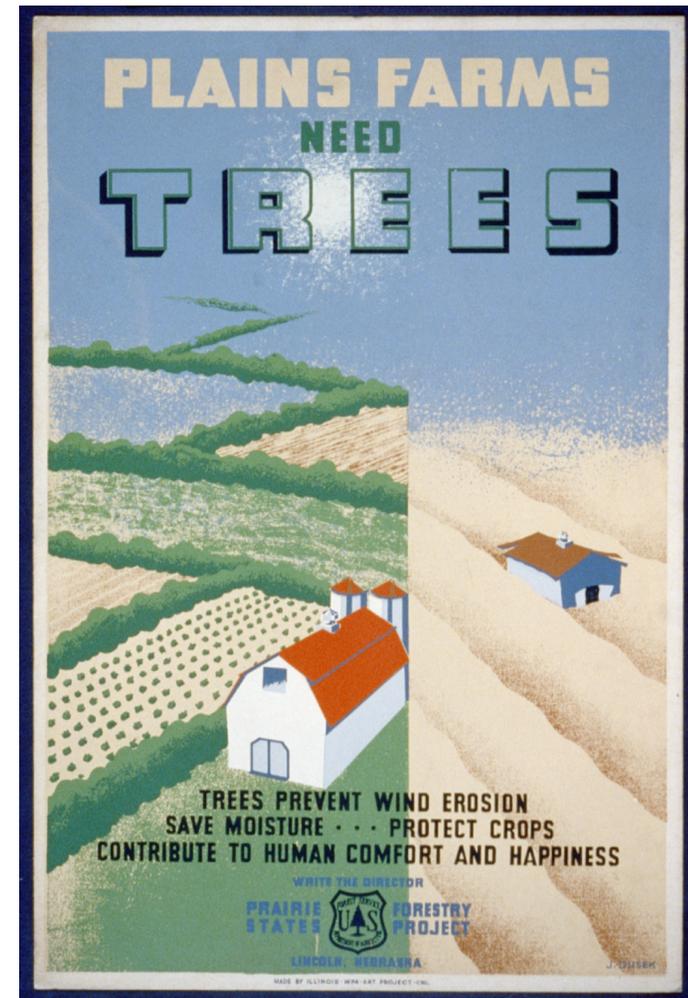
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Conservation/agroforestry poster created by artist Joseph Dusek between 1936–1940 (Work Projects Administration Poster Collection, Library of Congress). Available online: <http://www.loc.gov/pictures/item/98517930/>.

Credit for the agroforestry photos on the front and back cover go to: Front (clockwise starting top left): Steve Shifley, Allen Matthews, USDA National Agroforestry Center, Josh Gamble, Mack Evans, Kurt Belser, Mark Shepard, and Rich Straight.

Back (clockwise starting top left): Mack Evans, Steve Shifley, Mack Evans, Mark Shepard, Ken Mudge, Natural Resources Conservation Service, and the Forest Farming eXtension Community of Practice.



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