Chapter 9: Agroforestry and Wildlife

Chapter Highlights

- Agroforestry practices such as alley cropping, windbreaks, riparian forest buffers, silvopasture, and forest farming provide opportunities to manage for a diversity of habitats that benefit wildlife.
- Agroforestry can be used to reduce the negative consequences of landscape fragmentation by lessening habitat isolation through the use of plantings that are well thought out and well-connected with other habitats.
- Understanding the plant and wildlife communities that exist on a particular parcel of land, paired with an understanding of the land steward's time and resources available for habitat restoration and maintenance, are essential initial planning steps for any conservation-minded operation.

Wildlife Benefits in Your Agroforestry Operation

Regardless of what a farmer does on their land, including nothing, there are both positive and negative effects on wildlife. Many of our current agricultural practices, particularly those associated with larger farms and the associated increase in size of equipment, has drastically reduced the quality and quantity of available wildlife habitat. Agroforestry practices offer an opportunity to both provide benefits to wildlife as well as quality timber production. Many farmers view wildlife as an important byproduct of their land management activities, particularly wood production. Agroforestry practices' diverse plantings result in structural and spatial diversity. It is this species and structural diversity that is beneficial to wildlife.

The benefits received from wildlife are at least fourfold, including 1) aesthetic, 2) ecological, 3) economic, and 4) recreational benefits. Migratory birds, such as wood ducks and yellow warblers provide ample pleasure to the observer. Bees and flies are important pollinators in agroforestry systems, while foxes and weasels are important predators of seed-eating mice and others. Farmers can also benefit from agricultural tourism by welcoming birders, bicyclists and families that are interested in visiting the farm to teach their children about food onto their land. Another tourism opportunity is a hunting lease, which gives a hunter access to land to pursue wildlife. Ultimately, wildlife provide 1) endless opportunities for the amateur naturalist to learn about the interconnections among plants, animals, and their surroundings, 2) a plethora of photographic opportunities, and 3) entertainment at feeding stations.

What do I need to consider about wildlife and agroforestry?

For wildlife to be present, their basic needs must be met, including food, water, shelter and space. A shortage of any of these elements will severely limit the numbers of a given wildlife species that are able to be supported on a given property. In addition, many wildlife species have complex needs that include 1) the need for multiple habitats during their life cycle, 2) the need for different food items based on their age, 3) the difference in behaviors of the species between the breeding and non-breeding seasons, and 4) an annual migration of many birds, as well as some mammals and insects each year to warmer climates, where someone else is managing their habitat.

Types and amounts of wildlife that will benefit from agroforestry practices are dependent on the size of the agroforestry area, surrounding land uses, types of plantings, configurations of plantings, age of plantings, and the juxtaposition of different habitat types. Some wildlife species are known as area sensitive, needing large, contiguous areas of habitat in which to live. Other wildlife species thrive where there is a lot of edge habitat, the area where two habitat types intersect. Some wildlife species are *specialists*, animals that are reliant on just one or two food sources, for example. Others are *generalists*, animals that can either feed on a large variety of foods, live in a variety of different habitat types, or

Summary of Benefits

- **Aesthetic**: Wildlife provide auditory and visual beauty, and recreational interest.
- **Social**: Wildlife help provide a sense of place that attracts families, photographers, birdwatchers, hikers, hunters and anglers.
- **Ecological**: Wildlife diversity generally indicates high-quality habitat. Some animals provide soil aeration services, such as moles and ants; others disperse seeds and pollinate plants, such as birds and insects.
- **Economic**: Wildlife can provide you with an economic return when you open your land to recreation (e.g. birdwatching, hunting, guiding or agritourism). Indirectly, pollinators provide billions of dollars of pollinating services, and bats provide billions of dollars in insect "pest" control.

both. These characteristics of wildlife will partially determine the feasibility of their management in your agroforestry operation.

Geographic scale, or size, of both agroforestry areas and surrounding land use is an important factor in wildlife habitat management. The scale of agroforestry practices, typically 4-8 ha, is small enough that managing for many wildlife species is impractical. This includes larger-bodied animals and area sensitive species. If your agroforestry practice is embedded in a larger matrix of suitable habitat, it may be possible to benefit many large wildlife species. However, there are many smaller-bodied animals that can be managed within smaller areas.



Agroforestry practices embedded in some habitats can lead to negative impacts on current wildlife populations. The linear and fragmented makeup of many riparian forest sites can lead to a decrease in the different types of small mammals inhabiting an area, as well as birds, reptiles and amphibians. In some cases, the increase in habitat and reproductive success for songbirds can be negated because of an increase in nest predation. Importantly, landscape context matters when managing for wildlife. The wildlife benefit derived from agroforestry is directly related to the surrounding habitat matrix.

Fragmentation, or the isolation of habitats, poses another issue for wildlife. Whenever possible, it is preferable to restore larger fragments or more connected fragments of habitat than to restore many small and isolated fragments. Cowbirds reflect an important example: cowbirds lay their eggs in other birds' nests. Many songbirds are naive to this sort of "parasitic" behavior and will work to raise the larger and louder cowbird chick(s) at the expense of raising their own offspring. The rates at which cowbirds parasitize the nests of forest songbirds typically decline with distance from forest edges. Fragmentation also limits dispersal in amphibians and thereby decreases their opportunities to fully occupy wetlands. For wildlife to thrive, it is important to maintain or recreate habitat connectivity within a larger geographic area. Agroforestry practices can be used to reduce the negative consequences of fragmentation by lessening habitat isolation through the use of plantings that are well thought out and well-connected with other habitats.

A final consideration pertaining to habitat fragmentation and isolation is source and sink population dynamics. When installing agroforestry practices, it may prove to be very inviting to wildlife species, and in fact, be heavily used by wildlife. However, when such practices are isolated from other suitable patches of habitat, they can serve to increase predator use of the area and thus lead to an overall reduction in the prey species. This is because as the prey species disappear from the site, it becomes open and available for others of its kind to move in, thereby further increasing predator use of the area, and leading to another reduction or disappearance of the prey species from the area. This can be compounded when the site is irregularly shaped, which increases the amount of "edge" habitat which makes the prey species more vulnerable to predators.

The potential wildlife benefits that can result from your agroforestry operation are contingent upon your own goals and objectives for your property and the investment that you can and will make to integrate wildlife benefits with your timber and agricultural production. To maximize benefits to wildlife, a producer can slightly modify plantings and select plants that meet the needs of wildlife species with little impact to the production of forest products or field management. With careful selection of trees and shrubs, you can support wildlife while diversifying your returns. However, it is important to note compromise is inherent when you are balancing tree growth, crop production, and wildlife management. A strictly economic cost-benefit analysis is unlikely to result in favoring wildlife-focused land management. However, it's the previously mentioned benefits of wildlife that help to balance the scales. In some instances, discussed later in this chapter, it is also possible to earn some economic return on an investment in supporting wildlife habitat.

What lives here and nearby now?

The first step in constructing a wildlife management plan for your agroforestry area(s) is to conduct an inventory of the wildlife species present on your land. It is advised that you conduct an inventory prior to goal and objective setting, because your goals and objectives should consider the wildlife that is currently on the property. Your interest along with the amount of time and energy you have available to invest, will determine the frequency you go out to observe wildlife and therefore the completeness of your inventory. A good first step in conducting your inventory is to download an aerial map of your property or create your own map of your existing structures, crops, standing timber, and water features. This will be the foundation for your efforts to monitor wildlife. Spending time in the field to identify trees, shrubs and important understory plants will add detail to your map and provide information regarding current food, water and cover resources available to wildlife. Standard methods are available to inventory mammals, birds, amphibians and reptiles on your property. Some insect groups, such as butterflies and moths, are more easily observed and identified than others. Some wildlife species are active when people normally are during the day, and are thus more easily observed than species that are active mainly at night. Some species are year round residents, such as nuthatches and cardinals, while others are only in the area for part of the year such as yellow-rumped warblers and kingbirds. To be able to document the greatest percentage of wildlife that are currently using your property, it is necessary to get out in different seasons and at various times during the day. Citizen science programs and trainings in your area can provide you with the skills, checklists and sometimes even the equipment you need to inventory wildlife on your property. These events will also provide you with opportunities to meet like-minded individuals and the instructors running the trainings, and perhaps garner some assistance in your inventory work. Once you know what plants and wildlife already frequent your property, as well as the time and money you have and are willing to invest in a wildlife management plan, you're ready to define your goals and objectives.

Setting Goals and Objectives

You are more likely to meet with success in increasing wildlife on your property if you have clearly identified goals, and both short and long-term wildlife objectives. Your goals and objectives will guide you in your management activities and subsequent monitoring of wildlife populations on your land to help maximize the return on your investment. The identified end goal of your wildlife management e.g. to harvest deer, will influence the sorts of agroforestry practices you implement to meet your goal. In defining goals and objectives for wildlife, it's important to remember that as your agroforestry areas age and the structure and plant composition of these areas change, the wildlife species composition will also shift over time. As your forests mature, those wildlife species that are dependent on young, or early successional forest habitat will decline while species that are dependent on mature forests will appear and increase in number. For example, in very young stands, we can expect species such as quail and field sparrow to thrive, while in more developed stands, it is more likely that birds such as brown thrashers and northern cardinals with benefit. When the stand reaches maturity (30-60 years), species that are dependent on mast will increase, such as white-tailed deer, whitefooted mice and tree squirrels. The point is to recognize that wildlife species and benefits will change as your plantings mature. Knowing this from the beginning can lead to setting realistic goals and can reduce later disappointment.



> "Rabbits can cause considerable damage in agroforestry. Dugger et al. (2003) found that damage to oaks planted in plots with natural vegetation was greater than in plots that had been planted to redtop grass (85% of the bareroot seedlings clipped and 31% of the bareroot seedlings clipped, respectively)."
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> **–Millspaugh et al. 2009**

Your wildlife objectives will guide you in your choice of trees to plant, distance between plants, cover crops, and even the configuration of your fields. Some options may be more economically viable than others, while some options may give rise to more wildlife viewing opportunities. Another point regarding the setting of wildlife goals and objectives is to consider some of the potential downsides of managing for wildlife.

Wildlife can and may cause considerable changes perceived as damage. Eastern cottontail rabbits and white-tailed deer routinely feed on tree and crop plantings, as well as ornamental plants and even weeds. While rabbit damage is easily identified by the clean 45° cut made, white-tailed deer damage can be identified by the ragged ends they leave behind. During the summer, rabbit and deer damage to woody vegetation is minimal because of the abundance of green, leafy vegetation available, but they can do considerable damage to seedlings and saplings during the fall and winter. In addition to feeding on woody stems, male deer will rub their antlers on seedlings and saplings, sometimes knocking stems completely out of the ground or leading to misshapen boles and decreased wood value.

There are many methods available to reduce rabbit and deer herbivory in agroforestry plots. These range from fencing, which can be 100% effective but can also be quite costly, to protecting individual stems using plastic mesh tubes or shelter tubes (note that shelter tubes affect the micro-climate within them which is warmer and more humid during the day). Fall mowing may be effective in reducing rabbit herbivory because of the elimination of winter cover. Keep in mind that even a relatively small patch (< 10m2) may contain rabbits.

Agroforestry practices as habitat

Managing a diversity of habitat types will also tend to promote a diversity of wildlife. Agroforestry practices such as alley cropping, windbreaks, forested riparian buffers, silvopasture, and forest farming will provide you with opportunities to manage for a diversity of habitats that may benefit wildlife. Trees and shrubs can enhance wildlife habitat as well as provide additional products on the farm.

Alley cropping

Alley cropping systems are designed to grow an annual crop between rows of high value trees, like oak, pecan or walnut, until the trees are harvested or the alley crops are shaded out. Alley cropping diversifies plant structure for wildlife habitat. Such structure is important for birds, and the matrix of trees and crops provide travel corridors for mammals and reptiles. You can optimize benefits to wildlife by carefully choosing the agricultural crop to be planted and its configuration. Once the trees have matured to the degree that they are shading out the crop, that habitat becomes important for amphibians, which must travel from one activity area to another without drying out. herbaceous wind barriers) create a conservation approach to tolerating wide weather extremes.

Cover crops

A native cover crop mixture that includes native warm season grasses will benefit wildlife. Previous research in such habitat has garnered observations of greater bird abundance, species richness, and reproductive success.

Riparian forest buffers

Riparian buffers consist of streamside plantings of a mixture of grasses, shrubs, forbs and saplings, which are attractive to wildlife. While these buffers can serve as travel corridors for wildlife, they are not necessarily a good place for birds to reproduce, unless other high quality habitat exists nearby. These buffer strips can also be valuable as habitat and travel corridors for amphibians, but need to be about 100 m wide to protect stream amphibians. The tree canopy of buffers reduces water temperature, while roots and fallen leaves provide food and hiding places for wildlife. A potential downfall of streamside buffers for wildlife is that they can lead to reduced nest success in some birds, particularly grassland birds. These areas are most used by generalist birds.

Windbreaks

Windbreaks, plantings of trees perpendicular to prevailing winds, can protect soil, crops, live- stock, buildings and wildlife from harsh winds when properly designed and located. The microclimate that windbreaks create enables native insects to pollinate crops more efficiently. The size of the windbreak is often considered most important to bird diversity. However, it's important to note that birds that benefit the most from windbreaks are forest-edge and generalist species. Windbreaks have been reported to have negative effects on grassland birds due to higher predation and cowbird parasitism rates. Some mammals, such as white-tailed deer and cottontail rabbits benefit from windbreaks because of the mix of food and cover available. Windbreaks are most beneficial to wildlife when they are large and provide a diversity of structure, including both deciduous and coniferous trees, shrubs and a diversity of understory grasses and forbs.

Silvopasture

Silvopastures combine trees, forage and livestock in an intensively managed system. Silvopastures are typically less diverse than a natural forest understory, but incorporating clumps of native grasses and forbs can provide quality habitat for wild turkey and other animals.

Forest farming

High value specialty crops like ginseng and goldenseal can be cultivated under the protection of a forest canopy. This provides a harvestable product for the farmer which is an incentive to keep the land in forest habitat. The diversity created by forest farming attracts a variety of wildlife species.

Restoration of bottomland forests

Bottomland forests can be incredibly beneficial to wildlife because of the availability of mast from oaks and nut-producing trees, fruit from soft mass trees and the variety of structure provided by trees and shrubs. Bottomland forests are important for birds in every stage of development from grassland to mature forest. Recently a number of federal programs have aimed to restore some of the millions of hectares of bottomland forest that were converted to agricultural use in the 19th and 20th centuries. Although trees can be difficult to establish, newer techniques, which includes the use of larger seedlings with well-developed root systems, can increase the likelihood of planting success. Once established, oak species provide mast for waterfowl and deer and are favored foraging areas for spring-migrating and breeding warblers. Faster-growing tree species can also benefit wildlife by providing needed structure to forest songbirds. During the early years of an oak planting, this habitat will be used by a number of grassland species. By planting oaks in combination with fast-growing tree species that promote quick stand development, you can more quickly benefit and attract forest songbirds. The downside to this approach is that the taller trees provide perches for cowbirds, which leads to increased rates of cowbird parasitism on forest songbirds. However, the rates of cowbird parasitism are not only varied at the local level, but are also sensitive to regional and landscape effects such as regional forest cover.

Special applications

Many agroforestry practices have been adapted to help people and communities deal with problems, such as treating wastewater Photo - windbreak (pg. 132) and stormwater with fast growing willows and cottonwood trees. These trees also provide wildlife habitat and may be a future energy source.

Elements of Wildlife Habitat

Disturbance

Historically, fire, floods, wind, ice and wildlife browsing disturbed the land which in turn helped control invasive

species and promote native plant growth. Today, vegetation can be managed by mowing, disking, thinning, prescribed burning and grazing. The extent and timing of disturbances helps create diversity and structure. Timing can also minimize impact to wildlife, such as mowing after nesting is complete.

Vertical and horizontal structure

Different layers of vegetation allow an assortment of wildlife to utilize the same area. Each tier creates a niche in the habitat area. Five or more layers are optimal and include the canopy, understory, shrub layer, herbaceous layer and the floor.

Connectivity

Many species of wildlife need a minimum amount of a particular habitat type; if it gets to be too small they won't use it. Vegetation can be used to connect several small isolated areas within a landscape, thus making it more viable and increasing the usable space for wildlife.

Economic Opportunities Presented by Wildlife

Agritourism and hunting leases are just two of the ways in which you can diversify your farm income with wildlife. Agritourism in its broadest sense involves any agriculturally-based operation or activity that brings visitors to a farm or ranch. In the United States, it includes activities such as picking your own fruit, shopping at farm stands, horseback riding, honey or wine tasting, birdwatching, or learning about cheesemaking. The Whiterock Conservancy, in Coon Rapids, Iowa, provides an example of a working farm enterprise that has embraced agritourism in its mission. Its three-part mission includes: 1) Protect & Preserve the Natural Resources of the Middle Raccoon River Watershed, 2) Demonstrate Sustainable Multipurpose Land Management, and 3) Promote Low Impact Outdoor Recreation & Provide Environmental Education. Their approach to tourism is structured around education and stewardship, which emphasizes the diversity of the landscape managed with diverse methods and used by diverse audiences.

A hunting lease is an agreement between a land steward and a hunter or group of hunters, where the right to trespass and hunt is granted for a particular time and fee. Hunting leases are most popular in areas where little public land is available to hunt and access to private lands is at a premium. Before you delve into the world of hunting leases, it's important to consider what is reasonable to expect. The type and quantity of game animals depends upon not only your land, but that of the surrounding area. As your trees move through different phases of the growth cycle (i.e. seedling, sapling, mature tree), the type and extent of habitat available to game animals will change. The most profitable pay-to-hunt operations usually require the greatest investment in labor and management by the land steward.

Some general considerations when contemplating lease hunting include the following. To be effective and profitable, you need to have willing participants partake of the opportunity. It is therefore, suggested, that providing such opportunities near expanding urban and suburban areas will be advantageous. Another consideration is the "quality" of the hunting experience provided to clients. This includes cost of the lease, distance from the clients' homes, the abundance and variety of game animals, hunter safety, camping or lodging facilities and other amenities.

Finally, you'll need to consider what sorts of leasing opportunities will be available through- out your timber rotation. Early on, it may be that mourning doves provide an opportunity, but once the stand has matured, opportunities for turkey and white-tailed deer hunting will be available, which will require less intensive management on your part. The types of hunting leases are variable. In the past, many land stewards provided non-fee access with an informal verbal permission agreed to by a handshake. This may still be useful for managing nuisance populations, particularly if you don't want to invest the time or energy or simply are not interested in fee hunting. However, these agreements are becoming rare. They are most often still found in rural or rural-small town areas where hunters are more aware of farm-related issues and concerns. Another non-monetary hunting lease is an exchange of services, whereby a farmer allows hunting in exchange for a service such as the monitoring of land for trespassers or helping with farming operations. These arrangements can be either formal or informal.

There are four general categories of fee hunting:

1) daily lease;
2) short-term or season lease;
3) annual or multi-year lease; and
4) broker or outfitter lease.

A daily lease is often used when there is a relatively short hunting season and when a number of hunters can be accommodated on a small parcel of land. Most commonly, game species include pen-reared birds or mourning doves. This sort of lease is intensive for a producer to manage, requiring more interaction with hunters and more intensive wildlife habitat management to assure that game animals are available on the opening day of the season.

Short-term or season leases necessitate much less labor on the part of the producer. This sort of lease works best for species such as turkey or white-tailed deer. Some considerations for short-term leases include the use of equipment, such as blinds. You need to be sure that hunters do not use any kind of screw-in type of tree stand or climbing steps, which may damage the eventual value of the trees that you're growing.

In an annual or multi-year lease, a farmer enters into an agreement with a hunt club or a group of friends willing to share the cost of having long-term access to a hunting spot. An advantage to this sort of arrangement is that be the establishment of a long-term relationship with the land, the hunters may start to develop a sense of stewardship for the property and may ask to help conduct or participate in wildlife habitat management activities.

A broker or outfitter lease involves a middle man that rents all of the hunting rights from a land steward and then subleases to individual hunters by species or season. This alleviates a lot of the work by a land steward, who then only has to interact with one individual on all hunting related issues.

Regardless of the type of hunting arrangement that you enter into, one of the most important concerns for most land stewards has to do with liability. Most farmers fear being sued or held liable for injuries sustained by hunters or others while on the land. The degree of farmer liability differs by the status of the visitor or use, with trespassers being afforded the least protection and invited visitors, the most. A qualified lawyer and an insurance agent should be consulted before you enter into any hunting lease agreement or purchase liability insurance.

Additional Resources

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Agroforestry In Action

UNIVERSITY OF MISSOURI CENTER FOR AGROFORESTRY

INTEGRATING AGROFORESTRY PRACTICES FOR WILDLIFE HABITAT

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Agricultural practices and land-use decisions influence wildlife habitat and use by wildlife. Some actions can enhance habitats, while others negatively impact wildlife. Certain land-use practices have resulted in a decrease in the quality and diversity of available wildlife habitat on the farm. For example, more efficient farming practices, larger field sizes and the loss of field borders, such as those provided by windbreaks and brushy fence rows, have generally had a negative impact on habitat.

The agroforestry practices of forest farming, silvopasture, alley cropping, riparian forest buffers and windbreaks involve the deliberate integration of trees, shrubs and grasses with agricultural practices (crops and/or livestock). Benefits include:

- Opportunities for diversified income from value-added or alternative agricultural products
- Opportunities for long-term income, including timber sales
- Improved soil and water quality; reduction in nonpoint source pollution and erosion
- Enhanced wildlife habitat and biodiversity
- Sustained land resources for future generations

Agroforestry practices can be used to provide many benefits to a farm, such as improved water quality, soil stabilization and income opportunities. Agroforestry also can be used to provide diversity to a farm and enhance the potential to provide habitat for a variety of wildlife species.

When agroforestry is applied, the resulting land uses are often able to accommodate the needs of a variety of wildlife species – as well as offering opportunities for shorthand long-term income and environmental sustainability.

Through integrated combinations of trees, shrubs and grasses, agroforestry practices can provide a means to increase the availability of habitat for certain wildlife without sacrificing the potential to achieve a landowner's agronomic and economic goals and objectives.

The University of Missouri Center for Agroforestry, founded in 1996, works to

develop the science of using combinations of agricultural and forestry practices to achieve a more diverse, sustainable agricultural system. This collaborative effort is uncovering new information about the wildlife benefits of agroforestry practices through the use of alley cropping, windbreaks and riparian forest buffers, in addition to the alternative income opportunities the practices can provi

Wildlife habitat is the combination and environmental factors that requires for survival and reproduc includes the composition and struc vegetation on the land and e seasonal variation to that compo structure.

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Center for Agrofo

Read more about creating habitat for white-tailed deer, waterfowl, quail, wild turkey, and mourning dove in our technical guide on agroforestry and wildlife management.

Scan the QR code below or follow this link.

Floodplain restoration efforts for biodiversity and nutrient-density at the Missouri River Center

At a glance: The Missouri River Center (MRC) is a newly established collaborative conservation project in Huntsdale, Missouri. It's key purpose is to serve as a training and demonstration site for agroforestry practices suitable for big river floodplains and other Midwestern landscapes. In April 2022, Larry and Brenda Potterfield donated the 164-acre site to The Nature Conservancy (TNC) in Missouri. Since then, Preserve Engagement Manager Zack Miller, in partnership with the Center for Agroforestry, has led efforts to return this site to tree cover with plantings of native pecans, black walnuts, and other diverse, multifunctional perennials. The site aims to serve as a hub for collaboration and innovation, exploring how intentional ecological design at scale can simultaneously support food production, biodiversity, and community engagement in working landscapes.







Establishment: In October and November of 2024, Stacked Agroforestry, a local agroforestry contractor, led more than 60 volunteers in planting nearly 2,000 trees at the site. This planting included 30 acres of pecans and black walnuts established in an alley cropping system and a 3-acre riparian buffer. The buffer was planted in two blocks, with species selected for (1) timber production and mushroom log harvests and (2) 'honey flow' species that benefit pollinators with long-flowering, nectar-rich varieties.

Design and management: The site has a significant challenge ahead: to keep invasive Johnsongrass at bay, which Zack hopes to accomplish without the use of agricultural chemicals. Similar to attempts to combat bermuda grass at Columbia's Agriculture Park, he plans to chisel plow the Johnsongrass in winter to expose its rhizomes to frost and reseed with cover crops. The grass will also be shaded out through dense plantings and intensive use of multistrata growing space. Because the site will host many visitors of all ages, including children participating in hands-on field trips, it was important to Zack to create a management plan without chemical use that would be safe and accessible for place-based learning and interaction.

> ***"I think it's really important to remember how generous trees are. And if you plant out a farm, it's going to continue to give back to you. What's a nicer gift to pass on to your kids than mature trees that drop nutrition?"***

Since the site is in a floodplain, Zack has opted to avoid installing permanent irrigation. Should the site encounter drought conditions, Zack plans to individually water trees with water pumped from the river. Trees are mulched for both moisture retention and weed management, and protected from wildlife with tree tubes. Future plans for pest and weed management include livestock grazing, mowing before weeds go to seed, and continued dense plantings.

Financial and technical assistance: Zack works closely with the USDA Natural Resources Conservation Service for financial and technical assistance. The site's tree plantings are also supported by the John Deere Foundation. Equipment has been rented from Soil & Water Conservation Districts. Overyield software by Propagate and technical assistance form the Center for Agroforestry team helped Zack estimate costs, select species and cultivars, and determine tree row spacing and design.

Research and demonstration: Initial data collection for soil health, soil carbon, and bird and bat diversity is in progress at the site. This baseline data will help researchers and site managers monitor changes over time. For demonstration and recreational access, MRC will feature a 2.5-mile public trail connected to the Katy Trail and/or a boat ramp to the Missouri River. The site will also be used as an educational space for local environmental non-profit Missouri River Relief, which aims to (re)connect people with the Missouri River. With regards to plans for future harvests, the script has yet to be written. TNC is considering a variety of options that could benefit nearby communities, including a harvest-centered festival, a 'you-pick' pecan harvest, a perennial-focused restaurant on site, and/or potentially leasing out the land to beginning farmers.