Sustainable Agriculture: An Introduction

Sustainable Agriculture Planner that helps farmers plan crop rotations and practices to improve soil health.

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Photo courtesy USDA NRCS

Contents

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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

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 agro-ecology 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.

Little by little—one crop, one field, one family at a time—sustainable farming is taking root.

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 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.)

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

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

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

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

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

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 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

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.

(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

As 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 and *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

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

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/*

Selected Web Sites:

(for more go to *www.attra.ncat.org/fundamental.html*)

Agroecology: principles and strategies for designing sustainable farming systems
www.CNR.Berkeley.EDU/%7Eagroeco3/principles_and_strategies.html

Alternative Farming Systems Information Center
www.nal.usda.gov/afsic

Sustainable Agriculture: Definitions and Terms
www.nal.usda.gov/afsic/AFSIC_pubs/srb9902.htm

ATTRA—National Sustainable Agriculture Information Service
www.attra.ncat.org

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

Center for Rural Affairs
www.cfra.org/

Community Alliance with Family Farmers (California)
www.caff.org/

Conclusion:

In our pursuit of promoting sustainable agriculture and aiding farmers in their efforts to improve soil health, we have developed a comprehensive and multifaceted platform. Through diligent research and collaboration with experts, we have strived to provide farmers with the tools, knowledge, and resources they need to make informed decisions and implement sustainable farming practices.

Summarized Outcome of Our Work:

Crop Rotation Planner: We have developed an interactive tool that empowers farmers to plan crop rotations tailored to their specific needs, crop varieties, growth cycles, and soil health considerations. This tool aims to optimize crop yields while preserving and enhancing soil quality.

Soil Health Assessment: Our platform offers resources and guides for farmers to assess the health of their soil. It includes valuable information on soil testing, interpretation of results, and recommendations for soil amendments to enhance fertility and structure.

Crop Information Database: We have curated a comprehensive database of various crops, providing essential information on planting, growing, and harvesting each crop. This resource offers insights into soil preferences, nutrient requirements, and effective pest management strategies.

Sustainable Farming Practices Library: Our extensive library comprises articles, videos, and tutorials that delve into sustainable farming practices, such as no-till farming, cover cropping, organic methods, and integrated pest management. These resources serve as guides for adopting eco-friendly and profitable farming techniques.

Crop Calendar: Our customizable calendar assists farmers in planning optimal planting and harvesting dates based on their geographical location and crop preferences. It takes into account critical factors that affect crop success, such as weather conditions and local climate.

Weather and Climate Data: Our integration of weather and climate data helps farmers make informed decisions regarding planting, irrigation, and pest control. This feature aids in adapting farming practices to changing environmental conditions.

Community Forum: We have established a platform for farmers to connect, share experiences, and seek advice related to sustainable agriculture and soil health. This vibrant community fosters knowledge exchange and mutual support.

Resource Links: We provide links to valuable resources from government agencies, agricultural universities, and non-profit organizations, offering farmers additional support and information to advance their sustainable farming endeavors.

Case Studies and Success Stories: We share inspiring real-life examples of farmers who have successfully enhanced soil health and crop yields through sustainable practices. These stories serve as motivation and practical guidance.

In summary, our Sustainable Agriculture Planner website is a holistic resource hub designed to empower farmers with the knowledge, tools, and community support needed to make informed decisions and implement sustainable farming practices. Together, we aim to cultivate healthier soils, bountiful harvests, and a more sustainable future for agriculture.

Contribution of current work in sustainable development goal(s):

My project, the Sustainable Agriculture Planner that assists farmers in planning crop rotations and sustainable farming practices to enhance soil health, aligns with several Sustainable Development Goals (SDGs). Here's how your work contributes to these goals:

SDG 2: Zero Hunger: Your Sustainable Agriculture Planner helps farmers optimize their crop rotations, leading to increased crop yields and reduced soil degradation. This contributes to the goal of ensuring food security, improving nutrition, and promoting sustainable agriculture.

SDG 15: Life on Land: By promoting sustainable farming practices and soil health improvement, your project directly addresses this goal. Healthy soil ecosystems contribute to biodiversity preservation and sustainable land management.

SDG 9: Industry, Innovation, and Infrastructure: The development and deployment of your Sustainable Agriculture Planner represent innovation in agricultural technology and infrastructure, making farming more efficient and sustainable.

SDG 6: Clean Water and Sanitation: Sustainable agriculture practices, like those promoted by your planner, reduce the use of harmful chemicals and pesticides, which can contribute to the protection of water resources and the promotion of clean water access.

SDG 13: Climate Action: Sustainable agriculture practices, such as those supported by your planner, play a crucial role in mitigating climate change. Healthier soils sequester more carbon and reduce greenhouse gas emissions, contributing to climate resilience.

SDG 12: Responsible Consumption and Production: Your tool encourages responsible production in agriculture by optimizing resource use, reducing waste, and promoting sustainable farming practices, thus contributing to more responsible consumption patterns.

In summary, your Sustainable Agriculture Planner is a valuable tool that contributes to multiple SDGs by promoting sustainable farming practices, improving soil health, reducing environmental impact, and supporting the livelihoods of farmers. It aligns with the global agenda for sustainable development in agriculture and land management.

References:

Future Horizons: Recent Literature in Sustainable Agriculture
http://ianrwww.unl.edu/ianr/csas/extvol6.html

John Ikerd's Series of Papers on Sustainable Agriculture
www.ssu.missouri.edu/faculty/Jikerd/papers/default.htm

Land Stewardship Project
www.landstewardshipproject.org/

Leopold Center for Sustainable Agriculture
www.leopold.iastate.edu

Minnesota Institute for Sustainable Agriculture
www.misa.umn.edu/

Missouri Alternatives Center
http://agebb.missouri.edu/mac/

National Campaign for Sustainable Agriculture
www.sustainableagriculture.net

Sustainable Agriculture Network
www.sare.org

The New American Farmer: Profiles of Agricultural Innovation
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/

Notes