

# How to Conserve Biodiversity on the Farm:

## Actions to Take on a Continuum from Simple to Complex



Soil Life

Soil Cover

Water, Nest  
& Shelter  
Features

Flowering  
Plants

Native Plants

Plant  
Structure &  
Composition

Corridors



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# Biodiversity Continuum Chart

This chart lays out a progression of activities that increasingly support biodiversity and the benefits it provides to the farm. Each farm has a unique set of circumstances and will begin at different places in the continuum, depending on its need and capacity for supporting nature. Whether the need is for building better soil health and clean water, ensuring more complete pollination and effective pest control, or enhancing habitat for wildlife, the farm can start with small steps or take big strides to integrate biodiversity.

Agriculture comprises almost 60% of the continental U.S., and 40% of the Earth's landscape. As our population grows and our planet heats up, it is imperative that we take advantage of biodiversity and the benefits it provides. When doing so, the farm will be more resilient to changes in climate that will cause increasing drought and flooding, declining ecological balance of natural predators, and more pests and sterile landscapes. And just as important, the farm is addressing the worldwide biodiversity crisis.

## Extensive Agricultural Benefits

More complex farmscapes have the greatest potential of supporting plants and animals and the benefits they provide. Increased soil microbial diversity improves carbon storage and nitrogen fixation, water retention, and decreases plant pathogens. Extensive plant cover ensures water quality and soil conservation. The more complex the flowering, and especially native habitat with structural and compositional diversity, the more support for beneficial organisms and the quicker they colonize the farm. All help to increase yields and buffer against climate change.

## Broad Ecological Benefits

Clean water, food, shelter and nesting sites for wildlife are increasingly provided by farms moving through this continuum. Habitat of the highest conservation value supports priority species (threatened and endangered species, and keystone species whose small numbers have a large effect on their environment). Linking habitats to and conservation of grasslands, shrublands, woodlands, wetlands, and riparian areas promote long-term prosperity of stable wildlife populations. Meanwhile, carbon is stored in soil via woody debris and in the woody biomass of habitat, helping to reduce greenhouse gas emissions.

## Audience

This biodiversity continuum chart is for growers of all types to use, from a beginning farmer looking to start a direct-market operation, to a seasoned wholesale conventional grower striving to better control pests and diseases. Organic growers, who must conserve biodiversity, can benefit from this tool,<sup>1</sup> as well as organic certifiers who must assess conservation compliance (using steps 1 and 2). This tool is also for conservation planners to assist growers with management plans.

## How to Use this Biodiversity Continuum Chart

- Step 1:** Identify farm management needs for annual and perennial crops and pastures in the Ecological Parameters (Soil Life;<sup>2</sup> Soil Cover;<sup>2</sup> Water, Nest and Shelter Features; Flowering Plants; Native Plants; Plant Structure and Composition; and Corridors). Check the boxes if the activities are currently being used, and check the circles if they are being planned.
- Step 2:** Depending on what was achieved in Step 1, identify management needs for integrating wildlife on the farm (Pollinator Insects; Natural Enemy Insects; Reptiles and Amphibians; Birds; Bats; and Other Wild Mammals). Use check boxes or circles for current or planned projects, respectively.
- Step 3:** Review current and planned activities, making priorities based on the biodiversity goals for the farm.
- Step 4:** Refer to reference materials and other resources when preparing planned activities.
- Step 5:** Implement the plans and monitor the results over time. Make adjustments to management and future plans based on the monitoring.



## Biodiversity

Biological diversity (biodiversity) includes variety in all forms of life, from bacteria and fungi to grasses, ferns, trees, insects and mammals. It encompasses the diversity found at all levels of organization, from genetic differences between individuals and populations (groups of related individuals) to the types of natural communities (groups of interacting species) found in a particular area. Biodiversity also includes the full range of natural processes upon which life depends, such as nutrient cycling, carbon and nitrogen fixation, predation, symbiosis and natural succession.

## Organic Biodiversity Conservation

<sup>1</sup> Not all of the activities presented in this continuum have to be implemented in order for the operation to become or stay organically certified, but there should be continual improvement.

<sup>2</sup> The USDA National Organic Program NOP 5020-1 states that "Certified operations are required to implement measures that support natural resource conservation and biodiversity in addition to maintaining soil or water quality." The Natural Resources and Biodiversity Conservation Guidance NOP 5020 explains this in detail.

## A Note on Complexity

At any of the ecological scales (plot, field, field perimeter or landscape), complexity can be immense and overlapping. Soil life by itself can be very complex at the plot scale. Multi-crops and crop rotations can be complex on a field scale. Sequentially flowering native plant hedgerows bring complexity to the field perimeter scale. Diverse and connected habitat provides complexity at the landscape scale. The complexity presented in this continuum melds all of those ecological scales; whether or not they overlap or may be out of sequence because of their immensity, they add up to complex farm habitat.

## Other Considerations

Some weedy species are host to more pest insects than beneficials, so it can be optimal to plant natives. Before installing non-crop plants, determine whether any are host to pests and diseases of crops grown on the farm. Educate family and farm workers about increased biodiversity, including the fact that new plantings are not weeds.

Learn how activities performed on the farm can take advantage of biodiversity and the benefits it provides. When moving along the continuum from the Simple to the Complex (brown to blue), biodiversity is increased on the farm.

CONTINUUM 	<b>SIMPLE</b> activities to maintain biodiversity	----->	----->	----->	----->	----->	<b>COMPLEX</b> activities to improve biodiversity
ECOLOGICAL PARAMETERS	Soil Life <sup>2</sup>	Soil Cover <sup>2</sup>	Water, Nest & Shelter Features	Flowering Plants	Native Plants	Plant Structure & Composition	Corridors

**Step 1: Start with farm management on this page to assess activities across the continuum that work best for the situation and farm. Check boxes if activities are currently being used, and check circles if they are being planned.**

<b>Farm Management</b>	Support diverse micro- and macro-organisms in the soil, especially near plant roots:	Keep soil covered as much as possible:	Reduce water use:	Use non-invasive, sequentially flowering plants that provide nectar and pollen:	Plant natives to support a wide variety of food, shelter and nesting sites:	Increase structural and compositional diversity with native trees (including snags and downed trees), shrubs, wildflowers, and grasses:	Create native plant corridors, especially along waterways and swales / Support watershed level restoration:
<b>Annual crop</b> 	<input type="checkbox"/> ...by rotating crops, reducing tillage, or using cover crops, manure or compost <input type="radio"/>	<input type="checkbox"/> ...with crops, cover crops or non-invasive plants / Allow non-invasive plants to grow along fences, roadways and in ditches / Use filter strips <input type="radio"/>	<input type="checkbox"/> ...by planting crops appropriate for climate, and increasing soil organic matter and irrigation efficiency <input type="radio"/>	<input type="checkbox"/> ...inter-spersed in crops, or at the ends of crop rows, or by retaining at any time, at least part of one field with a flowering crop or cover crop for each farm location <input type="radio"/>	<input type="checkbox"/> ...in areas at the ends of crop rows, in prairie strips, hedgerows and windbreaks <input type="radio"/>	<input type="checkbox"/> ...in crop perimeters, and in natural areas on the farm (riparian areas, wetlands, grasslands, shrublands and woodlands) <input type="radio"/>	<input type="checkbox"/> ...by connecting farm habitat patches to natural areas on and off the farm <input type="radio"/>
<b>Perennial crop</b> 	<input type="checkbox"/> ...by using cover crops in understory <input type="radio"/>	<input type="checkbox"/> ...with cover crops or with non-invasive plants in understory and along fences, roadways and ditches <input type="radio"/>	<input type="checkbox"/> ...by planting crops appropriate for climate, and increasing soil organic matter and irrigation efficiency <input type="radio"/>	<input type="checkbox"/> ...in understory <input type="radio"/>	<input type="checkbox"/> ...in understory, buffer strips, hedgerows and windbreaks <input type="radio"/>	<input type="checkbox"/> ...in crop perimeters, and in riparian areas, wetlands, grasslands, shrublands and woodlands on the farm <input type="radio"/>	<input type="checkbox"/> ...by connecting farm habitat patches to natural areas on and off the farm <input type="radio"/>
<b>Pasture</b> 	<input type="checkbox"/> ...by managing mixed livestock with different grazing and soil impacts / Conserve natural grasslands <input type="radio"/>	<input type="checkbox"/> ...by rotationally grazing and controlling access to sensitive areas, particularly riparian zones and wetlands <input type="radio"/>	<input type="checkbox"/> ...by planting forage appropriate for climate, and increasing soil organic matter and irrigation efficiency <input type="radio"/>	<input type="checkbox"/> ...inter-spersed in pastures <input type="radio"/>	<input type="checkbox"/> ...inter-spersed in pastures, and in buffer strips, hedgerows and windbreaks <input type="radio"/>	<input type="checkbox"/> ...inter-spersed in pastures, and in riparian areas, wetlands, grasslands, shrublands and woodlands on the farm <input type="radio"/>	<input type="checkbox"/> ...by connecting pastures to natural areas on and off the farm <input type="radio"/>

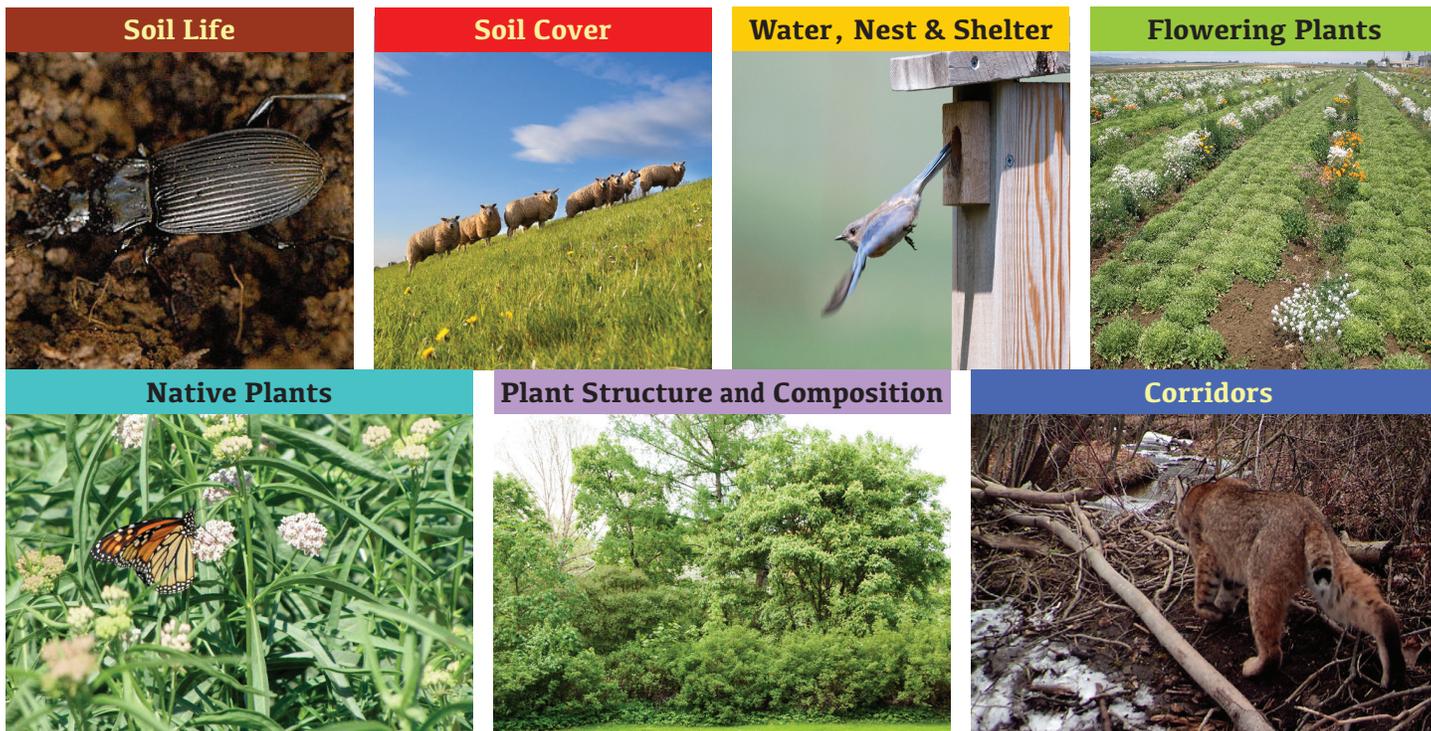
<b>CONTINUUM</b> 	<b>SIMPLE activities to maintain biodiversity</b>				
<b>ECOLOGICAL PARAMETERS</b>	<b>Soil Life<sup>2</sup></b>	<b>Soil Cover<sup>2</sup></b>	<b>Water, Nest and Shelter Features</b>	<b>Flowering Plants</b>	<b>Native Plants</b>

**Step 2: Assess activities to determine which wildlife to support below depending on what was achieved in Step 1 and on what the biodiversity goals are for the farm. Check boxes if the activities are currently being used, and check circles if they are being planned.**

<b>Pollinator Insects</b> 	<input type="checkbox"/> Support ground nesting bees by conserving non-tilled, well-drained areas <input type="radio"/>	<input type="checkbox"/> Support insects by leaving strips of cover crop as refuge / Keep 30% as undisturbed refuge when mowing, burning or haying a grassland or other habitat <input type="radio"/>	<input type="checkbox"/> Support pollinators with puddled water for drinking / Support tunnel nesting bees with bee blocks <input type="radio"/>	<input type="checkbox"/> Support insects with a balanced and extended food supply by including a mix of plants that flower before and after the crop <input type="radio"/>	<input type="checkbox"/> Support a wide variety of native bees, including those species with specialized body parts that can only use native plants <input type="radio"/>
<b>Natural Enemy Insects</b> 	<input type="checkbox"/> Support predatory beetles and other beneficial insects that live in soil by retaining untilled areas <input type="radio"/>	<input type="checkbox"/> Maintain bunch grasses, mulch or leaf litter for insects that live on the ground for some or all their life such as predatory beetles, damsel bugs, and snakeflies <input type="radio"/>	<input type="checkbox"/> Support dragonflies, parasitoid wasps and other beneficials with clean water for laying eggs, nest building, and drinking / Create brush piles <input type="radio"/>	<input type="checkbox"/> Install flowering plants to provide nectar and pollen for natural enemies <input type="radio"/>	<input type="checkbox"/> Support natural enemies with alternate prey found on native plants, when crop pests are not present <input type="radio"/>
<b>Reptiles and Amphibians (herps)</b> 	<input type="checkbox"/> Support herps by retaining untilled areas and rodent burrows <input type="radio"/>	<input type="checkbox"/> Support herps by retaining unmowed areas, and a ground layer refuge of decomposing plant matter, and rock piles <input type="radio"/>	<input type="checkbox"/> Support herps with clean water resources / Create pond <sup>3</sup> planted with non-invasive aquatic species / Create brush piles <input type="radio"/>	<input type="checkbox"/> Conserve grasses and wildflowers along wetlands and streams <input type="radio"/>	<input type="checkbox"/> Support herps by using native plants that generally support more insects as a food source than non-native plants <input type="radio"/>
<b>Birds</b> 	<input type="checkbox"/> Support burrowing owls and ground-foraging birds by retaining untilled areas <input type="radio"/>	<input type="checkbox"/> Support ground-nesting birds with plantings and unmowed areas or mowing only well before or after nesting season / Rotationally graze / Leave un-harvested grain field as a food source <input type="radio"/>	<input type="checkbox"/> Provide a dependable supply of fresh water for drinking, bathing, swimming and nest building / Provide nest boxes, nest platforms, raptor and insectivorous bird perches / Create brush piles <input type="radio"/>	<input type="checkbox"/> Support birds with plants that provide berries and seeds as food sources, especially those high in sugars in the spring and high in fats in the fall / Include red flowers to better attract hummingbirds <input type="radio"/>	<input type="checkbox"/> Support birds with native plants which harbor insects as bird food, along with berries and seeds as other food sources <input type="radio"/>
<b>Bats</b> 	<input type="checkbox"/> Support bats by retaining untilled areas that harbor crickets, beetles and other ground insects <input type="radio"/>	<input type="checkbox"/> Support bats by retaining plant cover which flying insects use <input type="radio"/>	<input type="checkbox"/> Protect bats by using wildlife escape ramps in water troughs / Create a pond <sup>3</sup> / Provide nest boxes on buildings <input type="radio"/>	<input type="checkbox"/> Install flowering plants that support night flying moths <input type="radio"/>	<input type="checkbox"/> Plant native trees (for some, especially in older years) that have loose or exfoliating bark for bat roosting sites <input type="radio"/>
<b>Other Wild Mammals, Including Predators</b> 	<input type="checkbox"/> Support ground insect-eating mammals by retaining untilled areas <input type="radio"/>	<input type="checkbox"/> Support wildlife by using proper grazing management, mowing and haying from the center outward to allow wildlife to escape, and leaving un-harvested grain to provide food and cover during the winter <input type="radio"/>	<input type="checkbox"/> Support wild mammals with clean drinking water by using natural grass and wetland plant filters <input type="radio"/>	<input type="checkbox"/> Support wild mammals with plants that produce berries and seeds <input type="radio"/>	<input type="checkbox"/> Support wild mammals with a diverse habitat that provides food and shelter <input type="radio"/>

<sup>3</sup> Creation of ponds must adhere with local, state and federal regulations.

CONTINUUM 	----->		COMPLEX activities to improve biodiversity	Co-existence	Benefits of Complex Systems	
ECOLOGICAL PARAMETERS	Plant Structure and Composition	Corridors	Managing Increased Diversity	Agricultural Benefits	Ecological Benefits	
<b>Continue to assess and determine which activities to use to support biodiversity. Check boxes if the activities are currently being used, and check circles if they are being planned.</b>						
<b>Pollinator Insects</b> 	<input type="checkbox"/> Support tunnel nesting bees with plants that have stems with hollow or pithy centers, and with snags  <input type="radio"/>	<input type="checkbox"/> Support monarch butterflies by providing linkages, especially when in flyway  <input type="radio"/>	<input type="checkbox"/> Plan any pesticide use so as not to harm pollinators  <input type="radio"/>	35 % of the world's crop production depends on pollinators / Better yields / Increase in honeybee health / Less need for bee hive rentals	75% of flowering plants depend on pollinators, including plants in wildlands / Pollinators are a food source for other organisms	
<b>Natural Enemy Insects</b> 	<input type="checkbox"/> Support predatory beetles, wasps and other beneficial insects by retaining snags and decomposing logs  <input type="radio"/>	<input type="checkbox"/> Support effective pest control with habitat close to crops.  <input type="radio"/>	<input type="checkbox"/> Plan any pesticide use so as not to harm beneficial insects  <input type="radio"/>	Control of pest insects / Increased yields / Aid in decomposition of organic matter / Reduced pesticides	Pest control in wildlands	
<b>Reptiles and Amphibians (herps)</b> 	<input type="checkbox"/> Support herps by retaining snags and downed logs  <input type="radio"/>	<input type="checkbox"/> Support herps by providing safe passage in corridors  <input type="radio"/>	<input type="checkbox"/> Learn difference between venomous and harmless snakes and let them both live / Plan any pesticide use so as not to harm herps  <input type="radio"/>	Pest insect and rodent control	Pest insect and rodent control in wildlands / Corridors support exchange of individuals in a population and increase genetic diversity	
<b>Birds</b> 	<input type="checkbox"/> Provide different food, shelter and nesting niches for birds that use trees (and snags), shrubs, wildflowers, grasses and leaf litter / Enlarge border area between crops and habitat  <input type="radio"/>	<input type="checkbox"/> Support the most birds by providing wide corridors, especially along and around waterways  <input type="radio"/>	<input type="checkbox"/> To discourage pest birds, eliminate their nesting sites on structures, or use falconry / For food safety, monitor raw-eaten crops for significant bird damage and feces / Plan any pesticide use to not harm birds  <input type="radio"/>	Reduction of weed seeds, pest insects and rodents	Pest insect and rodent control in wildlands / Agents of pollen and seed dispersal	
<b>Bats</b> 	<input type="checkbox"/> Retain a continuous supply of snags of different sizes and ages through time for bat roosting sites  <input type="radio"/>	<input type="checkbox"/> In bat migration corridors of Southwestern U.S. deserts, provide native flowering succulent plants  <input type="radio"/>	<input type="checkbox"/> Learn about the science of bats and rabies / Plan any pesticide use so as not to harm bats  <input type="radio"/>	Pest insect control / In the Southwest, pollination of agave for tequila / In the tropics, pollination and seed dispersal of various plants	Pest control, pollination and seed dispersal of cactus and agave in wildlands	
<b>Other Wild Mammals, Including Predators</b> 	<input type="checkbox"/> Support many species of wild mammals with food and shelter for denning, fawning, loafing and escaping from predators and adverse weather / Conserve, plant or, depending on the site, allow habitat to recolonize naturally.  <input type="radio"/>	<input type="checkbox"/> Support wide ranging mammals by allowing access through the farm some or all the time, using wildlife friendly fencing  <input type="radio"/>	<input type="checkbox"/> Use non-lethal pest and predator management such as guard dogs and bringing in vulnerable animals at night, and encourage natural wild predator-prey relationships (prevent livestock as prey) / For food safety, monitor crops humans eat raw for significant damage and feces / Ensure any pesticides used do not harm mammals  <input type="radio"/>	Pest insect and rodent control / Reduction of disease spread by wildlife when they use healthy, uncontaminated habitat	Pest insect and rodent control in wildlands / Corridors reduce genetic bottlenecks from habitat fragmentation / Top carnivores prevent overgrazing and over browsing of natural vegetation	



## Reference Materials

### Soils, Plants, Habitats and Corridors

USDA NRCS Food Web and Soil Health <http://1.usa.gov/27dU4py>  
 Controlling Soil Erosion. USDA NRCS. <http://1.usa.gov/1WpufPI>  
 Bringing Nature Home: How You Can Sustain Wildlife with Native Plants. Tallamy. 2009.  
 Michigan State: Native Plants and Ecosystem Services <http://nativeplants.msu.edu/>  
 Native Plants and Ecofriendly Landscaping. USDA NAL. <http://1.usa.gov/1TEWZ0n>  
 Yardmap: A Citizen Science Project Transforming Landscapes. Cornell University. [Yardmap.org](http://Yardmap.org)  
 Bring Birds Back: A Guide to Habitat Enhancement. CALPIF and PROBO. [bit.ly/1suZex8](http://bit.ly/1suZex8)  
 Conservation Buffers: Design Guidelines for Buffers, Corridors, and Greenways Bentrup. 2008. <http://nac.unl.edu/buffers/index.html>

### Wildlife

Attracting Native Pollinators. Mader et al. 2011. Xerces Society.  
 Conservation Biological Control Resource Center. Xerces Society. <http://www.xerces.org/cbc/>  
 Farming with Native Beneficial Insects. Mader et al. 2014. Xerces Society.  
 Insect Identification for the Casual Observer. [InsectIdentification.org](http://InsectIdentification.org)

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Photo credits. Front cover: N. Lounsbury, bumblebees on phacelia cover crop; p. 2: J. Baumgartner, bumble bee; Back cover: J. Lindsey at Ecology of Commanster, predatory beetle; K. Cole, bluebird leaving nest box; S. Earnshaw, flowers in endive crop; J. Anderson, monarch on asclepias; J. Davis, bobcat in Bobolink Farm

This chart is based on a concept presented in Kremen et al. 2012, and on research conducted by Amber Sciligo and Claire Kremen, UC Berkeley.

Merlin Bird ID App (free) <http://merlin.allaboutbirds.org>  
 The Bathouse Builder's Handbook. Tuttle et al. 2013. Bat Conservation International. <http://bit.ly/1QYKyed>  
 Fish and Wildlife Habitat Leaflets. Wildlife Habitat Council & NRCS. <http://1.usa.gov/27h3As4>  
 Living with Wildlife Fact Sheets. Washington State Department of Fish and Wildlife. <http://wdfw.wa.gov/living/>  
 The Internet Center for Wildlife Damage Management. <http://icwdm.org/>

### Diversified /Organic Farming Systems

Diversified Farming Systems: An Agroecological, Systems-based Alternative to Modern Industrial Agriculture. Kremen et al. 2012. <http://bit.ly/21WEsmH>  
 Guidance: Natural Resources and Biodiversity Conservation. NOP 5020. <http://1.usa.gov/1rWogON>  
 Response to Comments: Natural Resources and Biodiversity Conservation. NOP 5020-1. <http://bit.ly/1XlunPG>  
 Healthy Farm Index. The Organic Center. <http://bit.ly/1Tqu9DS>  
 Biodiversity Conservation: An Organic Farmer's and Certifier's Guide. Wild Farm Alliance. Summer 2016. [www.wildfarmalliance.org/](http://www.wildfarmalliance.org/)

### Empowering Farmers, Connecting Consumers, Protecting Wild Nature

Since 2000, Wild Farm Alliance has educated farmers about on-farm biodiversity conservation, assisted them with its practical implementation, and initiated policies that support farm stewardship.

Our mission is to promote a healthy, viable agriculture that protects and restores wild nature. Our work is centered on engaging and empowering those involved in the food and farming movement, including everyone from farmers to consumers.

We involve people at all levels in actions that produce real change - be that through community based activism, or simply by identifying and implementing individual solutions that increase biodiversity on the farm and on their plates.



Learn more and get involved:  
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