



# Sustainable Agriculture: An Introduction

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Photo courtesy USDA NRCS

## What is Sustainable Agriculture?

Sustainable agriculture is one that produces abundant food without depleting the earth's resources or polluting its environment. It is agriculture that follows the principles of nature to develop systems for raising crops and livestock that are, like nature, self-sustaining. Sustainable agriculture is also the agriculture of social values, one whose success is indistinguishable from vibrant rural communities, rich lives for families on the farms, and wholesome food for everyone. But in the first decade of the 21st Century, sustainable agriculture, as a set of commonly accepted practices or a model farm economy, is still in its infancy—more than an idea, but only just.

Although sustainability in agriculture is tied to broader issues of the global economy, declining petroleum reserves, and domestic

food security, its midwives were not government policy makers but small farmers, environmentalists, and a persistent cadre of agricultural scientists. These people saw the devastation that late 20th-Century farming was causing to the very means of agricultural production—the water and soil—and so began a search for better ways to farm, an exploration that continues to this day.

Conventional 20th-Century agriculture took industrial production as its model, and vertically-integrated agri-business was the result. The industrial approach, coupled with substantial government subsidies, made food abundant and cheap in the United States. But farms are biological systems, not mechanical ones, and they exist in a social context in ways that manufacturing plants do not. Through its emphasis on high production, the industrial model has degraded soil and water, reduced the biodiversity that is a key element to food security, increased our dependence

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on imported oil, and driven more and more acres into the hands of fewer and fewer “farmers,” crippling rural communities.

In recent decades, sustainable farmers and researchers around the world have responded to the extractive industrial model with ecology-based approaches, variously called natural, organic, low-input, alternative, regenerative, holistic, Biodynamic, biointensive, and biological farming systems. All of them, representing thousands of farms, have contributed to our understanding of what sustainable systems are, and each of them shares a vision of “farming with nature,” an agroecology that promotes biodiversity, recycles plant nutrients, protects soil from erosion, conserves and protects water, uses minimum tillage, and integrates crop and livestock enterprises on the farm.

But no matter how elegant the system or how accomplished the farmer, no agriculture is sustainable if it’s not also profitable, able to provide a healthy family income and a good quality of life. Sustainable practices lend themselves to smaller, family-scale farms. These farms, in turn, tend to find their best niches in local markets, within local food systems, often selling directly to consumers. As alternatives to industrial agriculture evolve, so must their markets and the farmers who serve them. Creating and serving new markets remains one of the key challenges for sustainable agriculture.

## How Do We Achieve Sustainability?

Farmers and other agricultural thinkers have established a strong set of guiding principles for sustainability, based on stewardship and economic justice. Producers and researchers are annually increasing the pace of improvements in agro-ecology systems, making them more efficient and profitable. More Cooperative Extension offices and colleges of agriculture are endorsing sustainable practices. And every year more farmers are seeing the wisdom and rewards—both economic and personal—in these systems. (Organic products are the fastest growing grocery segment in the United States.) Little by little—one crop,

one field, one family at a time—sustainable farming is taking root.

Off the farm, consumers and grassroots activists are working to create local markets and farm policies that support sustainable practices. They are working to raise consumers’ awareness about how their food is grown and processed—how plants, animals, the soil, and the water are treated. And they are working to forge stronger bonds between producers and consumers that will, in time, cement the foundations of locally and regionally self-sufficient food systems. In contrast to monocropped industrial megafarms that ship

*Jam processed on-farm is one example of a value-added product. Photo by Nathalie Dulex.*



throughout the world, the vision of sustainable agriculture’s futurists is small to mid-size diversified farms supplying the *majority* of their region’s food. (No one in Idaho has to give up orange juice, and there will still be cranberries in California for Thanksgiving.)

Listed below are some of the key considerations for making a farm more sustainable, along with relevant ATTRA publications in those areas. Because each farm is different, there’s no single formula for sustainable success, but these principles and publications are good places to begin learning what

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it will take. And for a more detailed look at some of these same fundamentals, see the ATTRA publication *Applying the Principles of Sustainable Agriculture*.

## Know Your Markets, Protect Your Profits, and Add Value to Your Products

- Diversify enterprises.
- Market outside the commodity supply chains and corporate vertical integrators.
- Emphasize direct marketing and premium specialty markets.
- Consider forming a cooperative with other farmers.
- Add value through on-farm processing.

- 🌱 *Holistic Management*
- 🌱 *Evaluating a Rural Enterprise*
- 🌱 *Moving Beyond Conventional Cash Cropping*
- 🌱 *Entertainment Farming and Agri-Tourism*
- 🌱 *Agricultural Business Planning Templates*
- 🌱 *Enterprise Budgets and Production Costs for Organic Production*
- 🌱 *Preparing for an Organic Inspection: Steps and Checklists*
- 🌱 *Direct Marketing*
- 🌱 *Farmers' Markets*
- 🌱 *CSA (Community Supported Agriculture)*
- 🌱 *Bringing Local Food to Local Institutions*
- 🌱 *Selling to Restaurants*
- 🌱 *Organic Certification and the National Organic Program*
- 🌱 *Organic Marketing Resources*
- 🌱 *Alternative Meat Marketing*



- 🌱 *USDA-RBS Series on Cooperatives*
- 🌱 *Keys to Success in Value-added Agriculture*
- 🌱 *Adding Value to Farm Products: An Overview*
- 🌱 *Grain Processing*
- 🌱 *Oilseed Processing for Small Producers*
- 🌱 *Food Dehydration Options*
- 🌱 *Soyfoods: Adding Value to Soybeans*
- 🌱 *Sorghum Syrup*
- 🌱 *Value-added Dairy Options*

*Fresh peaches at a farmers market in California. Photo by Erik Dungan.*

## Build Soil Structure and Fertility

- Reduce the use of synthetic fertilizers by increasing on-farm nutrient cycling.
  - Make fertilization decisions based on soil tests.
  - Minimize or eliminate tillage.
  - Think of the soil not only as a physical and chemical substrate but as a living entity; manage the soil organisms to preserve their healthy diversity.
  - Maintain ground cover year-round by using cover crops and mulches and by leaving crop residues in the field.
- 🌱 *Sustainable Soil Management*
  - 🌱 *Drought Resistant Soil*
  - 🌱 *Nutrient Cycling in Pastures*
  - 🌱 *Manures for Organic Crop Production*

*No-till soybeans growing through wheat stubble in Kansas. Photo courtesy USDA NRCS.*



Streams without conservation buffers run higher risks of streambank erosion, contamination with farm chemicals, and sedimentation, as well as offer no habitat for wildlife. Photo by Lynn Betts, USDA NRCS.

- 🌱 Overview of Cover Crops and Green Manures
- 🌱 Overview of Organic Crop Production
- 🌱 Farm-scale Composting Resource List
- 🌱 Conservation Tillage
- 🌱 Pursuing Conservation Tillage Systems for Organic Crop Production
- 🌱 Assessing the Pasture Soil Resource
- 🌱 Alternative Soil Testing Laboratories
- 🌱 Alternative Soil Amendments
- 🌱 Sources of Organic Fertilizers and Amendments

## Protect Water Quality on and Beyond the Farm

- Use soil-building practices that increase soil organic matter and support a biologically active humus complex.
- Use soil conservation practices that reduce the potential for water runoff and erosion.
- Plant perennial crops such as forages, trees, and shrubs.
- Plant catch crops or cover crops to take up nutrients that may otherwise leach into the subsoil.
- Provide buffer areas between fields and water bodies to protect against nutrient

Lady beetles look for aphids on a fava bean leaf. Scientists think the beetles might help in controlling Russian wheat aphids that now infest 17 Great Plains and Western states. Photo by Scott Bauer, USDA ARS.

and sediment movement into lakes and streams.

- Manage irrigation to enhance nutrient uptake and decrease nutrient leaching.
- Produce livestock in pasture-based systems.

- 🌱 Nutrient Cycling in Pastures
- 🌱 Protecting Water Quality on Organic Farms
- 🌱 Protecting Riparian Areas
- 🌱 Managed Grazing in Riparian Areas
- 🌱 Conservation Easements
- 🌱 Montana Irrigator's Pocket Guide
- 🌱 Constructed Wetlands
- 🌱 Conservation Tillage
- 🌱 Sustainable Soil Management
- 🌱 Drought Resistant Soil
- 🌱 Sustainable Pasture Management
- 🌱 Agroforestry Overview

## Manage Pests Ecologically; Use Minimal Pesticides

- Prevent pest problems by building healthy, biologically active soil; by creating habitat for beneficial organisms; and by choosing appropriate plant cultivars.
- View the farm as a component of an ecosystem, and take actions to restore and enhance pest-predator balances. Understand that the mere presence of a pest does not necessarily constitute a problem; base any intervention on monitoring



(crop scouting) and economic damage thresholds.

- Before intervening with a chemical, positively identify the pest species and learn about its life cycle and ecology. Implement cultural practices that alter the cropping system and surrounding habitat to make life more difficult for the pest and easier for its natural enemies.
- Use pesticides as the last resort, when biological and cultural controls have failed to keep pest populations below economically damaging levels. If you have to use chemicals, seek out the least-toxic pesticide that will control the pest.

🌱 *Biointensive Integrated Pest Management*

🌱 *Farmscaping to Enhance Biological Control*

🌱 *Sustainable Management of Soil-borne Plant Diseases*

🌱 *Integrated Pest Management for Greenhouse Crops*

🌱 *Principles of Sustainable Weed Management*

🌱 *Integrated Parasite Management for Livestock*

🌱 *A Whole Farm Approach to Managing Pests (SAN publication)*

## Maximize Biodiversity on the Farm

- Integrate crop and livestock production.
- Use hedgerows, insectary plants, cover crops, and water reservoirs to attract and support populations of beneficial insects, bats, and birds.
- Abandon monocropping in favor of crop rotations, intercropping, and companion planting.
- Plant a percentage of your land in trees and other perennial crops in permanent plantings or long-term rotations.
- Manage pastures to support a diverse selection of forage plants.
- Plant off-season cover crops.

🌱 *Farmscaping to Enhance Biological Control*

🌱 *Intercropping Principles and Production Practices*

🌱 *Companion Planting: Basic Concepts and Resources*

🌱 *Converting Cropland to Perennial Grassland*

🌱 *Sustainable Pasture Management*

🌱 *Multispecies Grazing*

🌱 *Agroforestry Overview*

🌱 *Woodlot Enterprises*

**A**s alternatives to industrial agriculture evolve, so must their markets and the farmers who serve them.



Ewes and lambs on pasture in Linn County, Oregon. Photo by Ron Nichols, USDA NRCS.

## How Can I Learn More About Sustainable Agriculture?

There is a wealth of historical, philosophical, scientific, practical, and policy-oriented writing on sustainable agriculture. The following list of books and Web sites is offered as a starting point.

### *Print Resources:*

AFSIC Staff and Volunteer (eds.). 1997 and 2001. Sustainable Agriculture in Print: Current Books. Special Reference Briefs Series no. SRB 97-05. Alternative Farming Systems Information Center. National Agriculture Library, Beltsville, Maryland.

[www.nal.usda.gov/afsic/AFSIC\\_pubs/srb97-05.htm](http://www.nal.usda.gov/afsic/AFSIC_pubs/srb97-05.htm) and [www.nal.usda.gov/afsic/AFSIC\\_pubs/srb9705u.htm](http://www.nal.usda.gov/afsic/AFSIC_pubs/srb9705u.htm)

For printed copies contact:

Alternative Farming Systems Information Center  
USDA, ARS, NAL, AFSIC  
10301 Baltimore Ave.  
Beltsville, MD 20705-2351  
301-504-6422  
[afsic@nal.usda.gov](mailto:afsic@nal.usda.gov)



Berry, Wendell. 1996. *The Unsettling of America: Culture and Agriculture*. 3rd edition. University of California Press, Davis. 256 p.

Bird, Elizabeth Ann R., Gordon L. Bultena, and John C. Gardner (eds.) 1995. *Planting the Future: Developing an Agriculture that Sustains Land and Community*. Iowa State University Press, Ames, IA. 276 p.

Horne, James E. and Maura McDermott. 2001. *The Next Green Revolution: Essential Steps to a Healthy, Sustainable Agriculture*. Food Products Press, an imprint of The Haworth Press, Binghamton, NY. 312 p.

Jackson, Wes. 1985. *New Roots for Agriculture*. 2nd edition. University of Nebraska Press, Lincoln, NE. 150 p.

Sustainable Agriculture Network. 2002. Resources from the Sustainable Agriculture Network. Sustainable Agriculture Research and Education (SARE) Program. Sustainable Agriculture Publications, 210 UVM, Hills Building, Burlington, VT 05405-0082.  
[www.sare.org/htdocs/pubs/](http://www.sare.org/htdocs/pubs/)

### *Selected Web Sites:*

(for more go to [www.attra.ncat.org/fundamental.html](http://www.attra.ncat.org/fundamental.html))

Agroecology: principles and strategies for designing sustainable farming systems  
[www.CNR.Berkeley.EDU/%7Eagroeco3/principles\\_and\\_strategies.html](http://www.CNR.Berkeley.EDU/%7Eagroeco3/principles_and_strategies.html)

Alternative Farming Systems Information Center  
[www.nal.usda.gov/afsic](http://www.nal.usda.gov/afsic)

Sustainable Agriculture: Definitions and Terms  
[www.nal.usda.gov/afsic/AFSIC\\_pubs/srb9902.htm](http://www.nal.usda.gov/afsic/AFSIC_pubs/srb9902.htm)

ATTRA—National Sustainable Agriculture Information Service  
[www.attra.ncat.org](http://www.attra.ncat.org)

Center for Applied Rural Innovation (Nebraska)  
<http://cari.unl.edu/sustainable.html>

Center for Rural Affairs  
[www.cfra.org/](http://www.cfra.org/)

Community Alliance with Family Farmers (California)  
[www.caff.org/](http://www.caff.org/)

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*A small dairy farm in Maryland. Photo by Scott Bauer, USDA ARS.*

Future Horizons: Recent Literature in Sustainable Agriculture

<http://ianrwww.unl.edu/ianr/csas/extvol6.htm>

John Ikerd's Series of Papers on Sustainable Agriculture

[www.ssu.missouri.edu/faculty/jikerd/papers/default.htm](http://www.ssu.missouri.edu/faculty/jikerd/papers/default.htm)

Land Stewardship Project

[www.landstewardshipproject.org/](http://www.landstewardshipproject.org/)

Leopold Center for Sustainable Agriculture

[www.leopold.iastate.edu](http://www.leopold.iastate.edu)

Minnesota Institute for Sustainable Agriculture

[www.misa.umn.edu/](http://www.misa.umn.edu/)

Missouri Alternatives Center

<http://agebb.missouri.edu/mac/>

National Campaign for Sustainable Agriculture

[www.sustainableagriculture.net](http://www.sustainableagriculture.net)

Sustainable Agriculture Network

[www.sare.org](http://www.sare.org)

The New American Farmer: Profiles of Agricultural Innovation

[www.sare.org/publications/naf/naf.pdf](http://www.sare.org/publications/naf/naf.pdf)

Sustainable Farming Connection

<http://sunsite.unc.edu/farming-connection/>

Sustainable Communities Network

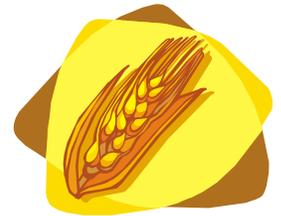
<http://sustainable.org/economy/agriculture.html>

University of California Sustainable Agriculture Research and Education Program

[www.sarep.ucdavis.edu/](http://www.sarep.ucdavis.edu/)

## Notes

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[www.attra.ncat.org/attra-pub/PDF/sustagintro.pdf](http://www.attra.ncat.org/attra-pub/PDF/sustagintro.pdf)

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