Science-Based Organic Farming 2010: Toward Local and Secure Food Systems

Shannon Moncure and Charles Francis
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University of Nebraska – Lincoln
Extension Division
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Editors' Introduction

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Organic farming includes growing food and fiber — animals, agronomic crops, horticultural fruits and vegetables, related products — as one dynamic and rapidly evolving component of our complex U.S. food system. Even as more farmers are moving toward organic certification and participation in an environmentally sound and economically lucrative market, questions arise about the long-term social impacts and sustainability of a set of practices that has gone from a movement to an industry. Consolidations in the organic trade have brought multinational corporations to the table, changing the nature of a grassroots activity that has grown by 20% per year for the past two decades: in the U.S. alone, this segment of the food system reached nearly $23 billion in 2008 sales:
http://www.organicnewsroom.com/2009/05/us_organic_sales_grow_by_a_who.html

The quest is broadening in our search for ***local and secure food systems***. Beyond the threats of terrorism, insecurity of long supply lines, and dependence of a global food chain on inexpensive fossil fuels, there is growing concern about how food can be produced locally. This implies local ownership and management, use of foods that are in season, promotion of closed materials cycles, and distribution of benefits from the food system in ways that the current organic certification system cannot assure. In this set of resource materials for 2010, we present organic farming in the context of family operations, environmental soundness, and social accountability.

Why do farmers convert to organic production, and what is its future? Why are local food security and connecting people to their food supply important? Are these idealistic questions that have no connection to "science-based organic farming," or do they help open a rich and productive discussion about the future of our food system?

Here we present publications and online materials about production practices for organic crops and animals, about processing and marketing, and about the certification process. But we also open the debate about the future of organic farming, and what alternatives might enhance the future of family farming and locally secure food systems. There is a fine line between education and advocacy, and we attempt at every turn to identify what is established through science and where opinion enters in. The idea that science is value-free is a myth; we introduce ethics, philosophy, and social values into this discussion to provoke further discussion and hopefully promote progress in establishing a long-term, sustainable, and equitable food system.

Why organic farming, and why local food security?

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Farmers convert to organic production for a variety of reasons. In a 20-year-old survey that was published in New Farm magazine, readers reported that personal health and safety, economic returns, and production of clean and safe food products were their principal motivations for conversion to organic methods of production.

One key strategy to achieve economic success and to add value to the land and other natural resources is to create a niche for products, as compared to producing a huge quantity of low-value commodity crops. Organic farming and direct marketing can help producers succeed in this new direction, if they are motivated to take some risks and explore new and creative ideas. If farmers also have a philosophy of eliminating purchased chemical fertilizers and pesticides, then there is a congruence of goals that may make this a profitable and sustainable alternative.

Food security concerns are just part of our nation's overall concerns in today's climate of international uncertainty. Can we depend on a global marketplace for all our needs and wants? One can conceive of doing without a T-shirt made in China or a laptop computer from Viet Nam, but not of doing without food – wherever that is produced. In the current political climate, the dominant focus of discussions on food security centers around maintaining international stability, fostering even more trade agreements, and protecting the dominance of global multinational corporations in the commodity and food trade business.

We propose that a more sustainable and less costly approach is to focus on development of local food initiatives and systems. Although this would require a change in mentality and food habits and move us away from often frivolous *wants* to concentrate more on basic *needs*, there are obvious benefits to a system that depends on local food production, processing and marketing and a strengthening of family farms – and families – at the same time. For instance, money spent for local foods can provide an impetus for rural community development and viability. In this resource guide, we look beyond organic food to consider the alternatives available through local food systems.

What is organic farming?

Simply put, certified organic farming is production of crops and animals relying on methods like crop rotation, integration of livestock and field crops, composting and other non-chemical means. The use of chemical fertilizers or pesticides, and transgenic plant or animal species, is not allowed if one wishes to be certified organic. Increasing consumer concern about where and how food is produced is one of the factors pushing us toward organic and local food. People want to be assured access to safe and healthy food products. There is interest and concern about food security, and discussion about the merits of a local food system as compared to the vulnerable globalized marketplace. These are all dimensions of organic farming.

In Nebraska we have a growing store of information for farmers seeking recommendations on organic farming practices and systems design. Most of the relevant information resides in farmers in the organic farming community, and we recognize the value of indigenous experience and of efforts to locate and promote use

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of appropriate technologies and practices tested on the farm. In addition to those of farmers, we have collected recommendations from Iowa and other nearby states, as well as from the National Sustainable Agriculture Information System (funded by the U.S. Department of Agriculture) and other national sources. One key site is the home of the National Sustainable Agriculture Information Service, or ATTRA.
http://www.attra.org/

In a global context, there is much more information available from Europe, since there is wide appreciation of organic farming in many European countries, as well as higher demand for organic products. A key source to access the technical literature from Europe and elsewhere in the world is the set of Organic E-prints that is available online:
http://www.orgprints.org/

One of the most comprehensive sites providing a window on European organic agriculture is the home page of FiBL [Forschungsinstitut für biologischen Landbau], the Research Institute of Organic Agriculture located in Switzerland. They provide current statistics about the amount of organic production in each country, the trends and changes that vary from one country to another, and a general resource for quick access to organic farming information, especially in Europe:
http://www.fibl.org/en/homepage.html

This collection of resources and references on organic farming is intended to help educators and specialists in Extension and other organizations to become better prepared to answer clients' questions. It is also designed as a primer for farmers interested in organic farming, so they can become acquainted with the regulations and practices necessary for certification, and design an efficient organic farming operation. We recognize both the importance of science and the value of farmer experience in bringing the best information possible into this resource database. Often the experience comes first, followed by research to validate the practical results in the field or to study the mechanisms of crop growth and response to different systems. This information can be used to design future organic systems. One site making the connection between producer knowledge and scientific study is the University of Nebraska Extension's Organic Working Group:
http://organic.unl.edu/

A common approach in making changes in farming is to increase efficiency by reducing inputs – thereby saving costs – or to substitute a crop or another type of input for what is currently used. Many farmers approach organic farming using the same monoculture model that has led to dominance of four major crops and two livestock species in Nebraska, with the end result little different from today's conventional, industrial agriculture. But a successful family farm with limited acres and resources should not necessarily look like a smaller version of a large industrial farm. Rather we should consider new models, and organic farming systems provide one alternative.

Organic farming is a complex challenge but a promising option for Nebraska farmers seeking additional income through adding value to their natural resources on the farm. In addition to the vagaries of weather and uncertain markets that face all farmers, organic production and marketing adds another series of requirements that

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must be met in order to be officially certified. The National Organic Program (NOP, since 2002) introduces some uniformity to these requirements and provides the basis for standards discussed in this handbook:
http://www.ams.usda.gov/nop/indexIE.htm

Myths about organic farming

To understand what organic farming is, perhaps it is useful to understand what it is not. Several common myths are powerful concepts that often pervade the coffee shop conversation and may abound in the mainstream of agricultural publications. Here we present a few of the myths along with the current realities of organic farming.

Myth #1: Organic farmers use no inputs.

Reality: Those who practice organic farming methods use inputs, but they are qualitatively different from conventional farming. There are no chemical fertilizers or pesticides, and no GMOs allowed in organic farming -- non-chemical inputs and methods are substituted for what is used in conventional farming systems.

Myth #2: Organic crop yields are always less than conventional.

Reality: Lower crop yields may be encountered during the transition from conventional to organic production, but many organic crop producers with experience have yields at least as high as, and often above, county averages. There is a learning curve for any drastically different method of farming (see Economics section for relevant statistics).

Myth #3: Organic farms are mostly small vegetable operations, not real farms.

Reality: There are numerous specialized smaller farms growing vegetables, but field crop and livestock operations can also be certified organic. In North Dakota, for example, Fred Kirschenmann and his family farm 3,500 acres organically. In Sweden, the average organic farm is about twice the size of the average conventional farm.

Myth #4: Products from organic farms must receive a premium for this to be profitable.

Reality: Although most organic products are marketed through special channels and do receive a premium, some go to local or direct markets with or without premiums. The additional income may be needed to offset higher production costs, especially labor. Some organic operations save enough on input costs to make them competitive even without price premiums for products.

Myth #5: You must certify the whole farm, not just one field.

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Reality: Most organic farmers start by certifying a small part of their farms, and often certify additional acres as organic later as they become more familiar with the systems and markets.

Myth #6: Organic farming is only for the counter-culture folks, not real farmers.

Reality: Most organic farmers are mainstream people who are in search of a way to produce pesticide-free food and add value to their land and other natural resources. They are seeking new and creative marketing approaches that keep value of the products on their farms and in the local communities.

[adapted from: Sustainable agriculture: myths and realities. C.A. Francis. 1990. Journal of Sustainable Agriculture. Volume 1, pages 97-106]

Relationship to sustainable agriculture & agroecology

There has been substantial attention to the search for sustainable agricultural practices and systems over the past two decades. These are defined as productive and profitable systems that cause minimal negative impact on the environment and result in maximum positive social impacts for families and rural communities. “If the system is not productive and profitable, it is hardly sustainable,” is a common statement from farmers. This is certainly true in the short term, and the short term is the only way we evaluate most systems’ success in the current economic environment. But to be sustainable for the long term we must conserve our production environment -- the soils and other natural resources on which all agriculture depends. And if we create a system that skews the benefits toward a few people in each community, region, or country, such a system hardly qualifies as a socially acceptable or equitable method of producing food, fiber, and fuel. Design and choice of sustainable systems need to include a thoughtful evaluation of their social impact – on people, families, and the community. An excellent series of publications on sustainable agriculture can be found through the SARE website:
www.sare.org/publications/

Agroecology has emerged as a science that deals with the integrated analysis of farming and ranching systems. Its recent definition as “the ecology of food systems” (Francis et al., 2003) suggests that we should be concerned with the path of energy and materials from the natural resource base, through the production system, to processing and marketing, and on to the consumer. A life cycle analysis of food systems further compels us to look at where waste is produced in the system, and how this could be reincorporated into the production process. Such an analysis leads us to compare the current dominant global food chain, with its one-way, flow through of materials and value, with local food systems alternatives that recycle materials and convert what we now consider wastes into resources. A current measure of sustainability is being developed at UNL by John Quinn and colleagues, and is called the *Healthy Farm Index:* http://hfi.unl.edu/hfi.shtml

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So, is an organic farming system sustainable? The answer could be yes, and no, and maybe! If the system is well designed, using renewable energy and other resources on the farm, and the markets are accessible and bring the maximum possible value back to the farm, family, and community, that organic system could very well be sustainable for the long term. On the other hand, an organic system that is poorly managed, uses extravagant equipment and exotic imported inputs, and gives little thought to creative marketing is likely to be highly unsustainable. Today's trend in organic farming is toward the industrial production and marketing model, and some consider this overall strategy to provide neither a secure food system nor one that is sustainable long term. Most organic farmers would answer the above question with "Maybe." If the planning is good, if there is adequate information about production alternatives and access to markets, if the weather cooperates, and if the benefits are equitably distributed in society, then maybe the organic system can be sustainable.

Our Sustainable Future Series

A book series was initiated with University of Nebraska Press in 1993 to promote scholarship related to sustainable agriculture and organic farming. The series provides an interdisciplinary forum for the discussion of issues and creative approaches bearing on the development of sustainable farming, communities, and natural resource use at the farm, landscape, regional and global levels. Many of the titles have relevance to organic farming and sustainable agriculture:

Our Sustainable Future Series: Available from Nebraska Press**
Charles Francis & Cornelia Flora, Editors

Topic(s)	Title	Author and Publication Date
Soil organic matter	*Building Soils for Better Crops*	Magdoff, 1993
Whole-farm organic crop and livestock production	*Future Harvest: Pesticide-Free Farming*	Bender, 1994
Integrated Pest Management	*Economic Thresholds for Integrated Pest Management*	Higley and Pedigo, 1997
Organic farming methods	*Good Growing: Why Organic Farming Works*	Duram, 2005
Economics of farming and impacts of federal farm programs	*Family Farming: a New Economic Vision*	Strange, 1988
Impacts of farm programs during the great depression	*Down and Out on the Family Farm*	Grant, 2002
The continuing challenge of designing farm programs that work	*Willard Cochran and the American Family Farm*	Levins, 2000
	The Curse of American Agricultural Abundance: a Sustainable Solution	Cochran, 2003
Challenges of resource use at local and regional levels	*Ecology and Economics of the Great Plains*	Licht, 1997

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	Ogallala: Water for a Dry Land	Opie, 2000
The question of preserving and exploiting biodiversity	*Making Nature, Shaping Culture: Plant Biodiversity*	Busch et al., 1995
	The Last Harvest: the Genetic Gamble that Threatens to Destroy American Agriculture	Raeburn, 1995
Resource use on a regional scale in forests and in the water arena	*A Conspiracy of Optimism: Management of the National Forests since World War Two*	Hirt, 1994
	Uphill Against Water: Great Dakota Water Wars	Carrels, 1999
National and global issues seen through the description of a nuclear disaster	*Chernobyl: the Forbidden Truth*	Yaroshinskaya, 1995
The potentials for a brighter future using creative design	*Green Plans: Blueprint for a Sustainable Earth*	Johnson, 2009

** University of Nebraska Press, 233 N. 8th St., Lincoln, NE 68588-0255

See the Press website: www.nebraskapress.unl.edu

Series web address:
http://www.nebraskapress.unl.edu/Catalog/ProductSearch.aspx?ExtendedSearch=false&SearchOnLoad=true&rhl=Our+Sustainable+Future&sj=750&rhdcid=750
Extension and Education Materials for Sustainable Agriculture

Another series of resources was started with the support of the Center for Sustainable Agricultural Systems at UNL with a grant from the Sustainable Agriculture Research and Education (SARE) program. The series includes a collection of class materials and syllabi from universities, proceedings of Extension workshops held across the North Central Region from 1995 to 1998, methods for comparing alternative farming systems, and collections of student writings from classes in *Agroecology* and *Urbanization of Rural Landscapes*, both courses taught at UNL in the spring semesters. We provide a complete listing of this series because most of its books contain information on aspects of organic farming, and because it is one resource that is specific to Nebraska and the region:

Green Book Series:
University of Nebraska Cooperative Extension
Charles Francis, Dept. Agronomy & Horticulture, Series Editor

Extension & Education Materials for Sustainable Agriculture
Volumes 1-17

[full descriptions and indexes for some volumes plus full text of Vol. 6 available at: http://cari.unl.edu/SustainableAg/volumes.shtml]

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All volumes are available for $15 per volume (cost of duplication) to students and educators from:

Charles Francis
102B KCR, Univ. of Nebraska
Department of Agronomy & Horticulture
Lincoln, NE 68583-0915

Vol. 1: Information from Regional Workshops, J.W. King & C.A. Francis, eds. January, 1994. 212 p. [collection of resource materials]

Vol. 2: Curricula for Undergraduate and Graduate Courses, J.W. King and C.A. Francis, eds. January, 1994. 178 p. [collection of syllabus and teaching materials from across the U.S.]

Vol. 3: Alternative Approaches to On-Farm Research and Technology Exchange, C. Francis, R. Janke, V. Mundy, and J. King, eds. April, 1995. 174 p. [papers from a symposium at the annual ASA meetings in Seattle, November 1995; printed with permission of ASA]

Vol. 4: Everyone a Teacher, Everyone a Learner. H. Carter and C. Francis, eds. May, 1995. 245 p. [papers from the North Central regional PDP workshops in Nebraska and Indiana, March-April, 1995]

Vol. 5: Shared Leadership, Shared Responsibility. H. Carter and C. Francis, eds. December, 1996. 276 p. [papers from the North Central regional PDP workshops in Wisconsin and North Dakota]

Vol. 6: Future Horizons: Recent Literature in Sustainable Agriculture. G. Hegyes and C.A. Francis, eds. September, 1997. 222 p. [compendium of 93 reviews of recent books in ecology and sustainable agriculture by more than 30 reviewers; full text available online at the above website]

Vol. 7: Linking People, Purpose, and Place: An Ecological Approach to Agriculture. H. Carter, R. Olson, and C.A. Francis, eds. February, 1998. 266 p. [papers from the North Central regional PDP workshops in Ohio, Kansas, and Minnesota]

Vol. 8: Procedures for Evaluating Alternative Farming Systems: A Case Study for Eastern Nebraska. R.K. Olson. July, 1998. 310 p. [lRichard K. Olson's PhD dissertation comparing production, economics, and energy use in five alternative systems cropping and crop/animal in eastern Nebraska]

Vol. 9: Facing a Watershed: Managing Profitable and Sustainable Landscapes in the 21st Century. H. Carter, R. Olson, and C. Francis, eds. 1998. 264 p. [papers from the North Central Regional PDP workshops in Illinois, Michigan, and Iowa]

Vol. 10: Small Farming Systems for the Midwest *and* Reintegrating Agriculture and Community in the Midwest. R. Olson and L. Bauer, eds. 166 p. [seminar papers from a 2-semester series held in 1998 and 1999 at University of Nebraska – Lincoln]

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Vol. 11: Urbanization of Rural Landscapes: Syllabus and Teaching Materials from a University Course. R. Olson, editor. 1999. 335 p. [class syllabus from the first course in *Urbanization of Rural Landscapes*, a new offering for graduate and undergraduate students at UNL]

Vol. 12: Urbanization of Rural Landscapes II: Second Syllabus and Teaching Materials from a University Course, Spring 2000. C. Francis and D. Mortensen, eds. June, 2000. 316 p. [class syllabus from the third course in *Urbanization of Rural Landscapes* at UNL]

Vol. 13: Action Education in Land Use Decisions: Student Views on Urbanization and Farmland Loss. M. Schneider, C. Francis, and D. Esseks, eds. June 2003. 165 p. [letters to the editor, book reviews, and student semester projects summaries from course in *Urbanization of Rural Landscapes*]

Vol. 14: Education in Agroecology: Reports and Publications from the NOVA University Program. C. Francis, G. Lieblein, L. Salomonsson, N. Sriskandarajah, T.A. Breland, and J. Helenius, eds. August, 2003. 229 p. [copies of journal articles, book chapters, and working drafts of papers from the Nordic Region education program in Agroecology and Ecological Agriculture]

Vol.15: Adventures in Experiential Learning: Student Creativity in a Course on Urban Sprawl, 2004. M. Schneider and C. Francis, eds. May 2004. 117 p. [letters to the editor, book reviews, and student semester projects summaries from course in *Urbanization of Rural Landscapes*]
letters to the editor, book reviews, and student semester projects summaries from course in *Urbanization of Rural Landscapes*]

Vol. 16 Practical Education in Agroecology: Project Reports on Current Issues in Agriculture and Food Systems. M. Schneider and C. Francis, eds. May 2004. [project reports from Agroecology 435/835, Spring]

Vol. 17 Losing Farms and Food Production: Student Perspectives on Urbanization of Rural Landscapes. T. Hansen and C. Francis, eds. June 2005. [letters to the editor, book reviews, student projects, and portfolios from course in *Urbanization of Rural Landscapes*]

SARE Programs in the North Central Region

Published in August 2006, *Developing and Extending a Sustainable Agriculture: A New Social Contract*, provides a detailed look at the SARE-financed research, education, and on-farm development activities over the time period since 1987 when the first LISA (Low-Input Sustainable Agriculture) program was established. There are chapters on soil fertility, pest management, and grass-based livestock and dairy farming. Others include whole-farm planning, economics of sustainability, and how to envision future systems. The statewide sustainable agriculture program in Iowa is discussed as a good model for other states to follow, and the North Central Regional program is described in detail. A full chapter by Dr. Fred Kirschenmann and R. George Bird is dedicated to the imperatives for organic farming in the future. The book is

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published by Haworth Press, and the editors are Charles Francis (UNL), Ray Poincelot (Fairfield University), and George Bird (Michigan State University).

Three Recent Reviews

Three recent reviews of organic agriculture, especially when considered together, well represent all sides of the current debate of the sustainability of farming organically. *Organic farming: an international history* provides an excellent review, especially of research and experience originating in German and other European traditions, was assembled by veteran research and opinion leader William Lockeretz (2007). This book is especially valuable to farmers and the science community in the Western Hemisphere, since we are not well acquainted with basic literature in the German language. Sixteen chapters rich with references to past and current practices provide one of the most comprehensive collections of information on organic farming that has ever appeared. Especially useful is the historical and current overview of research and methods presented by Stinner (2007), who describes the blend of on-farm and experiment station trials that has provided a foundation for farming practice recommendations.

Lockeretz, W., editor. 2007. *Organic farming: an international history*. CABI, Wallingford, Oxfordshire, U.K.

In contrast to this positive perspective on organics, other European scientists take a critical look at both the research and the expectations for future organic production. *Organic crop production – ambitions and limitations* was edited by Swedish soil scientists Holger Kirchmann and Lars Bergström (2008). Although the history section is well written and the details on organic soil amendments and strategies are especially valuable, the overall tone is highly pessimistic about both the potentials of organic systems to achieve adequate yields and the science behind current recommendations. The chapter authors are almost unanimous in their skepticism, suggesting a careful selection of narrow disciplinary specialists who are more comfortable with the world view that more and better conventional technology will solve all future food challenges using current systems, in spite of the resource limitations already described.

Kirchmann, H., and L. Bergström, editors. 2008. *Organic crop production – ambitions and limitations*. Springer Science + Business, Amsterdam, Netherlands.

More in tune with the Lockeretz review is the recent American Society of Agronomy monograph, *Organic farming: the ecological system* (Francis, 2009) that relates farming practices, understanding of components and mechanisms, and design of systems using natural environments as models. Understanding the sustainability of natural ecosystems, the importance of biodiversity, resilience, cycles and conservation of resources, among other principles, will be key to creating durable and productive systems in the face of limitations. Authors of the fifteen chapters share experiences and perspectives from the North American context, and represent a highly diverse and productive collection of agroecozones and farming systems.

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Francis, C., editor. 2009. *Organic farming: the ecological system*. Monograph 54, Amer. Soc. Agronomy, Madison, Wisconsin, U.S.A.

What is in this organic farming online document?

In this set of resources we attempt to anticipate as many questions as possible that educators and advisors will hear from clients. We start with the importance of organic farming and how conversion from conventional systems is accomplished. Later sections describe the certification regulations and how they are administered. Sections on organic crop management, soil fertility, and plant protection bring together the practices that must be integrated into production systems. Organic livestock production is a growing response to consumer demand, and we present information that applies to beef and dairy, swine and poultry systems. A section on organic gardening is included in anticipation of small-scale organic questions from clients. We have added a section on organic management of landscapes, thinking at the individual home or acreage level. We have also added a section on related topics, such as sustainable communities, sustainable landscaping, using native plants in the landscape, edible landscaping, wildcrafting, windbreaks, riparian buffers and wildlife habitat, that may be of interest to educators and farmers considering organic production in Nebraska. The document contains several links to valuable online resources, such as the National Organic Program standards, the OCIA requirements as one example of a certification procedure, the 2009 Guide to Nebraska Fresh Produce, as well as references to a number of newsletters and other information resources on organic farming and gardening.

This is a work in progress. The information is available in CD format (by request) as well as online, so that you can create a loose-leaf binder to add materials and change others as new publications become available. We hope this will become a living resource on your desk, and that you will share with us any information you find especially relevant for Nebraska.

Shannon Moncure and Charles Francis, editors January 2010

Contact: Chuck Francis, 279 Plant Sci., Univ. Nebraska, Lincoln, NE 68583-0817
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References for the basics of organic agricultural production

The International Federation of Organic Agriculture Movements (IFOAM) works to standardize organic certification rules and is an umbrella group over national certification groups. Organic production and processing generally is based on these principles and ideas, most of which are incorporated into the rules of the many local and national certification groups around the world.

The Principal Aims of Organic Production and Processing (IFOAM, 2003)

[Table adapted from 2nd Revision Draft of the 2002 IFOAM Basic Standards 2003, International Federation of Organic Agriculture Movements]

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Organic Production and Processing is based on a number of principles and ideas. All are important and this list does not seek to establish any priority of importance. The principles include:

- to produce sufficient quantities of high quality food, fiber, and other products.
- to work compatibly with natural cycles and living systems through the soil, plants and animals in the entire production system.
- to recognize the wider social and ecological impact of and within the organic production and processing system.
- to maintain and increase long-term fertility and biological activity of soils using locally adapted and available cultural, biological and mechanical methods as opposed to reliance on outside inputs
- to maintain and encourage agricultural and natural biodiversity on the farm and nearby areas through use of sustainable production practices and protection of plant and wildlife habitats.
- to maintain and conserve genetic diversity through attention to on-farm management of genetic resources.
- to promote the responsible use and conservation of water and all life therein, and preserve water quality on the farm and in the watershed.
- to use renewable resources to the greatest extent possible in production and processing systems and avoid pollution and waste.
- to foster local and regional production and distribution of food and other products, in contrast to a global food system.
- to create a harmonious balance between crop production and animal husbandry and production, integrating the two types of enterprises in efficient mixed systems.
- to provide living conditions that allow animals to express the basic aspects of their innate behavior, and to maintain concern for animal welfare
- to utilize biodegradable, recyclable, and recycled packaging materials, and to minimize packaging to that level consistent with maintaining a quality product.
- to provide everyone involved in organic farming and processing with a quality of life that satisfies their basic needs, within a safe, secure, and healthy working environment.
- to support the establishment of an entire production, processing and distribution process that is both socially just and ecologically responsible.
- to recognize the importance of, protect, and learn from, indigenous knowledge and traditional farming systems.

IFOAM's most recent version of their Norms document can be found at: www.ifoam.org/about_ifoam/standards/norms/norm_documents_library/norms_documents_library.html

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The Science Base of Organic Farming & Transition

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Arrival of science into methods of organic farming

We recognize and applaud farmers' efforts to develop practices, crop rotations, and systems that have been successful in organic farming. In fact much of the relevant information today comes from farmer experience, or from cooperative work between farmers and researchers who apply rigorous design and statistics to evaluate results and arrive at recommendations. We think it is important to evaluate ALL sources of information for their relevance to each specific system. Just because something appears in a newsletter or is shown on a field day without the technical rigor usually associated with science and testing hypotheses does not mean that the idea is less valuable – it is just tested in a different way. And we urge skepticism of science, since everything that appears in a technical journal is not an absolute truth but rather the careful testing of an idea or practice within one specific set of conditions. The bottom line is that a "science base" for organic farming can be found in a number of ways, and the thoughtful student, teacher or farmer interested in this area will consider the source, the methods, and even the vested interest that may be behind a given recommendation.

Agriculturists and researchers in Germany and in the U.K. had early interest in the science behind the methods of farming that we now recognize as precursors to organic food production. Several notable publications based on travel to other regions of the world were important in the emergence of interest in those organic methods. F.H. King's (1911) travel to Japan, Korea and China, and Albert Howard's (1943) work in India made significant contributions to understanding the methods used for centuries in areas with high population densities and pressure on resources. The early 20th Century development of concepts in organic and biodynamic farming was summarized well by Richard Harwood (1983); his article from a workshop in Tanzania is a useful resource:

Harwood, R.R., editor. 1983. Resource-Efficient Farming Methods for Tanzania. Rodale Press, Inc., Emmaus, Pennsylvania.

Rebecka Milestad (2003) describes the growth of organic farming – a set of practices and a philosophy that includes both social and ecological goals beyond just production and economics – as a critique of conventional agriculture. She cites the early work of Rudolph Steiner in Austria in biodynamic agriculture and the establishment of an organic farm in 1927, and the organic-biological movement in Switzerland started by Hans and Maria Müller and Hans Peter Rusch. In Great Britain Sir Albert Howard (who worked in India) and Lady Eve Balfour were among the key founders of organic agriculture. Soil fertility was the foundation of most organic systems, but the early proponents also were looking at problems of the industrialization of agriculture, the need

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for more people to be involved in food production, and a holistic view of nature and farming systems. Key references are given in the Harwood article, and several noted at the end of this section.

Principles of organic farming taken from the IFOAM (2002) statement and regulations are listed in the Editor's Introduction. Key issues are:

- avoiding use of synthetic fertilizers or pesticides
- no use of transgenic organisms (popularly called GMOs)

Growth of organic farming in the U.S. was greatly stimulated by the publications of J.I. Rodale (1945, 1948) and his son Robert Rodale (1983), and the magazines *Organic Gardening and Farming* (later called *Organic Gardening*) and *The New Farm* from Rodale Press in Pennsylvania.

Current status and science-based resources on organic farming

According to the USDA (http://www.ers.usda.gov/Data/Organic/#national), there were over 4 million certified organic acres in the U.S. in 2005, accounting for about 0.5% of total crop and pasture land. About 4.66% of vegetable production is certified organic. There is still far less research in the U.S. relative to the acres in organic farming (Sooby, 2003), although this situation is changing rapidly. The Organic Farming Research Foundation website has up-to-date information on the state of research in the U.S. and grants available:
http://www.ofrf.org/

To put this U.S. situation in perspective, there are about 19 million certified organic acres in Europe (7.74 hectares), according to the website of the FiBL (Research Institute for Organic Agriculture) center in Switzerland:
http://www.organic-world.net/fileadmin/documents/data-sheets-public/1-4-land-share-farms-by-region-ex5.xls

Their site includes current links to statistics for each country in Europe, making it a valuable reference for anyone interested in what is happening in that part of the world. One of FiBL's valuable links is to the Danish Research Centre for Organic Farming (DARCOF): http://orgprints.org/about.html, whose "organic eprints" service provides open access to electronic articles on organic farming. There has been a wealth of research on both crops and systems in the European context, and any serious student or practitioner should turn to those resources when frustrated with the limited research in the U.S.

Closer to home, Dr. Kathleen Delate at Iowa State University prepared an excellent overview of *Fundamentals of Organic Agriculture* at Iowa State University in 2003 (Delate, 2003). A copy of the full-color ISU bulletin PM 1880 is available on the web:
http://www.extension.iastate.edu/Publications/PM1880.pdf

Although many of its statistics have become out of date, the majority of this Bulletin is still very valuable reading for anyone interested in organic agriculture. Dr.

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Delate cites the definition of organic agriculture from the National Organic Standards Board of the USDA: "*an ecological production management system that promotes and enhances biodiversity, biological cycles, and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain, or enhance ecological harmony. The primary goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil life, plants, animals, and people"* (NOSB, 2003). The ISU bulletin gives a brief history of organic farming, and goes on to offer several useful statistics as of 2003, organic soil and pest management, and comparisons of conventional and organic production.

In the last decade, many other sources of data on organic agriculture have emerged. The Organic Trade Association and the USDA's Ag Census are two good sources for related statistics:
http://www.ota.com/organic/mt/business.html
http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_2_US_State_Level/st99_2_044_044.pdf

A valuable resource for teachers and those planning other types of educational activities is the website and publications from the Agroecology and Food Systems Program at University of California, Santa Cruz. Their *Resources for Teaching Sustainable Agriculture Skills and Concepts* is available in full text format from the website, or it may be purchased for $25 per copy from the UCSC program.
http://socialsciences.ucsc.edu/casfs/education/instruction/index.html

Reasons for converting to organic systems.

As noted above, farmers convert to organic production systems for a variety of reasons. These include economics and the potential for selling a higher-value product, the health and safety for farmer and farm family that come from operating without synthetic chemicals, and the pride in knowing that they are growing and selling a product that has a special value for customers. Most organic farmers have multiple reasons for converting to a different system of production. And some certified growers make annual decisions about whether to continue certification or not. There are certainly successful local markets for products that are advertised as "pesticide free" without having the official certification.

Most prominent among reasons to convert to organic farming are economic. Farmers are impressed with higher prices per bushel for organic corn and soybeans, and to be sure there have been contracts for the organic commodity crops that have reached these levels and more. Yet there is no difference in the impacts of supply and demand in the organic sector – when too many people enter the arena the prices fall and it becomes a buyer's market. We urge farmers to investigate the markets carefully, do a tight enterprise budget (According to Oklahoma State University: Enterprise budgets estimate profitability for agricultural enterprises while documenting management practices and the resources and technology used.), factor in the three years needed for certification, and then make the decision to convert to realize these

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prices. The organic option is not for the faint of heart, and it is certainly not a way to quickly salvage a farm operation that is in financial difficulty. This is a long-term process, and one that takes substantial planning.

The health and safety reasons for converting to organic farming are self-evident. Farmers often tell us they never did like handling toxic chemicals, and the organic strategy gives them an option to eliminate this element from their practices and their farms. Until the widespread availability of other options, many have been reluctant to try something that was considered so far from the mainstream. Others say they "don't want to go back to the hoe" which is a popular myth about organic farming. Such myths abound, and their popularity is one key reason why it is important to discuss the scientific basis for organic farming. We are never "going back" to older systems, but rather making rational choices among available technologies, whatever their source and history.

Some farmers say that they want to have a safe farmstead, without having storage for toxic materials, so that this will be a good place for raising a family. And they want children to have access to the fields and all the buildings so they will have an opportunity to be an integral part of farming. This is another argument for the moderate scale of family farming, with smaller equipment and livestock alternatives that children can have for FFA and 4-H projects. Such involvement is difficult on the industrial farm with large equipment, heavy applications of chemicals, or specialized livestock operations that do not lend themselves to children's involvement.

These are among the reasons farmers give for conversion to organic farming, and for choice of operating on a small or moderate scale. Dr. David Suzuki offers another perspective on "why organic farming" in the following Science Matters article:

Science Matters by David Suzuki

Science Matters is published weekly in newspapers across Canada.

Organic farming a realistic alternative

Jun 07, 2002

Strange how a movement that began with the best of intentions has managed to generate so much animosity. I'm talking about organic farming. But while a few people seem convinced it's a scam, the research continues to suggest otherwise.

Organically grown food is certainly popular. People buy it for any number of reasons - they say it tastes better, they're concerned about the effects of pesticide residue on their families' health and they believe it is less harmful

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to the environment. They're willing to pay a premium price for it too.

Because the organic movement is relatively new, there has not been a wealth of scientific data to confirm organic farmers' anecdotal observations that this method produces good yields while maintaining healthier soils and ecosystems. Such claims are too good to be true, according to some proponents of industrial agriculture. A few years ago, the Nature of Things did a program on organic farming. I thought it was a Mom and apple pie-type show that everyone would love. To my amazement, we were inundated with letters of outrage from university agriculture facilities and chemical companies, arguing that conventional monocultures with copious inputs of synthetic fertilizers, pesticides and herbicides were the only way we could possibly feed our growing human population.

Today, some critics seem genuinely angry at the success of the organic movement. They've written books and published articles in journals saying that organic farmers are starry-eyed idealists who are trying to bring back 19th century farming practices which will reduce yields by four times and thus, if widely adopted, will lead to mass starvation.

But organic farming isn't about turning back the clock, it's about moving forward. It's about smart farming to help maintain healthy ecosystems. Conventional farming produces high yields, but there are also enormous costs - pollution of groundwater, rivers, lakes and coastal areas, and reduced soil productivity through nutrient leaching. The use of pesticides and herbicides also kills beneficial non-target species and poses a health risk to farm workers and potentially to consumers. None of these "external" costs are factored in to the price of conventionally grown crops.

Organic farming seeks to reduce these external costs and it seems to be working. According to a landmark 21-year study recently published in the journal *Science*, organic farming can produce good yields, save energy, maintain biodiversity and keep soils healthy. The study took place on 1.5 hectares in Switzerland using four farming methods and several different crops. Crop yields, on average, were 20 per cent lower using organic methods, but they required 56 per cent less energy per unit of yield. Organic plots also had 40 per cent greater colonization by fungi that help plants absorb nutrients, three times as many earthworms and twice as many pest-eating spiders.

Some crops fared better under organic systems than did others. Potatoes, for example, produced 38 per cent lower yields, but winter wheat was just 10 per cent lower. The researchers sum up, "We conclude that organically manured, legume-based crop rotations utilizing organic fertilizers from the

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farm itself are a realistic alternative to conventional farming systems."

Other studies have also shown similar results. A comparison study completed last year on apples, for example, found that organic crops can produce yields similar to conventional crops, and they taste better. Another paper published in the *Journal of Applied Ecology* last year found that using organic methods to grow tomatoes can promote biodiversity while maintaining productivity.

It is important to keep in mind that there is much that we don't know about agriculture and there is likely no ultimate answer to our food production needs. To feed our growing population we have to be open to all ideas, new and old. And we mustn't let the entrenched interests of the commercial agriculture and biotechnology industries dictate the future of our food when less intensive and damaging alternatives are available.

Science Matters, David Suzuki Foundation, http://www.davidsuzuki.org/
Vancouver, BC

Conversion or transition process

Several organic farmers have told us that the most difficult step in transition to organic is the mental change that must take place before anything happens in the field. This of course is only the first step in a long process. Much of the rest of this report and the associated website deal with specific practices for crop choice, design of a fertility program, decisions on components of integrated pest management, and the adoption of a rigorous marketing program that brings value back to the farm or ranch. The official rules for organic certification provide some guidelines for the conversion process. But these are not specific to any particular farm, and groups such as the Organic Crop Improvement Association chapters include many farmers who are happy to act as mentors for others who are just starting out. We recommend that people start on the learning curve as soon as possible, so that they can sort out the many available resources and design a strategy that is appropriate for their operation. The National Organic Program (NOP) site is:
http://www.ams.usda.gov/nop/indexIE.htm

One book that lays out guidelines and recommended practices for the conversion process was published in 2005 by the Canadian Organic Growers. *Gaining Ground: Transitioning to Organic Farming* "covers all bases – from soil-building and planting to certification and marketing." As such, it is a valuable guide for farmers, not only in Canada but also in the U.S. Much of the book is based on interviews with Canadian organic farmers, reinforcing our observation that much of the available organic farming information is coming from those who have tested alternatives and found out which ones work well.
http://www.cog.ca/shop/index.php?main_page=product_info&cPath=1&products_id=190

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The ATTRA website has a valuable section on certification and an overview of the national requirements. Various subtopics on the site provide guidelines to the conversion process, including choice of crops and management options and what has been successful for farmers.
http://www.attra.org/attra-pub/organcert.html

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Email: jane@OFRF.org; Website: http://ofrf.org/publications/sos.html

Walters, C. 1996. Weeds: control without poisons. ACRES U.S.A, P.O. Box 91299, Austin, TX http://www.acresusa.com/books/closeup.asp?action=search&prodid=6&catid=&pcid=2

Walters, C. Jr. and C.J. Fenzau. 1979. An ACRES U.S.A. primer. ACRES U.S.A. P.O. Box 91299, Austin, TX

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Certification for Organic Farming & Processing

Note: The published extension information on certification for Nebraska is drastically out of date. This section is based on a prior publication by Jane Sooby and David Baltensperger from the Panhandle Research and Extension Center, and reviewed for updating by Chelsea Phillippe in the University of Nebraska-Lincoln Spring 2004 class on "Science-Based Organic Farming and Gardening" as part of a semester project. Information is also based on a lecture by Amy Griner, then education coordinator with OCIA International. There is substantial information on current standards in the Appendices that include the National Organic Program and the OCIA regulations. Finally, a new NebGuide for organic production in Nebraska is in the planning stages.

As we update the 2010 Edition of this document, we note that there is continuing pressure on the USDA to modify the requirements for organic certification, including adding materials to the acceptable list, considering approval of use of GMOs, allowing minimal time on outside grazing, and generally pushing the organic farming and food industry toward a more industrial model that resembles the mainstream food system in the U.S. There is also growing interest among organic farmers to further differentiate their operations and their products from the industrial organic industry; it is unclear what form this may take. For this reason, we subtitle this resource document "locally secure food systems" in recognition of the movement to search for alternatives. This is a rapidly growing concern, and there will likely be change in philosophy and practice in organic farming in the future.

Organic Certification

Until 2002, the rules for organic certification in the U.S. varied somewhat depending on the organization that was in charge of setting the rules and conducting inspections. Some states had their own certification rules, most under the umbrella of the international organization IFOAM. Since October, 2002, the USDA maintains a national set of standards governing all organic food production and processing in the U.S. These standards provide several levels of official labels, as described in PM 1880 from Iowa State University. All state and private certifying organizations must now comply with the provisions of the national standards.
http://www.ams.usda.gov/nop/indexIE.htm
http://extension.agron.iastate.edu/organicag/

Under the National Organic Program, in order to sell organic products, a farmer and/or rancher must become certified through a certifying organization. A list of local Nebraska and Midwest certifying agencies can be found at the end of this section. Farmers should search for a certifying agency that would best fit their needs before investing time and money in the certification process. Each group enforces the same

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regulations under the guidelines of the NOP, according to the type of crop grown and market where the farmer wishes to sell.

A good general source of details on organic certification, including details on materials that are allowed and not allowed, is the complete OCIA certification guidelines that are available on the web. This resource includes OCIA's certification requirements in both English and Spanish:
http://ocia.org

There is also substantial information available from the National Sustainable Agriculture Information Service in Fayetteville, Arkansas on their ATTRA website. Their Organic Certification page, in particular, provides a wealth of information and resources on the certification application and documentation processes:
http://www.attra.org/organic.html

Today in Nebraska there are certified organic fields of wheat, millet, oats, barley, corn, soybean, dry edible beans, and alfalfa. Other minor crops grown and marketed organically include amaranth, blue corn, popcorn, spelt, and many vegetable species on a small scale. There are fewer organic livestock producers, since certification requires the use of all-organic feed, but there is growing interest in this type of enterprise. Over the last few years, the State of Nebraska has provided support in the form of cost share for the certification process. It is worth checking the NE State Department of Agriculture's website to see if this support is available in a given year. The latest cost-sharing press release from the NDA can be found at the following link:
http://www.agr.state.ne.us/newsrel/march2009/organic_cost_share.htm

Steps in Certification

Details and steps in the certification process are slightly different for each official certifying organization, but since they all operate under the same federal umbrella the process is similar. An example of the details is provided in *Guidance on Putting Your Audit Trail in Place* (OCIA International, Lincoln, NE, CL-W-003, Revision B, 2002).
www.ocia.org/QMS/EN/QS/Procedures/EN-QS-P-026.doc

Other OCIA forms including:

- Prior Land Use Affidavit
- Field History Form
- Organic Seed Search and/or Purchase Record
- Non-GMO Affidavit
- Farm Input Record
- Buffer Strip Record
- Farm Equipment Clean-out Record
- Combine Clean-out Affidavit
- Bin Register
- Farm Sales Record Summary
- Request for Certificate Acceptance

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- Checklist for Preparing for Inspection
- Yearly Field Activity Log

… can be found at: http://www.ocia.org/ResourceCenter/PublicQMS/default.aspx

The certification process begins with the farmer researching a prospective certification organization based on the type of crop, markets, and how the certification agency will help meet the farmer's goals. Once a certification group is chosen, the application process begins. The farmer's responsibility is to develop a farm plan which details the transition the farm will go through to become organic and explains how organic practices will be conducted. It takes at least three years for a conventional farm to become organic, due to the requirement of a 36-month period during which the farm or land in question must be free of certain synthetic products and practices. The certification organization will provide more specifics on this 36-month transition. In special circumstances, for example land coming out of CRP or long-term alfalfa with no application of prohibited inputs, it may be possible to certify the land immediately. The certification agency reviews the farm plan and makes suggestions.

Once the farm plan is accepted, which may take a couple of drafts, the certification group will arrange for a qualified inspector to visit the farm. The inspection includes a tour of the farm and a review of the farmer's audit trail and complete application. The audit trail is basically the documentation of everything that goes on at the farm. The inspector will then give an exit interview with the farmer. The last step is the final review and decision by the certification organization to certify the farm as organic if it sufficiently meets all the criteria. Once the farmer is holding the organic certification it can legally sell products with the organic label, but not before.

The certification standards at the national level were a long time coming. From the passage of the legislation to the drafting of guidelines to the public review process, there was an incredible number of years during which the existing certifying agencies lobbied for their positions and the public, and the commercial agriculture industry and interests weighed in with opinions on what should be allowed and what should not. The public response to a call for commentary on the organic legislation was one of the largest ever experienced by the Department of Agriculture.

Especially vocal were the food industry groups that attempted to "water down" the requirements to make them as close as possible to conventional practices. Some of the most contentious issues surrounded use of certain pesticides, soil amendments, and especially the use of transgenic crop varieties (GMOs). There is continuing pressure to change the requirements, with most requests leaning toward a liberalization of the rules. The Organic Standards section of the Organic Consumers Association is a good place to keep up to date on the continuing attempts to change the organic food standards or production requirements: http://organicconsumers.org/sos.cfm

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Contact People and Certification Groups

The Nebraska state contact for the USDA National Organics Program is:

Steve Martin
Nebraska Dept. of Agriculture
P.O. Box 94947
Lincoln, NE, 68509-4947
Phone: 402-471-6863
Fax: 402-471-2759
Email: steve.martin@nebraska.gov

The Nebraska state contact for the USDA National Resources Conservation Service (NRCS) is:

Corey Brubaker
State Conservation Agronomist
Federal Building, Room 152
100 Centennial Mall North
Lincoln, NE 68508-3866
Phone: 402-437-4164
Email: corey.brubaker@ne.usda.gov
http://www.ne.nrcs.usda.gov

Most certifying organizations work with farmers and ranchers in most U.S. states. However, it can be helpful to work with a more local certifier. Here is a listing of available certification organizations in Nebraska:

OneCert 2601 'B' Street, #1, Lincoln, NE 68502
Contact: Samuel K. Welsch, 402-420-6080
E-mail: sam@onecert.net Website: www.onecert.net
Scope: crop, livestock, wild crop, handling Accredited: 4/22/03

Organic Crop Improvement Association
1340 N. Cotner Boulevard, Lincoln, NE 68505
Contact: Jeff See, 402-477-2323
E-mail: JSee@ocia.org Website: www.ocia.org
Scope: crop, livestock, wild crop, handling Accredited: 4/29/02

Here are some certification organizations in other Midwestern states:

Iowa

Iowa Department of Agriculture Organic Program
502 East 9th Street, Des Moines, IA 50319
Contact: Maury Wills, 515-281-5783
E-mail: maury.wills@iowaagriculture.gov Website: www.iowaagriculture.gov
Scope: crop, livestock, wild crop, handling Accredited: 4/29/02

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Certified Organic, Inc.
500 1st St., Keosauqua, IA 52565
Contact: Nanette Rambo, 866-581-6428
E-mail: certifiedorg@netins.net Website: www.certifiedorginc.org
Scope: crop, livestock, wild crop, handling Accredited: 11/12/02

Maharishi Vedic Organic Agriculture Institute
P.O. Box 2006, Fairfield, IA, 52556
Contact: Carl Jorgensen, 641-469-5477
E-mail: mvoai@maharishi.net Website: www.mvoia.com
Scope: crop, livestock, wild crop, handling Accredited: 4/29/02

Colorado

Colorado Department of Agriculture
Division of Plant Industry, 700 Kipling Street, Suite 4000
Lakewood, CO 80215-8000
Contact: Mitch Yergert 303-239-4138
E-mail: mitchell.yergert@ag.state.co.us Website:
http://www.colorado.gov/cs/Satellite/Agriculture-Main/CDAG/1167928162828
Scope: crop, livestock, wild crop, handling Accredited: 10/16/02

Wisconsin

Midwest Organic Services Association
P.O. Box 821, 122 W. Jefferson Street, Viroqua, WI 54665
Contact: Bonnie Wideman, 608-637-2526
E-mail: bwideman@mosaorganic.org Website: www.mosaorganic.org
Scope: crop, livestock, wild crop, handling Accredited: 4/29/02

Nature's International Certification Services
P.O. Box 131, Viroqua, WI 54665
Contact: David Engel, 608-637-7080
E-mail: david.engel@naturesinternational.com Website:
www.naturesinternational.com
Scope: crop, livestock, wild crop Accredited: 2/10/03, 3/17/08 (wild crop)

Ohio

Ohio Ecological Food and Farm Administration
41 Crosswell Rd., Columbus, OH 43214
Contact: Lexie Stoia Pierce, 614-262-2022
E-mail: lexie@oeffa.org Website: www.oeffa.org
Scope: crop, livestock, wild crop, handling
Accredited: 4/29/02

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Global Organic Alliance, Inc.
P.O. Box 530Bellefontaine, OH 43311
Contact: Betty J. Kananen, 937-593-1232
globalorganicalliance@hughes.net Website: www.goa-online.org
Scope: crop, livestock, wild crop, handling
Accredited: 4/29/02

North Dakota

International Certification Services, Inc.
(dba, Farm Verified Organic and ICS-US)
301 5th Street, Medina, ND 58467
Contact: Annie Kirschenmann, 701-486-3578
E-mail: info@ics-intl.com Website: www.ics-intl.com
Scope: crop, livestock, wild crop, handling Accredited: 4/29/02

Resource Used to Compile this List

A list of the 98 accredited certifying groups, including those in the U.S. and those in other countries, is available on the USDA website of the National Organics Program. Although only two of these certifiers are currently located in Nebraska, a number of the organizations are used for certification by Nebraska farmers. It is useful to talk to current organic farmers to assess their experiences with different certifying groups, and to make a good choice that is appropriate for each farm, farmer and location. The entire list can be accessed at the NOP website from USDA:

USDA. 2009. National Organics Program: Accredited Certifying Agents. http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateJ&navID=NationalOrganicProgram&leftNav=NationalOrganicProgram&page=NOPACAs&description=USDA%20Accredited%20Certifying%20Agents&acct=nopgeninfo

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Organic Crop Management

Management of organic cropping systems requires careful manipulation of the production environment in order to maintain adequate soil fertility, minimize weed and insect pest problems, and cope with residue in the field while maintaining appropriate levels of soil moisture. There are some guidelines or requirements in the design of rotations within the organic certification rules, and many common-sense elements in the design of organic cropping systems. In this section we discuss choice of crop and cultivar, seed sources, crop rotations, land preparation and residue management, planting dates, patterns and densities, and overall system planning. Managing soil fertility and controlling crop pests are covered in dedicated sections, since these topics are of vital interest to farmers making the conversion from conventional to organic production systems. Several key publications are listed in this section to illustrate the wealth of information available on the web and from Cooperative Extension and other sources in the Midwest.

One of the most valuable websites and information resources available is ATTRA, the Applied Technology Transfer to Rural Areas, created and managed by the National Center for Appropriate Technology (NCAT). This is now more widely known as the National Sustainable Agriculture Information Service, with several offices throughout the U.S. Funded by a grant from the USDA, this center depends on annual appropriations through Congress and each year there is some pressure to reduce or eliminate their funding. Any support you can provide to keep this information service up to date and functioning well is highly appreciated – this can be done through your senators and representatives. Information from the center is available by phone, by fax, and most quickly and readily through the website:
http://www.attra.org/

ATTRA's ***Organic Farming*** section contains links to a wide range of resource materials; it is organized into sections on:

- Organic Regulation, Certification, Transition and History
- Organic Fruits
- Organic Vegetables, Flowers and Herbs
- Organic Field Crops
- Organic Livestock
- Organic Control of Pests
- Organic Soils & Fertilizer Issues
- Organic Marketing

In addition to more than 80 resources about specific farm practices for organic crop and livestock production, the site contains links to other organic farming websites and organizations including certification groups, the National Organic Program (NOP),

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the UN's Food & Agriculture Organization (FAO), the Organic Farming Research Foundation (OFRF), the Organic Trade Association, the Organic Consumers group, USDA and its Economic Research Service (ERS), and state sites that have emphasis on organic farming:

http://www.attra.org/organic.html

Choice of Crops, Cultivars, and Seed Sources

As with any decisions on crop management, some of the most important are the choices of adapted crops that have a ready market, choices of specific hybrids or varieties to plant, and in the case of organic production, the sources of seed that are available. There is some comfort in growing crops that are well known and with which we have experience – corn, soybeans, grain sorghum, wheat, alfalfa – and there is an established organic market for these crops if one is willing to invest the time and energy to seek out buyers. Often this means finalizing contracts with reputable dealers before the crop goes into the ground. It makes sense to consider recommendations from the conventional literature and Extension publications on these common crops, since the top varieties in one system are likely the best ones in most other systems. However, most successful organic farmers continually seek more diversity, and will also produce crops that are in demand in the marketplace but are not currently being produced locally.

Choice of varieties and seeking available seed sources can be quite challenging. Researchers are in the process of testing the genotype by system interaction to find whether some cultivars in fact respond better in organic systems than in conventional crop production systems. We do know that there are some specific traits that will help a variety do well in an organic system – for example the capacity to germinate quickly and develop a competitive crop canopy to compete with weeds. Although this is an important trait for any system, it is especially important when dealing with weeds in a number of integrated ways that do not include herbicide application. Often, organic farmers will delay planting to allow early-season control of weeds, and this will require a shorter-season cultivar in the organic cropping system.

Since organic seed is not available for many minor crops, nor of adapted cultivars of some major crops, farmers are faced with the decision of choosing the best variety for which organic seed is available, or changing to a less-adapted variety that has cheaper or available seed. If there is any doubt about the acceptability of a seed source within the rules of certification, a farmer is urged to check with the certification group. Information from the ATTRA website on characteristics of seed and organic seed sources is available under the Organic Field Crops section: "Suppliers of Seed for Certified Organic Production":
http://www.attra.org/attra-pub/altseed_search.php?

There is particular interest in finding seed that is free of GMOs, since this type of cultivar is prohibited by organic certification rules. An organization and newsletter called The Organic and Non-GMO Report is available with the latest news on GMOs, tolerance levels, and other legal issues that are in the news. See their newsletter online:

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http://www.non-gmoreport.com

One of the largest organic seed producers used to be NC+ Hybrids in Lincoln, Nebraska. After its takeover by Remington Seed Company of Indiana, NC+ Organics became a new company, Blue River Hybrids. It is now located in Kelley, Iowa, and sells organic corn, soybean, alfalfa, clover, sorghum and sudangrass seeds. http://www.blueriverorgseed.com/

Crop Rotations

The NOP rules include a section on crop rotations (paragraph 205.205, found, among other sites, at the U.S. Government Printing Office site below) that states "The producer must implement a crop rotation including but not limited to sod, cover crops, green manure crops, and catch crops that provide the following functions that are applicable to the operation:

- Maintain or improve soil organic matter content;
- Provide for pest management in annual and perennial crops;
- Manage deficient or excess plant nutrients;
- Provide erosion control."

http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?type=simple;c=ecfr;cc=ecfr;sid=4163ddc3518c1ffdc539675aed8efe33;region=DIV1;q1=national%20organic%20program;rgn=div5;view=text;idno=7;node=7%3A3.1.1.9.31#7:3.1.1.9.31.3.342.6

It is obvious in designing crop rotations that one size does not fit all. The OCIA regulations, for example, specify that any single set of guidelines or rules for specific crops would scarcely be applicable to the wide range of climates, soils, and agroecoregions where farmers are certified to produce organic crops. There are regional guidelines for rotations; these are set by each local chapter in the case of OCIA.

General guidelines would include rotation of unlike crops to maximize the potential for weed management (described in a later section), including rotation of cereals with legumes, summer crops with winter crops, or annual crops with perennial crops. This type of cropping sequence helps with management of weeds that are specifically adapted to field conditions in one crop species. The worst possible scenario is to plant the same species consecutively in the same field, a practice that is highly discouraged in organic farming and is only allowed under very unusual circumstances. The potential for weed buildup and for weed resistance to herbicides should be a real concern for conventional farmers as well, and either continuous culture of the same crop or even use of the same herbicide (eg. Roundup©) should be avoided for this reason. The natural development of chemical resistance in weeds is assured in any such "monochemical" system. Organic rotational systems seek to avoid this type of problem through biodiverse cropping sequences and cover crops in the off-season to provide cover and compete with unwanted species.

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There are many research publications and ongoing projects to study organic crop rotations. A quick search on the web will reveal a number of studies from Canada and European countries as well as the U.S., and extensive publication lists, for example:
http://www.organicagcentre.ca/ResearchDatabase/res_field_rotation.asp
http://www.informaworld.com/smpp/content~content=a713782034~db=all~order=page#
http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/ind10745

Land Preparation and Residue Management

There is little specific information on unique land preparation guidelines for organic farming systems, since most of the same principles and practices from conventional farming apply to organic systems as well. The goal of basic tillage is to prepare a seedbed for the subsequent crop, and much research and education has been done to convince farmers that there is little need for preparation of the entire field when the seed will be planted in a narrow band that is 30 inches or more from the next narrow seedbed strip across the field.

For this reason and to preserve moisture, many farmers in the western cornbelt have moved to reduced tillage or no-till systems. Leaving previous crop residues on the soil surface helps reduce the loss of soil due to water flow and soil erosion when rain dislodges soil particles. An irregular residue pattern on the surface also reduces potential for wind erosion of soil particles and thus further protects against soil loss. The challenge in these systems for organic farmers is weed management, as it is not possible to spray an herbicide across the field to eliminate unwanted species. One solution has been use of ridge till with no prior land preparation before planting (Thompson, 1999) and scalping off the top of the ridge just in front of the no-till planter units. Weeds in the row are controlled with one or two passes of the rotary hoe, and weeds between the rows during a hilling up pass with a no-till cultivator. This is one of the few methods that appear to work well with no chemical applications. For articles from *The New Farm* on the Thompson experience, see:
http://www.newfarm.org/depts/iowa_pioneers/1102/thompsons/index.shtml

Other references can be found on the web for no-till organic production:
http://www.newfarm.org/features/0104/no-till/index.shtml
http://attra.ncat.org/attrapub/organicmatters/conservationtillage.html
http://www.sare.org/publications/diversify/diversify03b.htm

Planting Dates, Planting Patterns, and Planting Densities

There are specific reasons why non-traditional planting dates, more diverse planting patterns, and higher planting densities might be used in organic cropping systems. Often organic farmers plant summer annual crops later than the optimum date for conventional systems in order to use one or more cultivations to control the first flushes of weeds in the spring. In this case it may be necessary to plant a variety with a shorter time to maturity.

One unique application of different planting dates is to avoid contamination of an organic crop by pollen from GMO hybrids in nearby fields. Enough separation of

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planting dates could solve the problem if the GMO crops were planted at the normal early date, and the organic crops to be protected were delayed in planting by several weeks. The challenge of pollen drift and the legalities of liability are yet to be resolved, and these problems are a topic of many conversations in the organic farming community. For an example of an article:
http://www.agriculture.purdue.edu/aganswers/story.asp?storyID=3293

Some planting patterns can add diversity to the in-field environment and help protect against pests. Strip cropping, relay systems, annual/perennial crop combinations, and different crop planting dates can all create a non-uniform in-field biological system that can interrupt movement of vectors and insect pests. Just the move away from a large, monoculture field may be enough to discourage the reproduction of some pests, and to maintain pest populations below the economic threshold. Organic farmers practice other methods of control as described in a later section of this document. Some references on diverse planting patterns are:
http://www.eap.mcgill.ca/MagRack/AJAA/AJAA_5.htm
http://www.peisland.com/agrtour/xslope.html
http://www.forestry.iastate.edu/res/stripcropping.html

In organic cropping systems in which some type of mechanical weed management such as the rotary hoe will be used, farmers often increase the rate of seeding by 10-20% to compensate for the loss of some plants during the cultivation operation. This is a common practice for ridge-tilled corn or soybeans in the Midwest, when there is no use of chemical herbicides. Although not popular in the U.S., there are often one or two spring cultivations on winter cereals in Europe to control emerging annual weeds. The flexible tine cultivator spikes wander around the crowns of the overwintered rye, wheat, or barley, and there is relatively little damage to the crop. Again, there may be need to increase planting density to compensate for lost crop plants. Some references are on the web:
http://www.eap.mcgill.ca/CPW_7%20htm.htm [advantage of winter cereal]
http://www.merfield.com/research/organic-weed-management-a-practical-guide.pdf
http://www.acornorganic.org/pdf/cashcropprofile.pdf

Overall Cropping Systems Design

A good example of organic practices and recommendations for one Midwest crop is the Iowa State University bulletin on organic soybean production by Kathleen Delate (PM1881, August 2003):
http://www.extension.iastate.edu/Publications/PM1881.pdf

A practical alternative that can speed the conversion process is to certify land that has previously been in the CRP program. Again there are recommendations from Iowa State University on how to farm these lands in the first year with soybeans:
http://extension.agron.iastate.edu/sustag/resources/soycrp.html

It is this type of Extension publication that is badly needed for all of our major crops. Even more important will be the development of thoughtful, creative, and practical publications on design of overall cropping systems, especially those that incorporate

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crops and animals on mixed farms. Most experiences will come from farmers, and one role of Cooperative Extension can be to record, evaluate, and publicize the most useful results for other farmers to use.

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On-Farm Testing

In the absence of research results on organic practices and systems, and knowing that most effective systems will be specific to place and to the circumstances of each farm, many organic farmers have taken on their own research. A number of useful guidelines and methods are available:
http://ofrf.org/grants/on-farm_research_guide.pdf

Farmscaping

The manipulation of the ecosystem with annual and perennial plants that provide habitat and food sources for beneficial organisms can play an important role in overall crop health. Examples of "farmscaping" include, but are not limited to: managing hedgerows, creating nesting areas for birds and bats, and utilizing perennial and annual plants. Key considerations in crafting a farmscape plan are the ecology of pests and beneficials, timing, identification strategies, and encouragement of plant establishment. A good overview of farmscaping to enhance biological control can be found at the ATTRA website:
http://www.attra.org/attra-pub/farmscape.html

References and Resources

Thompson, R. 1999. Alternatives in agriculture. Thompson On-Farm Research and Wallace Institute, 2035 190th St., Boone, IA 50036-7423. [and other years of same publication]
http://www.newfarm.org/depts/iowa_pioneers/1102/thompsons/index.shtml

The Iowa State University production guide for organic soybean and its general bulletin on organic farming are excellent references, and should be consulted for an overview on management of crops in the western Corn Belt and Great Plains:

Fundamentals of Organic Agriculture [PM 1880, May 2003]
http://www.extension.iastate.edu/Publications/PM1880.pdf
Growing Organic Soybeans on Conservation Reserve Program Land [PM 1881, August 2003]
http://www.extension.iastate.edu/Publications/PM1881.pdf

The ATTRA website includes a comprehensive list of publications on organic farming, especially in crop management, and is cited elsewhere in this website:
http://www.attra.org/organic.html

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Soil Fertility for Organic Crop Production

Guidelines for maintaining soil fertility and the recommended crop nutrient management practices, as well as allowable and prohibited materials are given in the NOP (2002) rules in paragraph 205.203. These describe requirements in very general terms; specific recommendations must be site, season, and crop specific.

Much of the early work on organic farming systems centered on establishing and maintaining a healthy soil. This was described in the observations of F.H. King who found that the “farmers of forty centuries” in China and elsewhere in East Asia had kept soil nutrients at adequate levels by cycling nutrients within the farming and human community, including re-use of all organic materials and human wastes. In fact, the term “waste” is a misnomer; these materials should be termed “resources.” The work of Sir Albert Howard in India, and subsequent reports from the U.S., U.K., and Europe, all placed soil fertility at the top of the list of challenges for establishing productive and sustainable organic systems. Soil fertility was also the central focus of research in Missouri by Dr. William Albrecht, an early pioneer in study of the details of organic farming.

Albrecht, W.A. 1975. The Albrecht papers, Vol. I and II. Charles Walters, Jr., editor. Acres, U.S.A., Metairie, LA.

King, F.H. 1911. Farmers of forty centuries. Rodale Press, Emmaus, PA.

Howard, A. 1943. An agricultural testament. Rodale Press, Emmaus, PA.

Harwood, R.R. 1983. International overview of regenerative agriculture.

Harwood, R.R., editor. 1983. Resource-efficient farming methods for Tanzania. Rodale Press, Inc., Emmaus, Pennsylvania.

A primer on soil ecology is a useful foundation for discussion of maintaining soil fertility for crop production. The section by Bird, Berney, and Cavigelli in the *Michigan Field Crop Ecology* publication from Cooperative Extension (MSU Extension Bull. E-2646, 1998) is an excellent resource for those interested in starting to design a strategy for an organic soil fertility program. The authors describe the components of soil: minerals, water, air, and organic matter, and how these interact with soil management to provide different types of soil texture. The biotic components include plant roots, soil bacteria, fungi, actinomycetes, nematodes, arthropods, earthworms, and others that provide 3,000 to 15,000 pounds per acre of biomass in roots alone, and an additional 1,300 to 13,000 pounds per acre of biomass in the living and dead soil organisms.

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Subsequent sections in the MSU bulletin give more detail on soil carbon and soil nitrogen, and how these nutrients interact in complex cropping systems.

Cavigelli, M.A. et al (editors). 1998. Michigan Field Crop Ecology: Managing Biological Processes for Productivity and Environmental Quality. Michigan State Univ. Ext. Bull. E-2646. 92 pp. [available from MSU Cooperative Extension, $12]

The website for MSU Publications is:
http://web2.msue.msu.edu/bulletins/subjectsearch.cfm

Another general reference on soil fertility, including the soil environment, is the book, *The Non-Toxic Farming Handbook* published by ACRES, U.S.A. This book focuses both on building soil organic matter and encouraging key decomposers or microorganisms that work on breaking down organic matter into available nutrients, and on biologically active carbon that can help the soil store water, fix nutrients and buffer salts. Much of what is written here has been substantiated by laboratory science, yet other ideas such as the magnetic flows and energy patterns across the field await thorough testing before these hypotheses can claim to withstand the rigor of scientific proof. The ACRES, U.S.A. handbook also has a number of good recommendations on the effects of different tillage operations on soil structure and fertility, and the actions of various macro and micro nutrients.

The Non-Toxic Farming Handbook. 1998. P.A. Wheeler and R.B. Ward. ACRES U.S.A., P.O. Box 91299, Austin, TX 78709.
http://www.acresusa.com/books/closeup.asp?prodid=19&catid=4&pcid=2

The national SARE program has published *Building Soils for Better Crops Third Edition*, by Fred Magdoff of the University of Vermont, long-time advocate of practical and resource-efficient soil fertility management, and Harold van Es from Cornell University. The new edition includes effective management strategies that farmers can use to maintain soil organic matter using primarily on-farm, internal resources. It also details how fertility management can accompany appropriate crop and cover crop choices that influence soil structure and soil health, and how to interpret soil test results for cost-effective soil fertility management. The entire text is available on SARE's website:
http://www.sare.org/publications/bsbc/bsbc.pdf

Building Soils for Better Crops, third edition. 2009. Fred Magdoff and Harold van Es. SARE Outreach Publications, P.O. Box 753, Waldorf, MD 20604-0753:
http://www.sare.org/publications/soils.htm

Another useful and practical handbook on organic field crop production is published in Canada. Canadian Organic Growers' *Organic Field Crop Handbook* includes a number of chapters on soil fertility and healthy soils, and the production practices recommended to create these soils under northern farming conditions. It also provides a list of general organic production principles (taken from the Canadian General Standards Board) that are useful guidelines in our search for efficient and profitable farming strategies (pp. 3-5):

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1. protect the environment, minimize soil degradation and erosion, decrease pollution, optimize biological productivity and promote a sound state of health;
2. replenish and maintain long-term soil fertility by optimizing conditions for biological activity within the soil;
3. maintain diversity within, and surrounding, the enterprise, and protect and enhance the biological diversity of native plants and wildlife;
4. recycle materials and resources to the greatest extent possible within the enterprise;
5. provide attentive care that promotes the health and behavioral needs of livestock; and;
6. maintain the integrity of organic food and processed products from initial handling to point of sale

Organic Field Crop Handbook, Second Edition. 2001. Janet Wallace, editor. Canadian Organic Growers Inc., 323 Chapel St, Ottawa, ON. K1N 7Z2. This and other publications are available from their website: http://www.cog.ca/otherpubs.htm

In general, the guidelines from the U.S. National Organics Program (2002) describe a common sense approach to maintaining soil health and fertility with such suggestions as “select and implement tillage and cultivation practices that maintain or improve the physical, chemical and biological condition of the soil and minimize soil erosion.” This is good advice for any farming system. Crop nutrients must be managed “through rotations, cover crops, and the application of plant and animal materials.” The organic matter must be managed so as not to contaminate the soil with heavy metals, pathogens, or prohibited substances. There are also specific rules on application of manure and compost.

If there are any doubts about what is allowed or not allowed, the farmer is urged to consult with the certifying group to be sure a practice is acceptable before using a specific material. A good overview of soil quality and soil fertility is provided by the Iowa State University Bulletin 1882 compiled by Kathleen Delate et al.: http://www.extension.iastate.edu/Publications/PM1882.pdf

Crop Rotations

Crop rotations are so important to the organic system that they are discussed in several sections of the handbook. Rotations of cereals with legumes can result in a sustainable soil nutrient situation, but only if enough legumes are present in the sequence to provide for the high nitrogen use of the cereals. For example, soybean is a common legume in Midwest crop rotations, yet the crop extracts more nitrogen with the harvest than the crop can fix during the growing season. It has been called a “nitrogen sparing crop” because of soybean’s lower needs for nitrogen compared to corn and other cereals.

In general, crop rotations contribute to the biological structuring of a whole-farm cropping and crop/animal system. This system includes the choice of crops, crop

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cultivars and crop sequence, as well as management practices that depend upon an understanding of biological processes.

C.A. Francis and M.D. Clegg. 1990. Crop rotations in sustainable production systems. Ch. 8 in: Sustainable Agricultural Systems, C.A. Edwards et al.(editors). Soil & Water Conservation Society, Ankeney, Iowa. P. 107-122.

C. Francis and P. Porter. 2010. Ecology in sustainable agriculture practices and systems. CRC Critical Reviews in Plant Science (in press)

Crop rotations are described on the ATTRA website, along with substantial information about other practices and systems for organic farming: http://attra.ncat.org/attra-pub/organiccrop/tools2.html

This site describes the importance of forage legumes or other hay crops to a crop rotation, a difficult component to manage unless the farmer is equipped for alfalfa production or has livestock integrated with crop production. With the exodus of livestock from most Midwestern farms, there is no demand for forage unless there is an over-riding reason to include such crops in the rotation. Organic systems provide this compelling reason, since there is need to capture nitrogen through N fixation by legumes. There is more difficulty generating the nitrogen needed for heavy N consumers such as corn if there are no forage legumes in the crop sequence and no livestock on the farm. Some organic farmers, for example Jim Bender in Nebraska, maintain that it is nearly impossible to establish an adequate nutrient base in organic farms without livestock:

Jim Bender. 1994. Future Harvest: Pesticide-Free Farming. Nebraska Press, Lincoln, Nebraska.

The Figure below shows one example of a crop rotation that may be used successfully on organic farms in the Midwest.

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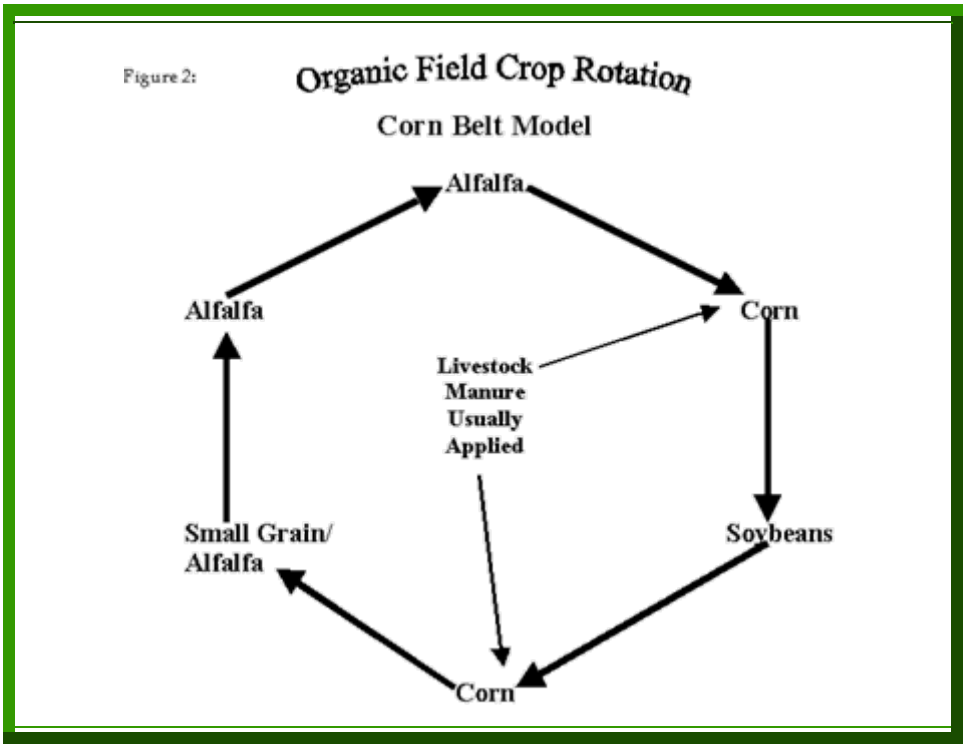

Source: ATTRA website.

Here are the summary points made on the ATTRA site about this generalized rotation (items taken directly from the website):

- Legumes fix nitrogen in the soil, providing for subsequent non-legumes in the rotation.
- Several insect pest cycles are interrupted, especially that of the northern and western rootworm species, which can be devastating to corn.
- Several plant diseases are suppressed, including soybean cyst nematode.
- Weed control is enhanced as perennial weeds are destroyed through cultivation of annual grains; most annual weeds are smothered or eliminated by mowing when alfalfa is in production.
- Livestock manures (if available) are applied just in advance of corn, a heavy nitrogen consumer.
- All crops can be marketed as is, or fed to livestock on-farm and be converted into value-added milk, meat or other livestock products.

Yet another summary of principles to consider when designing crop rotations is from Hardy Vogtman of the International Federation of Organic Agriculture Movements (IFOAM) and printed in *The Real Dirt* [p. 8-9, reference below]. He lists these general recommendations:

- Follow deep-rooted crops with shallow-rooted ones;
- Alternate crops having high and low root biomasses;
- Alternative nitrogen-fixing crops with nitrogen-demanding crops;

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- Follow slow-growing crops with weed suppressing crops;
- Where soilborne pests or diseases exist, don't follow one host crop with another; time plantings appropriately;
- Keep soils covered as much as possible; undersowing, green manures, and winter cover crops are important; and
- Farmers should consider crop suitability to climate and soil, balance between cash- and forage crops, seasonal labor requirements, and cultivation and tillage operations.

Several other sections of this book discuss cover crops, vegetable and herb production, small fruits, greenhouse systems, and marketing options.

The Real Dirt: Farmers tell about Organic and Low-Input Practices in the Northeast, Second Edition. 1998. Miranda Smith & Elizabeth Henderson, editors. Northeast Region SARE Program, 655 Spear St., University of Vermont, Burlington, VT 05405.

Cover Crops

As described in the section on crop rotations, including enough legumes in the sequence is difficult in most current Midwest farms due to the absence of livestock. One of the best ways to incorporate legumes is to use cover crops, either concurrently with the summer annual or as the summer crop begins to mature. Cover crops provide more than fixed nitrogen or a capacity to trap nutrients that would otherwise be subject to erosion or leaching. They can also reduce the impact of raindrops that are intercepted before striking the soil, prevent loss of soil and nutrients by reducing erosion, and increase infiltration of rain water thus reducing water loss from the immediate field environment. Addition of cover crops to the system also adds organic matter to the field which will improve soil structure and tilth, add a carbon source, and increase soil microbial activity. These ideas are summarized in a chapter in *Sustainable Agriculture Systems* by Douglas L. Karlen and Andrew N. Sharpley, a resource that includes 17 pages of references:

Management strategies for sustainable soil fertility. 1994. D.L. Karlen and A.N. Sharpley. Ch. 3 in *Sustainable Agriculture Systems*, J.L. Hatfield and D.L. Karlen (editors), Lewis Publishers, Boca Raton, Florida. pp. 47-108.

One of the large challenges for Nebraska farmers and others in the western cornbelt and Great Plains regions is limited rainfall. A number of cover crop strategies that are possible farther east where rainfall averages more than 40 inches per year are not feasible in our region with 30 inches or less. Depending on distribution of the rain, there is often not enough for summer annual crop growth, with unpredictable and periodic drought at some point in the season. This leaves scant opportunity for growth of a cover crop, and planting cover together with the principal crop could reduce yields of the latter. There is a window at the end of the season, while the summer annual crop is maturing and the leaves begin to senesce or fall, when years with adequate moisture could support cover crop growth. This is the most likely window for planting a relay cover crop species into the maturing cereal or soybean crop. A key reference is the

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book edited by the late Jim Power, a collection of chapters written by authors for a 1987 conference in Athens, Georgia:

> The role of legumes in conservation tillage systems. 1987. J.F. Power, editor. Soil Conservation Society of America, Proc. Natl. Conf., Univ. Georgia, Athens, GA. April 27-29.

Compost and Manures

Animal and green manures and compost are central to organic crop production, and specific rules apply to the preparation of these composts. For example, raw manure cannot be applied to land without composting unless this is for a crop not intended for direct human consumption. Animal manure must be composted unless it is applied and incorporated into the soil no less than 90 days before harvest of a product whose edible part of the plant is not in contact with the soil, or no less than 120 days if the product is in contact with the soil. The guidelines for composting of all types as listed in the regulations recommend that the process achieve:

- An initial C:N ratio between 25:1 and 40:1 for best nutrient use;
- A temperature between 131 and 170 degrees F for 3 days in a closed vessel; or
- The same temperature for 15 days in a windrow system with at least five turnings.

Several formulas and calculators can be found online that assist with determining the C:N ratio of a given mix of materials, such as the following site from Cornell University: http://compost.css.cornell.edu/calc/cn_ratio.html

The temperature of compost piles can be measured with compost thermometers. Information about compost thermometers can be found at the site below: http://www.compostinfo.com/main/links.htm

Direct application of fresh manure with immediate incorporation is the best way to get the maximum amount of nutrients back to the field production environment. Often this is not convenient to the farming schedule, or requires timely labor that is not available. There also may not be fields available to receive the manure. In these situations, composting is an excellent way to stabilize manure's nutrients and reduce water content to ease transport and handling.

When manure is simply left in a pile (stockpiling) there is a loss of around 50% of the N due to volatilization, and there are likely to be excessive odors and fly problems associated with the storage area as well as where this is applied. Somewhat less N is lost during the composting process, especially if some additional carbon sources such as wood chips, sawdust or discard hay are added to the compost windrow. The compost should be turned regularly to speed the process, assure that weed seed and plant pathogens are killed throughout the compost mass, and mix the materials more thoroughly to attain a more uniform product.

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There has been a substantial amount of research on composting and the long-term effects of the application of compost on crop growth, as well as the value of compost in terms of nutrients. Some general references on composting include:
http://www.gardenorganic.org.uk/composting/index.php [from U.K.]
http://www.pakissan.com/english/issues/composting.shtml [from Pakistan]
http://www.agf.gov.bc.ca/resmgmt/publist/300series/382500-15.pdf [from British Columbia]

There is a wealth of information on composts and manures on the ATTRA website under organic agriculture, as well as a search capability from the organic home page. Likewise, the New Farm homepage has a search option that reveals nearly 200 references on composts and manures from their back issues and contemporary electronic site that is continuously updated.
ATTRA site: http://attra.ncat.org/organic.html
The New Farm site: http://www.newfarm.org/

Publications available from University of Nebraska–Lincoln on the management of composts and manures include:

G1563	Manure Incorporation and Crop Residue Cover - Part I: Reduction of Cover
G1564	Manure Incorporation and Crop Residue Cover - Part II: Fine-tuning the System
G1939	Sewage Sludge Utilization for Crop Production

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These publications can be located at any Extension office around the state, or through the Extension website:
http://www.ianrpubs.unl.edu/epublic/pages/index.jsp

Systems Design

Attention to design of the whole system is important to maintaining soil fertility in organic systems. The design of a rotation sequence of crops should include consideration of soil nutrients as well as crop protection against pests (weeds, insects, pathogens) and suitability of individual fields for specific crops. One principle of sustainable agriculture and also of organic farming is location specificity, or designing cropping systems and practices that are unique to time and place and not homogeneous over a large area for convenience of maximum economic efficiency. This often means working with smaller rather than larger fields, very timely field operations compared to long-term scheduling of many locations for efficiency of equipment transportation, and increased labor and management costs because of the need to fine-tune field activities in response to weather and to specific conditions in each field.

Also important to system design is the integration of all the elements; this is especially critical in an organic system in which the crops and animal enterprises should complement each other. This integration can help maintain an agroecological balance among inputs and outputs, locate enterprises and plan their sizes so that resources can move efficiently from one to another, and organize sale of products to maintain a reasonable cash flow through the year. As stated in *The Real Dirt*, "diversity is valued because it gives ecological balance and spreads economic risks among enterprises. In order for a diverse system to be maintained … all elements including timing, labor needs, nutrient cycling, and marketing must work in a complementary manner." In this same book the design issues are expanded to community level, where the current challenges of establishing a cooperative group of farms on the landscape are made more difficult where there are few viable connections between farmers and consumers.

References and Resources

Albrecht, W.A. 1975. The Albrecht papers, Vol. I and II. Charles Walters, Jr., editor. Acres, U.S.A., Metairie, LA.
King, F.H. 1911. Farmers of forty centuries. Rodale Press, Emmaus, PA.
Howard, A. 1943. An agricultural testament. Rodale Press, Emmaus, PA.
Harwood, R.R. 1983. International overview of regenerative agriculture.[article described in the introductory section of this handbook]

This Extension Bulletin from Michigan State University is part of their series on ecological approaches to agriculture, and is highly recommended as a general reference on sound and sustainable management techniques and systems. MSU also offers bulletins on integrated pest management (IPM), ecological production of fruit crops, and other related topics that have relevance to organic agriculture. Search under "Sustainable Agriculture" for a good starting point:

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http://web2.msue.msu.edu/bulletins/subjectsearch.cfm

Several links to the U.C. Santa Cruz training handbook on organic farming and gardening are included below:

Teaching Organic Farming & Gardening: Resources for Instructors
[Note that the manual totals 604 pages]
http://casfs.ucsc.edu/education/instruction/tofg/contents.html

Introduction/How to Use This Resource

Part 1 Organic Farming and Gardening Skills and Practices (title page)

- Unit 1.1 Managing Soil Fertility
- Unit 1.2 Garden and Field Tillage and Cultivation
- Unit 1.3 Propagating Crops from Seed, and Greenhouse Management
- Unit 1.4 Transplanting and Direct Seeding
- Unit 1.5 Irrigation: Principles and Practices
- Unit 1.6 Selecting and Using Cover Crops
- Unit 1.7 Making and Using Compost
- Unit 1.8 Managing Arthropod Pests
- Unit 1.9 Managing Plant Pathogens
- Unit 1.10 Managing Weeds
- Unit 1.11 Reading and Interpreting Soil Test Reports
- Unit 1.11, Part 2

Part 2 Applied Soil Science (title page)

- Unit 2.1 Soil Physical Properties
- Unit 2.1, Part 2
- Unit 2.2 Soil Chemistry and Fertility
- Unit 2.2, Part 2
- Unit 2.3 Soil Biology and Ecology

Part 3 Social and Environmental Issues in Agriculture (title page)

- Unit 3.1 The Development of U.S. Agriculture
- Unit 3.2 Social Issues in Modern Agriculture
- Unit 3.3 Environmental Issues in Modern Agriculture
- Unit 3.4 Introduction to Sustainable Agriculture

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There are immense numbers of materials on the web and in libraries on organic management of crop nutrients. Some good possibilities include:

Chaney, D.E., L.E. Drinkwater, and S. Pettygrove. 1992. Organic soil amendments and fertilizers. U.C. SAREP, Publ. 21505. U.C. Davis.

Coleman, E. 1995. The new organic grower: a mater's manual of tools and techniques for the home and market gardener. Chelsea Green Publ, White River Junction, VT.

Magdoff, F., and H. Van Es. 2000. Building soils for better crops, Second edition. Sustainable Agr. Network, Handbook Series No. 4. National Agr. Library, Beltsville, MD.

Van Horn, M. 1995. Compost production and utilization: a growers guide. U.C. Division of Agr. & Natural Res. Publ. 21514, U.C. Davis.

More Useful Websites

The NRCS website about soil quality includes references to organic farming and other practices related to soil fertility and pest management:
http://soils.usda.gov/sqi/

Ontario's Ministry of Agriculture Food and Rural Affairs has a website related to organic farming practices and systems, and another general site for information on soil fertility:
http://www.omafra.gov.on.ca/english/crops/organic/organic.html
http://www.omafra.gov.on.ca/english/crops/soils/fertility.html

The ATTRA website is useful for information on organic nutrient supplies and how to design systems for maintaining soil fertility.
http://attra.ncat.org/organic.html

The New Farm website has a Google-based search engine that revealed more than 33,000 web hits on soil fertility; this would be a fruitful site for information on soil fertility in organic farming and other reduced input systems.
http://www.newfarm.org/

We find the Iowa State University Extension Bulletin PM 1882 on Soil Quality to be a valuable resource:
http://www.extension.iastate.edu/Publications/PM1882.pdf

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Plant Protection and Crop Management

Protecting organic crops from pests and disease requires that producers use a variety of management tools. In this section, weed management, insect management, and disease management are discussed. It is important to recognize that these management practices can be farm specific, vary seasonally, and depend on crop type and climate conditions. However, the integration of pest and disease management strategies is essential to maintaining and enhancing production. The ATTRA website (www.attra.org) has a useful summary of challenges an organic producer may encounter. Pest and disease issues may be the greatest challenges faced by producers who are transitioning to an organic system.

The Pesticide Treadmill

Resistance: Pesticide use exerts a powerful selection pressure for changing the genetic make-up of a pest population. Naturally resistant individuals in a pest population are able to survive pesticide treatments. The survivors pass on the resistance trait to their offspring. The result is a much higher percentage of the pest population resistant to a pesticide. In the last decade, the number of weed species known to be resistant to herbicides rose from 48 to 270, and the number of plant pathogens resistant to fungicides grew from 100 to 150. Resistance to insecticides is so common — more than 500 species — that nobody is really keeping score.

Resurgence: Pesticides often kill off a pest's natural enemies along with the pest. With their natural enemies eliminated, there is little to prevent recovered pest populations from exploding to higher, more damaging numbers than existed before pesticides were applied. Additional chemical pesticide treatments only repeat this cycle.

Secondary Pests: Some potential pests that are normally kept under good control by natural enemies become actual pests after their natural enemies are destroyed by pesticides. Mite outbreaks after pesticide applications are a classic example.

Residues: Only a minute portion of any pesticide application contacts the target organism. The remainder may degrade harmlessly, but too often water, wind, and soil will carries pesticides to non-target areas and organisms, affecting the health of human, domestic animal, and wildlife populations. Public concerns over residues are deepened by the lack of research and knowledge about possible synergistic interactions between pesticide residues and the hundreds of other synthetic chemical residues now found in the environment.

Excerpt from "Biointensive Integrated Pest Management", available at: http://www.attra.org/attra-pub/PDF/ipm.pdf

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Management Strategies and Resources

Specifics on insect, weed, and disease management can be found in Subpart C, "Organic Production and Handling Requirements," of the National Organic Program (NOP) Final Rule:
http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELDEV3003494&acct=noprulemaking

Weed Management

A weed is simply a plant, growing out of place, taking advantage of field resources unused by the crop. Weeds can become burdensome to field crops as they compete for water, soil nutrients and sunlight. Some weeds can be toxic to livestock, or can act as hosts for pests. If weeds are not properly managed they can reduce crop yield and set seed that will increase future weed problems.

Central components of organic weed control are crop rotation, tillage, mulching, livestock grazing, plant spacing and mechanical weed control. (The guidelines laid down for weed management are in section 205.206 of the NOP Final Rule.) In practice, various weed management strategies allow the farmer to develop angles of management that are farm, field, and even crop specific. Non-chemical weed control will also help to reduce the 240 million pounds of herbicides applied each year in the Midwest. Iowa State Extension's PM 1883, prepared by Kathleen Delate and Robert Hartzler, is a useful resource:
http://www.extension.iastate.edu/Publications/PM1883.pdf

Crop Rotation

Crops tend to promote weeds with a similar life cycle. It is useful to alternate crops with different life cycles and periods of growth in the field, for example sod-based crops such as alfalfa or pasture, with small grains such as wheat, oats, and rye, then with row-based crops such as corn, grain sorghum, or soybeans. In such rotations, any one weed will have trouble establishing itself year after year because of the varied effects of weed canopies, weeds spacing, and weed suppression properties of the rotating crops.

Tillage

Frequent tillage is the most common practice for weed management in organic systems. Often farmers plant organic crops later than normal, providing time to perform one or two light tillage operations to kill the first flushes of summer annual weeds before planting. The rotary hoe is a good friend of organic farmers, and it is common to use this implement once or twice on summer annuals – just before the crop emerges and when the crop is 4-8 days old. Field cultivation of row crops is used to hill up the crop, killing weeds and covering weeds in the same pass. For winter small grains, some European farmers use a light spring-tooth harrow in early spring to kill small emerging weeds; this is not a common practice in the U.S., but could be an option to explore.

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Mulching

Mulching is spreading large amounts of straw, old hay, wood chips, etc. on bare soil and among crops. Mulch regulates soil moisture and temperature as well as suppressing weeds and, in some instances, returns organic material to the soil. Plastic mulches are also permitted by NOP standards but often are considered a high-input practice as they are managed through drip irrigation, soluble organic fertilization and seasonal removal. There is also the problem of storing or disposing of plastic mulch after the season.

Livestock

Grazing animals can disperse seeds by walking through a crop field but are more likely to deposit them in their manure. In one study, manure from 17 of 20 New York dairy farms averaged 45 weed seeds per pound -- 90,800 seeds per ton of manure. *(Mt. Pleasant and Schlather. 1994. Weed Technology 8:304-310)* Weed seed germination will decrease after digestion and storage, and a well managed schedule of grazing locations and rotations can greatly reduce the amount of weed seed transferred by manure to crop fields.

Row Spacing and Crop Density

Closer row spacing leads to greater competition with weeds growing within the crop rows as well as between, by quickly establishing a leaf canopy and increasing competition for available sunlight. High seed germination rates are also critical in developing an early competitive canopy. Planting when the soils are adequately warmed will assist in quick germination.

Propane Flame Burning

Flame weeding, or flame cultivation, employs propane gas burners to control weeds. Flames are directed at established weeds that are seared by the heat, disrupting the plant leaf and causing it to wilt and die. Propane flame burners can be used to control weeds both between and within rows. For more information see: http://attra.ncat.org/attra-pub/PDF/flameweedveg.pdf

Insect Management

The number of insect species worldwide is greater than the number of all other species of known organisms combined. Unchecked growth of insect populations may lead to reductions in crop vigor, size, visual aesthetics and overall yield. Even so, much more attention has been given to insects as “pests” than warranted by the evidence. Many species of native bees and flies pollinate crops, a process essential for some fruit formation and seed yield. Beneficial insects may also serve to effectively suppress the development of harmful pest populations. Organic growers should take a “whole system approach”-- replacing external chemical inputs with an understanding of how biological resources on the farm can be used to promote insect suppression.

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Bug Vacuums

Field vacuuming in organic farming has been developed as an alternative way to manage insects. Vacuum machinery prevents pest damage by sucking insects from growing crops and "battering" them to death. Peaking in the late 1980s and early '90s, vacuuming is not often seen in today's fields yet offers an innovative approach to insect management without pesticides.
http://www.attra.org/attra-pub/PDF/bugvacuums.pdf

Integrated Pest Management (IPM)

IPM integrates a combination of techniques that monitor and evaluate populations of pests and beneficial organisms on the farm. It encourages a variety of management practices but also seeks to ensure that no one practice is in conflict with another. IPM seeks ecological and economic solutions to reduce chemical input costs, reduce on farm and off farm environmental impacts and promote sustainable pest management. A consideration of all possible pest management strategies should be done before any action is taken.
http://attra.ncat.org/attra-pub/PDF/ipm.pdf
http://www.ipmnet.org/

Disease (Pathogen) Management

Plant diseases are caused by a diverse group of pathogenic organisms. Disease pathogens include viruses, bacteria and fungi, all of which exhibit very different biological characteristics but share similar disease development traits. Soil pathogens have a limited area of dispersal, attacking a susceptible plant's roots that are dispersed towards the pathogen. Foliar pathogens range widely across North America, dispersing by spores and affecting plant leaves. As in other pest management practices crop rotation, tillage, row spacing, cover crops, and altered planting dates are effective strategies in containing the damages of pathogens. A good resource with general information about plant disease management on crops is provided by a California Extension Bulletin 7252, *Plant Disease Management for Organic Crops*, focusing on principles that are generally applicable, as well as specific cases for west coast crops:
http://anrcatalog.ucdavis.edu/pdf/7252.pdf

Vegetable disease management in the northeast U.S. is described in a bulletin from the University of Vermont. The focus is on prevention of diseases, and on limiting their spread once they occur:
http://www.uvm.edu/vtvegandberry/factsheets/diseasemanagement.html

Disease management in organic systems in the Canadian plains provinces is described in a bulletin from Manitoba:
http://www.gov.mb.ca/agriculture/crops/insects/fad64s00.html

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Additional Resources

Print Resources:

Pickett, Charles H., and Robert Buggs, eds. 1998. Enhancing Biological Control: Habitat Management to Promote Natural Enemies of Agricultural Pests. Berkeley: University of California Press.

Bowman, Gregg ed. 1997. Steel in the Field: A Farmer's Guide to Weed Management Tools. Handbook series Book 2. Burlington, VT: Sustainable Agricultural Network.

Smith, Richard, W. Thomas Lanini, Mark Gaskell, Jeff Mitchell, Steve Koike, and Calvin Fouche. 2000. Weed Management for Organic Crops. Publication 7250. Oakland, CA: University of California Division of Agriculture and Natural Resources.

Council for Agricultural Science and Technology (CAST). Integrated Pest Management: Current and Future Strategies. Task Force Report No. 140, June 2003.

Wheller, Phillip and Ronald Ward. The Non-Toxic Farming Handbook. 1998. Acres U.S.A. P.O. Box 8800 Metairie, Louisiana 70011

Gips, Terry. Breaking the Pesticide Habit -- Alternatives to 12 Hazardous Pesticides.International Alliance for Sustainable Agriculture. 1987.

Michigan State University Extension Bulletin E-2704. Michigan Field Crop Pest Ecology and Management. January 2000.

Ellis, Barbara and Fern Bradley. "The Organic Gardener's Handbook of Natural Insect and Disease Control". Rodale Press, Inc. 1992.

Web Resources:

University of California Agriculture and Natural Resources Integrated Pest Management Program.
www.ipm.ucdavis.edu

This section of the UC-Davis IPM website is dedicated to addressing individual crop, disease, and insect problems through IPM guidelines.
http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html

Sustainable Agricultural Network: A Whole-Farm Approach to Managing Pests.
This bulletin outlines how to apply ecological principals to control pests on your farm.
http://www.sare.org/publications/farmpest/farmpest.pdf

National Sustainable Agricultural Information Service (ATTRA)

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Site offers specific PDF or HTML publications for disease, insect, and weed management.
http://www.attra.org/pest.html

The Association of Applied IPM Ecologists was established in 1967 to exchange philosophical ideas and technical information. Their website provides a good introduction of organization as well as an extensive base of IPM Agricultural links.
http://www.aaie.net

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Organic Livestock Production

Information on certification for organic livestock production is presented in detail in both the NOP and the OCIA standards that are available online. The standards for organic livestock production provide guidelines for making management decisions and assuring appropriate living conditions for livestock that will limit environmental stress and promote animal health. These are useful guidelines for successful production of livestock in any system, as low stress and good health lead to profitable livestock production. The standards also delineate what substances can and cannot be used in feeding and in health care, and guidelines for space and conditions in housing livestock. General information about organic beef and dairy, hogs, sheep, goats and poultry is provided on the ATTRA website: http://attra.ncat.org/livestock.html

Events in the U.K., Canada, and the U.S. surrounding "Mad Cow" disease, as well as E. coli and other contamination scares, have caused people all over the world to become interested in organic meat production. There is currently a push to institute a tracking system is the U.S. with more stringent rules on labeling meat and other products by country of origin similar to the system used in the EU. These events also provide a market opportunity for organic farmers.

The web is a near-endless source of information on organic livestock production and marketing; only a brief sampling of relevant items is presented here:

Training broadcast from Washington State Univ. in 2004:
http://ext.wsu.edu/noas/archive/

Livestock handbook from the Canadian Organic Growers: http://www.cog.ca/olh.htm

Marketing options from the Canadian Organic Livestock Association (COLA):
http://www.colabeef.ca/

NCAT/ATTRA has an organic livestock workbook online, covering allowed practices and products and a section on pastures and hay crops, all in compliance with the NOP:
http://www.attra.org/attra-pub/PDF/livestockworkbook.pdf

Bibliography on organic livestock production by Mary Gold of AFSIC:
http://www.nal.usda.gov/afsic/AFSIC_pubs/srb0405.htm

According to the USDA's National Organic Program (NOP), "livestock includes cattle, sheep, goats, swine, poultry, fish, wild or domesticated game and horses raised for slaughter or used as draft animals. There are even standards for organic bee-

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keeping. Regardless of whether they're raised as breeding stock, as dairy animals, or for slaughter, all livestock is covered by the NOP." Some of the questions that come up most frequently regard feeding and feedstuffs, health care and housing, and what record keeping is necessary to meet certification standards.

Feeding Organic Livestock

A substantial body of information has been accumulated on livestock feeding, especially in pasture-based systems. Early experimental results on grass feeding in Tifton, Georgia showed substantial advantages in both costs per pound of gain and in nutritional value of beef, as reported in *Organic Farming: Yesterday's and Tomorrow's Agriculture* (Wolf, 1977). The Georgia data showed a return to capital, land, labor, and management of $9.66/head for calves and -$18.63/head for yearlings on concentrate diet, and a return per head of $59.13 for calves and $23.97 for yearlings on an all-forage diet.

Studies continue in the area of livestock feeding:

Organic sheep and beef grazing in a non-arable hilly area of Wales:
http://www.organic.aber.ac.uk/library/Eight%20years%20of%20organic%20farming%20at%20Pwllpeiran.pdf

Comparing major cost items in organic, grazing and confinement dairy farms in Wisconsin:
http://cdp.wisc.edu/pdf/Major%20Costs%20WI%20organic%20graze%20confine.pdf

Conversion of cattle and sheep suckler operations in France:
http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6T9B-47RRVCH-6&_user=10&_rdoc=1&_fmt=&_orig=search&_sort=d&_docanchor=&view=c&_searchStrId=1057077348&_rerunOrigin=google&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=173ef5be88e4e91bef1aa81d6e297c58

One person who has popularized grazing systems as well as careful management of grazing lands is Alan Savory with his books and educational programs related to Holistic Management (Savory, 1990). Another popular speaker, Joel Salatin, farms in Virginia and is author of several practical field guides to farming and marketing: *Pastured Poultry Profits* (1993), *Salad Bar Beef* (1995), and *You Can Farm: The Entrepreneur's Guide to Start and $ucceed in a Farming Enterprise* (1998). His enthusiasm and common sense approach to farming and direct marketing are contagious, and his books contain many practices that are highly appropriate for organic livestock production. These books are available from:
http://www.polyfacefarms.com/books.aspx

Summarized briefly, organic livestock must be fed organic feed except under very unusual circumstances such as a national, state or local weather emergency or a fire or flood on an organic farm. Among the allowed (acceptable) materials are: feed raised by organic production practices, natural vitamin and mineral supplements, and fresh water from sources where contamination is unlikely.

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Materials that are restricted include: conventional feeds (up to 40% allowed in animals raised for slaughter, but none is allowed within 90 days of slaughter, or within 30 days of milking or laying); antibiotics (some allowed for treatment of specific diseases, but not within 90 days of slaughter or 30 days of milking or laying); holistic verterinary medicines and practices (check regulations for allowable homeopathics, radionics, herbal preparations, and acupuncture); and vaccination (not within 90 days of slaughter or 30 days of milking or laying).

Prohibited materials include synthetic hormones or urea; plastic pellets for roughage; routine administration of medications not in connection with treatment of a specific malady or disease; and synthetic pesticides or fertilizers. If there is any doubt about use of specific products, farmers should consult the latest regulations of the NOP or their certifying agency – these materials are all online.

The National Organic Standards Board (NOSB) recommends that conventional feed be allowed only if the organic feed supply has been compromised by a national, state or local weather emergency, or by fire or flood on an organic farm. Again, if there are any doubts about what is acceptable as an organic practice the farmer is urged to contact the certifying organization before making a decision to make sure that a practice is in line with the requirements.

A list of suppliers of approved organic feeds is given on the ATTRA website, and is continually updated for accuracy:
http://attra.ncat.org/attra-pub/livestockfeed_srch.php

Housing and Health Care for Organic Livestock

Healthy living conditions and attentive care are considered first steps in the prevention of illness. Therefore, animals must not be overcrowded, and must be allowed periodic access to the outdoors and direct sunlight. Antibiotics, wormers and other medications may not be used routinely as preventative measures. See the NSOB's National List for their recommendations for the use of medications in organic livestock:
http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateN&navID=NationalListLinkNOPNationalOrganicProgramHome&rightNav1=NationalListLinkNOPNationalOrganicProgramHome&topNav=&leftNav=&page=NOPNationalList&resultType=&acct=nopgeninfo

Here are some of the details from the NOP (Paragraph 205.239):

- Livestock must have access to the outdoors, shade, shelter, exercise areas, fresh air, and direct sunlight suitable for the species, and its stage of production and the climate;
- Access to pasture for ruminants;
- Appropriate clean, dry bedding – if the bedding is typically consumed by the animals, it must comply with the feed requirements (described above);

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- Shelter designed for natural maintenance, comfort and opportunity to exercise; temperature level and air circulation/ventilation; and reduction of potential for injury;
- Temporary confinement is allowed because of inclement weather, animal's stage of production, conditions where health and safety of animals could be jeopardized, and risk to soil or water quality;
- Manure must be managed in ways that do not contaminate crops, soil or water by plant nutrients, heavy metals, or pathogenic organisms; also management should include maximum recycling of nutrients.

Needless to say, most of these requirements are common sense issues regarding the safe and healthy treatment and management of livestock. They also contribute to good productivity. Forms for the documentation needed to certify for the housing of organic livestock are found on the ATTRA site: http://www.attra.org/attra-pub/PDF/livestockforms.pdf

Record Keeping for Organic Livestock

Records must be kept on all feeding and health care practices for each animal or flock, and there must be a verifiable audit trail to trace any animal or flock back to the farm. This includes where all animals were acquired, the conditions of the farm where animals were born, and how they were raised. There are specific requirements for different livestock species, and examples of some of these are provided here (NOP paragraph 205.236). In general, a paper trail must be kept with all details to show compliance with these requirements:

- Poultry or poultry products must be from animals that have been under continuous organic management beginning no later than the second day of life;
- Milk or milk products must be from animals that have been under continuous organic management beginning no later than one year prior to production of milk; there are some exceptions when the entire herd is being converted;
- Breeder stock can be brought into an organic operation at any time, provided such animals are gestating and the offspring are to be raised as organic, and the mothers must be brought in no later than the last third of gestation;
- Any livestock removed from the organic operation may not be sold or labeled as organically produced;
- Breeder or dairy stock not under continuous organic management since the last third of gestation cannot be sold or labeled as organic;
- Producer must maintain adequate records to preserve the identity of all organically managed animals and edible and non-edible animal products produced in the operation.

These regulations on feeding, health, and record keeping are described in much greater details in the regulations of the NOP or in the specific materials provided by each certification organization. They should be kept handy as a ready reference to answer any questions that come up while making management decisions in organic livestock production operations. Some examples of additional available references and

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useful websites are provided here. This is not an exhaustive list, but it is meant to serve as an entry into the considerable literature on organic livestock production.

An example is OCIA's certification program; their website has general information on certification including specific details on documentation:
http://www.ocia.org/documents/standards-docs/LivestockGuidanceDocs.pdf

The site also contains many other resources for organic producers, including all the documents needed regarding crops and livestock.

An example of the information available from private organizations comes from Organic Valley, a cooperative for milk production and other products that so far is farmer-owned and independent of multinational corporations. Their website is:
http://www.organicvalley.com

Overview of Practical Organic Livestock Growing

The Canadian Organic Growers assembled a practical book in 2004*, The Organic Livestock Handbook:*
http://www.cog.ca/our-services/publications/organic-livestock-handbook/

The *Handbook* is divided into three sections:

*Section 1 e*xplains the principles of organic livestock husbandry and includes chapters on animal welfare, nutrition and health care, and converting to organic methods.

Section 2 provides information on various management tools available to the farmer. Topics covered are health care alternatives, methods to control internal parasites, management-intensive grazing, manure management, fly control, handling to minimize stress, marketing, certification and record keeping.

Section 3 addresses, for each livestock type, those aspects of management that are particularly significant in an organic farming system. It uses examples from Canada and the northern United States to illustrate the various types of organic livestock enterprises that exist today, from dairy cows to honey bees.

The book has been recently reprinted and updated from the original edition, with photos and figures to illustrate the information in the text. An appendix describes different livestock standards in Canada, and current information on consulting services and organic supplies. Although this is most relevant in Canada, farmers in northern U.S. states will also find the information useful.

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Print References and Resources

At a workshop in South Dakota, Joel Salatin was asked how many families could potentially earn their livings on his 93-acre farm in Virginia, where the farm now supports four families. Without missing a beat, Joel said "We have calculated that – the number is 24 families." Here are books by a hard-working and visionary farmer, a person who not only succeeds as a small-scale entrepreneur but can articulate that message in writing and on the speaker's podium. We recommend that you attend one of his presentations, or at the very least read one of these books:

http://www.polyfacefarms.com/

Salatin, J. 1996. Pastured Poultry Profits. Polyface, Inc. Swope, Virginia.
Salatin, J. 1996. $alad Bar Beef. Polyface, Inc. Swope, Virginia.
Salatin, J. 1998. You Can Farm: the Entrepreneur's Guide to Start and $ucceed in a Farming Enterprise. Polyface, Inc. Swope, Virginia.

This book is an early summary of cultural practices for good soil fertility and organic pest protection, but also includes management issues such as manure use and rotations, and evaluation of the economics of organic farming. Much of the information is taken from the *Organic Gardening and Farming* magazine published by Rodale Press, and the author cites the editors of the magazine as among the important contributors.

Wolf, R. (editor) 1977. Organic Farming: Yesterday's and Tomorrow's Agriculture. Rodale Press, Emmaus, Pennsylvania.

Canadian Organic Growers. 2004. The Organic Livestock Handbook. Canadian Organic Growers, Box 6408, Station J, Ottawa, Canada, K2A 3Y6, Canada.
http://www.cog.ca/our-services/publications/organic-livestock-handbook/

Useful Websites

Recent Growth Patterns in the U.S. Organic Foods Market, by Carolyn Dimitri and Catherine Greene, ERS Agriculture Information Bulletin No. AIB777. 42 pp, September 2002
http://www.ers.usda.gov/publications/AIB777/

This website contains a 42-page summary of the current situation on organic foods and markets in the U.S. Included are two sections on organic livestock production and marketing: *Organic Dairy Products* (p. 16-17) and *Organic Meat, Poultry, and Eggs* (p. 18-19). These sections are available for quick reference.
http://www.ers.usda.gov/publications/aib777/aib777.pdf

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Pastured Products Directory for Nebraska. Sponsored by “Eat Wild”, the Clearinghouse for Information about Pasture-Based Farming.

The Nebraska section is one part of this national resource on where to find pasture-based livestock, including beef, sheep, buffalo, poultry, and wild game. Although not all farms are certified organic, the operations listed provide some excellent ideas on creative marketing strategies and how to add value to livestock products. Another section of this website holds a comprehensive list of nutrition-related scientific references that can lead the interested reader into details on fat and vitamin content, human health, environmental impacts, antibiotics, and worker health in confinement versus pasture-based systems.
http://www.eatwild.com/products/nebraska.html
http://www.eatwild.com/references.html

Livestock - Dairy, Meat and Poultry Production. A Canadian website called “Cyber Help for Organic Farmers: a Rural Capacity Building through Organic Agriculture Project.”

This site contains a long list of links to other websites on organic livestock production, including organic rules, beef and dairy, swine, goats and sheep, poultry including eggs, and bison. There are further links on pasture management, animal health and welfare, and marketing livestock products. This one is worth a visit, and along with ATTRA could be the best place for “one-stop shopping” of relevant websites on organic livestock.
http://www.certifiedorganic.bc.ca/rcbtoa/training/livestock.htm

ATTRA Website. National Sustainable Agriculture Information Service.

One of the most popular and informative websites for organic and sustainable agriculture in the U.S., the ATTRA information resource service from Fayetteville has been attractive to small farmers for years. Their site contains regulations on certification, field crops and livestock, fruits and vegetables, herbs and flowers, pest and nutrition management, and marketing among other topics. The ease of accessibility and people ready to answer specific information requests have long made the ATTRA resource one of the premier sites for agricultural transitions and opportunities.
http://attra.ncat.org/organic.html

Scientific References

Eat Wild Website

This website features journal references relevant to grass-based production. They are sorted into categories and some of the most significant studies are highlighted in the web list.

- Fats in products from pasture-raised and confinement-raised animals
- Health benefits of diets with a low ratio of Omega-6 to omega-3 fatty acids
- Vitamin content of products from pasture-raised and confinement-raised animals
- Environmental consequences of grass-based versus confinement-based animal production

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- Animal health and welfare in grass-based and confinement-based animal production
- Questionable ingredients in feedlot diets
- Consequences of the use of feed antibiotics, steroids, and other drugs in animal production
- Worker health in animal confinement operations
- Meat quality
- Food safety
- Added health benefits of products from pastured animals

http://www.eatwild.com/references.html

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Science-Based Organic Farming 2010: Toward Local and Secure Food Systems

Organic Gardening: Market and Home

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Research in agronomy and horticulture focuses primarily on crop technologies including synthetic fertilizers, herbicides, and pesticides. Organic growing is most often associated with gardens, and not with large-scale monocrop agriculture – and this is reflected in the larger amount of information in books and available on websites on organic gardening than has been compiled for organic farming. Some key individuals and institutions, however, continue to work in organic systems, and organic gardening information and techniques can be useful to larger production operations as well as on a small scale.

The vigorous magazine and book publication efforts of groups such as Rodale Press are largely responsible for the preponderance of organic gardening information. Numerous books have become available containing techniques for pest management, composting, interplanting, adaptation of cultivars for different zones, and all the details on different philosophies for organic garden management. Several of these resources are provided at the end of this section.

Information on organic gardening is provided in this handbook because Extension educators are likely to receive many questions from clients about specific pests in the organic garden, and how to manage soil fertility on a smaller scale. This section includes general information about rotations, mulching and cultivation, location and planting dates, and pest management. For more specific information, please refer to the *References and Resources* and *Useful Websites* listed at the end of the section.

Soil Basics, Crop Rotations

The University of Nebraska-Lincoln (UNL) Institute of Agriculture & Natural Resources (IANR) document “Organic Gardening in the Backyard,” by Dale Lindgren and colleagues includes all the important principles of organic gardening and can serve as a general resource for success by “consideration of many factors, including resistant cultivars, crop rotation, sanitation, incorporation of organic matter, garden location, and insect and disease control.” The authors point to the importance of organization and record keeping, especially for designing rotations to avoid insect and disease problems. Because certain related crops such as tomatoes and peppers are susceptible to the same insects and pathogens, they should not return to the same site for three to five years. A detailed garden map made each year can help gardeners remember exactly where certain crops have been planted and will facilitate useful crop rotations to help

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reduce or avoid insect and pathogen problems that affect plants within the same plant families.
http://digitalcommons.unl.edu/extensionhist/1004/

For more information, see the following University of Nebraska documents:

Fertilizers for Vegetables in Home Gardens:
http://www.ianrpubs.unl.edu/sendIt/g945.pdf

An older version of this document has been archived:
A Gardener's Guide for Soil and Nutrition Management in Growing Vegetables
http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=2011&context=extensionhist

Intensive Gardening Techniques
http://extensionhorticulture.unl.edu/Articles/SJB/Intensive.shtml

Mulches, Cultivation, and Composting

Weed and water management are problems in organic gardening systems just as they are in organic farming systems. Garden mulches can be used in the summer to reduce the amount of water lost through evaporation and to help control weeds. Winter mulches can also be used to help the garden retain moisture and prevent the loss of perennial plants. The Lindgren et al. resource listed above suggests various sources of mulch available to the gardener, including grass clippings, hay or straw, wood shavings or sawdust, and ground corn cobs available here in the Midwest. Many of these mulching options are well-suited to the small areas of a home garden, while they would not be feasible for a larger field area because of materials costs or the labor needed to install them.

The authors point out that mulching effectiveness depends on the material and the thickness of application. They also note that while there are many benefits, the mulch can bring in weed seed, and if grass clippings come from neighbors' yards on which chemicals are applied, this could compromise the organic status of the garden.

Another publication about landscapes that describes mulching alternatives is available at:

Mulches for the Home Landscape
http://www.ianrpubs.unl.edu/epublic/pages/publicationD.jsp?publicationId=187

Methods of cultivation and management of the garden environment can contribute to overall success. Weed management can be achieved through the use of mulches, mechanical cultivation using a tiller, manual removal, or through the use of garden implements such as hoes and other cultivators. The garden environment can also be managed through careful inspection of all incoming plants and removal of all diseased or insect-infested plants. Observation of the garden is important for maintaining a biological balance and relatively weed, insect, and disease-free environment.

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Composting is key to the success of organic gardens, offering a natural, non-intensive source of the nutrients necessary to all horticulture crops, as well as many other benefits. Food scraps, weeds, plants that are removed, grass clippings, and other organic materials can be composted and later used for fertility, weed, and water management. Details on composting in the home garden are described in the Nebraska Cooperative Extension NebGuide 86-810, *Garden Compost*, which is also available at:

NebGuide: Garden Compost (Revised 2006)
http://www.ianrpubs.unl.edu/epublic/pages/publicationD.jsp?publicationId=526

Location and Irrigation

Most gardeners are limited in the choice of sites and size of a garden, but some guidelines can help inform the choice of a site that will stimulate plant growth and limit pest problems. Shaded areas will generally reduce crop growth and provide an environment for more plant diseases. The site should be well drained; drainage can be improved by incorporating compost or other organic matter in areas of poor soil or putting a gravel layer beneath the garden to enhance drainage. Obviously this is an expensive and time-consuming activity, and only applicable to smaller areas.

Additionally, access to water is important for our unpredictable climate. Drip irrigation uses water efficiently and is preferable to sprinklers, since the latter may keep the foliage wet and more susceptible to leaf diseases and some insects. Another strategy known as the “Ruth Stout No-Work Gardening” plan, found in a book by the same name published by Rodale Press, suggests distributing deep mulch over the garden soil surface and letting it decompose there. The mulch is just moved aside in spring to allow planting, and then pushed back around plants as they grow. This has been used by the Francis family in their organic garden with success in Lincoln for over ten years.

Pest Management

Good garden sanitation and irrigation practices can help avoid problems with pests. Avoiding wet foliage at night, as mentioned in the previous section, helps reduce problems with disease. Some pest problems can be avoided by altering planting dates. For example, a delayed planting of some vegetables can avoid the major insect infestations of early summer. Planting dates will depend on moisture availability and the temperature regime.

The best method to control insects is to plant resistant varieties of vegetables, although these are not always available. Row covers can be used to physically protect plants from insects, a workable solution for the small areas generally found in home gardens. Metal screens and fencing can also be used as an exclusionary tactic on small areas to prevent larger insects as well as other pests such as rabbits. Trap crops such as nasturtium for aphids, or physical traps such as shingles laid on the ground, can attract problem insects to a collection point from which they can be destroyed. Some

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insects that are of large enough size, such as the Colorado Potato Beetle, can be removed from plants by hand in a small garden.

Spraying plant leaves with water or a soap solution can remove and even prevent some insect problems. Biological control methods such as *Bacillus thuringiensis* (Bt), pyrethrins, rotenone, sulfur, insecticidal soaps, and nicotine sulfate are allowed in organic gardening since they are biologically derived and/or acceptable for organic production. There are many home remedies, and a wide range of products offered on the commercial market. Some of these methods are effective, but common sense should be the guide in selecting such products. The gardener should seek good references from independent sources or talk to people who have employed these methods to determine if they are effective, safe, and cost-efficient.

The following websites contain useful insect management information:
http://www.attra.org/attra-pub/farmscaping/fsaddlreading.html [ATTRA]
http://muextension.missouri.edu/explore/agguides/hort/g06220.htm [Missouri]
http://anrcatalog.ucdavis.edu/pdf/7251.pdf [California]
http://anrcatalog.ucdavis.edu/merchant.ihtml?pid=3706&step=4 [California]
http://www.cals.ncsu.edu/sustainable/peet/IPM/insects/04insect.html [North Carolina]
http://www.colostate.edu/Depts/CoopExt/4DMG/VegFruit/organic.htm [Colorado]

References and Resources

The periodical with the most comprehensive coverage of organic gardening is from Rodale Press in Emmaus, Pennsylvania. The magazine was originally called "Organic Farming and Gardening", but was split into the current magazine called simply "Organic Gardening" and "The New Farm" that was published for 15 years. The latter is again available online:
http://www.organicgardening.com/ [*Organic Gardening* magazine]
http://www.newfarm.org/ [website for *The New Farm*]

Rodale Press also has a number of books dedicated to organic gardening. A useful book that can be used as a quick reference is *Rodale's All-New Encyclopedia of Organic Gardening*, Fern Marshall Bradley and Barbara W. Ellis (eds). ©1997,Rodale Press.

Many other books are available on organic gardening. The following books are available in UNL Libraries (http://iris.unl.edu/):

The Best Of Organic Gardening : Over 50 Years Of Organic Advice and Reader-Proven Techniques From America's Best-Loved Gardening Magazine, 1996, edited by Mike McGrath ; contributing editors, Vicki Mattern and Jill Jesiolowski, Emmaus, Pa. : Rodale Press ; [New York] : Distributed in the book trade by St. Martin's Press

Easy Compost : The Secret To Great Soil and Spectacular Plants, 1997, Beth Hanson, editor, Brooklyn, N.Y. : Brooklyn Botanic Gardens,

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The Encyclopedia Of Natural Insect & Disease Control : The Most Comprehensive Guide To Protecting Plants--Vegetables, Fruit, Flowers, Trees, And Lawns--Without Toxic Chemicals, c1984, edited by Roger B. Yepsen, Jr , Emmaus, Pa. : Rodale Press

Four-Season Harvest : How To Harvest Fresh Organic Vegetables From Your Home Garden All Year Long, 1992*,* Eliot Coleman ; illustrations by Kathy Bray ; foreword by Barbara Damrosch, Post Mills, VT : Chelsea Green Pub.

Gaia's Garden : A Guide To Home-Scale Permaculture, 2001, Toby Hemenway, White River Junction, Vt. : Chelsea Green Pub. Co.

Healthy Harvest : A Global Directory Of Sustainable Agriculture & Horticulture Organizations 1992 , Healthy Harvest Society, Davis, CA : agAccess

Micro Eco-Farming : Prospering From Backyard To Small Acreage In Partnership With The Earth, 2004, Barbara Berst Adams, Auburn, Calif. : New World Pub.

The New Organic Grower : A Master's Manual Of Tools And Techniques For The Home And Market Gardner, 1989, Eliot Coleman ; illustrations by Sheri Amsel, Chelsea, Vt : Chelsea Green

The Permaculture Garden, 2005, Graham Bell; illustrated by Sarah Bunker, East Meon, Hampshire, U.K. : Permanent Publications

Rodale's Illustrated Encyclopedia Of Organic Gardening, 2002, Henry Doubleday Research Association; editor-in-chief, Pauline Pears, New York, N.Y. : DK Pub.,

Solar Gardening: Growing Vegetables Year-Round The American Intensive Way, 1994, Leandre Poisson and Gretchen Vogel Poisson ; illustrations by Robin Wimbiscus and Leandre Poisson, White River Junction, Vt.: Chelsea Green Pub. Co.

Useful Websites

University of Nebraska-Lincoln Institute of Agriculture & Natural Resources (IANR) NebGuides and other documents

Reference Material for Commercial Vegetable Producers and Extension Agents
http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1820&context=extensionhist

Selected Vegetable Cultivars for Nebraska
http://www.ianrpubs.unl.edu/sendIt/g1896.pdf

Seed Sources for Commercial Vegetable Production
http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1822&context=extensionhist

General and Specialty Mail-Order Seed Sources
http://www.ianrpubs.unl.edu/sendIt/g1895.pdf

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Income Generation Using Alternative Crops
http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1831&context=extensionhist

Weights & Measures Guidelines for Sales at Farmers Markets, Roadside Stands and Other Commercial Outlets
http://www.ianrpubs.unl.edu/sendIt/g1944.pdf

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University of Nebraska-Lincoln Extension in Southeast Nebraska
Horticulture http://lancaster.unl.edu/hort/
Organic Gardening: http://lancaster.unl.edu/hort/Articles/2005/organic.shtm

USDA Alternative Farming Systems Information Center
http://www.nal.usda.gov/afsic/ofp/
http://www.nal.usda.gov/afsic/AFSIC_pubs/org_gar.htm

The ATTRA website mentioned in various parts of this handbook has a number of publications on organic vegetable production and season-extending for horticultural crops:
http://attra.ncat.org/organic.html
http://www.attra.org/horticultural.html
http://www.attra.org/attra-pub/seasonext.html

The Kansas Center for Sustainable Agriculture and Alternative Crops website lists sustainable gardening publications (pdf), including Alternative Pest Controls for Gardens, Conserving Water in the Garden and Cover Crops for Vegetable Growers, available at:
http://www.kansassustainableag.org/Library/S.htm#sustainablegardening

Iowa State University's Continuing Education & Communication Services Extension, site lists publications on gardening, including soils, weed management, IPM, composting, mulches, Community Supported Agriculture, non-chemical pest control and fruits & vegetables pest management. A few are included in Spanish.
http://www.extension.iastate.edu/pubs/ga.htm

The University of Missouri's Extension website contains several documents (search "organic gardening").
http://extension.missouri.edu/

Colorado State University's Cooperative Extension site also offers organic gardening resources (search "organic gardening").
http://www.colostate.edu/Depts/CoopExt/4DMG/index.htm

North Carolina State University (NCSU) has been especially active in management of sustainable vegetable systems, including organic gardens. Dr. Mary Peet has prepared many of these publications focusing on production in the Southern U.S., but also containing information relevant to most areas:
http://www.cals.ncsu.edu/sustainable/peet/index.html

NCSU's Organic Gardening site index lists many resources (not all are appropriate for our growing conditions).
http://www.ces.ncsu.edu/depts/hort/consumer/hortinternet/organic.html

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Many other universities offer relevant information on organic vegetable production. A few websites with useful information are listed here:

Rutgers University Organic & Sustainable Living links
http://aesop.rutgers.edu/~organic/links.htm

Cornell University http://www.hort.cals.cornell.edu/

University of Connecticut
http://www.hort.uconn.edu/ipm/homegrnd/htms/ipmfcts.htm

The Ohio State University (search “organic”)
http://ohioline.osu.edu/hyg-fact/1000/index.html

There is a wealth of material from across the globe; a small sampling of websites is listed here: non-profits, educational institutions, and private companies.

Canada
http://www.cog.ca/index.htm
http://www.planetfriendly.net/organic.html

United Kingdom
http://www.organiccatalog.com/catalog/
http://www.organicgarden.org.uk/
http://www.hdra.org.uk/

United States
http://supak.com/store/gardening/
http://www.gardenersnet.com/organic.htm

New World Publishing (Books & Online Resources for Farmers & Market)
http://www.nwpub.net/

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Science-Based Organic Farming 2010:
Toward Local and Secure Food Systems

Processing and Marketing Organic Products

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The marketing model used in conventional agriculture is not easily applied to organic systems. Currently, local elevators that accept organic grains are not common, though they do exist in some areas. Whether growing organic grains, herbs, fruits and vegetables, or raising organically certified livestock, farmers who transition to organic production must also transition their marketing strategies. Producers who have always sold to local elevators will find that quality time will be needed to do a good job with marketing organic products.

That said, marketing organic crops and products can bring high premiums, and can provide farmers with a stable customer base and market. Local marketing, in particular, allows farmers to avoid the vagaries and fluctuations of commodity markets. When the farmer can set product prices, he or she has more control over farm profits. The farmer also establishes personal connections with consumers, as described in detail in the section on local food systems.

This section provides information about processing opportunities and local marketing strategies of organic food crops, and provides a list of organic grain buyers in Nebraska.

Processing Organic Foods

There is rapid consolidation of companies in the organic food processing and marketing arena, as described in the introduction to the handbook. Expansion of markets for organic food definitely increases demand and production, which leads to a positive impact of non-chemical methods on agricultural fields, waterways, and the overall rural landscape and environment. There are many unanswered questions about who eventually benefits from this process of industrialization; providing references to trade publications will help spur conversations in this arena.

The best single source of information on processing is the trade magazine ***Organic Processing: Strategies for Best Practices in Food, Fiber, and Personal Care*** published by the Target Group Inc. in Glendale, California. Many small-scale, organic farmers would point to this as an example of the industrialization process, rather than a useful direction for the future of local food systems. Nonetheless, it is currently the source of processing information most widely read by people in the organic industry; those interested should look here for information on what is happening in the trade: http://www.organicprocessing.com/

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Marketing Products within Local Systems

Community-based marketing and value adding are key strategies for connecting farmers and consumers in a local system. A condensed list of specific marketing strategies is provided below. For more in depth information, references, and resources, see *Sustainable Vegetable Production from Start-Up to Market* (complete reference is provided in the following section).

Farmers' Markets

According to the USDA's National Farmers Market Manager Survey, "Between the year 2000, when AMS conducted its first comprehensive national survey of farmers markets, and the end of 2005, the number of farmers markets in the United States increased 43 percent, from 2,863 to 4,093, an average growth rate of 8.6 percent a year… In 2005, managers reported that 25.2 percent of vendors used their market as their sole marketing outlets."
http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5077203&acct=wdmgeninfo

Nebraska has several operational farmers' markets across the state. The latest version of a Nebraska Department of Agriculture publication, *Your Guide to Nebraska Fresh Produce*, can be found at this site:
http://www.agr.state.ne.us/pub/apd/produce.htm

The guide includes a Producer Index and a list of communities in Nebraska with farmers' markets.

Community Supported Agriculture (CSA)

"CSA is a relationship of mutual support and commitment between a local farmer and community members who pay the farmer an annual membership fee that helps to cover the production costs of the farm. In turn, members receive a weekly share of the harvest during the local growing season. The arrangement guarantees a farmer financial support and enable many small to moderate- scale organic family farms to remain in business. Ultimately, CSA created 'agriculture-supported communities,' where members receive a wide variety of really fresh foods harvested at their peak of ripeness, flavor, and vitamin and mineral content" (Robyn Van En Center for CSA Resources, www.csacenter.org). A NebGuide titled, *Community Supported Agriculture*, by Paul Swanson can be found at:
http://digitalcommons.unl.edu/extensionhist/69/

Restaurant Agriculture

Organic farmers can specialize in wholesaling products directly to restaurants. This strategy is particularly rewarding when marketing to chefs who seek high quality produce at high quality prices. An Iowa State University Extension publication called *Local Food Connections: from Farms to Restaurants* can be accessed here:
http://www.extension.iastate.edu/Publications/pm1853b.pdf

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Institutional Food Services and Farm-to-School Programs

Schools, hospitals, nursing homes, summer camps, and prisons are potential markets for local crops. While there is often a fair amount of "red tape" associated with entering these institutions, there are several examples where the model has been successful. Two Iowa State University Extension publications are especially useful: *Local Food Connections: From Farms to Schools:*
http://www.extension.iastate.edu/Publications/PM1853A.pdf

… and *Local Food Connections: Food Service Considerations:*
http://www.extension.iastate.edu/publications/pm1853c.pdf

Regional Identity Markets

This marketing strategy combines agriculture, tourism, value-adding, and direct marketing using regional place names to evoke an area's history, culture, and landscape. Regional identity marketing is not new to Nebraska, but could be increased and used to more growers' benefits. Product names referring to names and places such as "Husker," "Sandhills," "Niobrara," and "Bohemian Alps" can be used to identify farm products. Further, adding the label "organic" to these titles, when appropriate, adds more local value and identity to product names.

Connecting with Ethnic Communities

The United States is home to many ethnic groups and accompanying cultural traditions. Food is an integral component of culture, and presents another opportunity for direct marketing of farm products. Specialty markets are increasing for a diverse array of fruits and vegetables, herbs, dairy products, goats, lamb, and live poultry.

Buy-Local Campaigns

Over $550 million in agricultural products were sold directly to consumers in 1997, indicating a clear desire of many consumers to buy from local farmers. As a result, campaigns promoting the purchase of local foods also serve as market exposure for local farmers. The *Be a Local Hero* campaign in Pioneer Valley, Western Massachusetts is a prime example of a successful venture. Their website is full of useful information, as well as success stories from the Community Involved in Sustaining Agriculture (CISA) group:
http://www.buylocalfood.com/
http://devsoc.cals.cornell.edu/cals/devsoc/outreach/cardi/programs/afcd/ncrfi.cfm

Buy Fresh – Buy Local Campaign in Southeast Nebraska

A vigorous program to promote local food in Lincoln and surrounding areas has been launched in collaboration with the Nebraska Sustainable Agriculture Society and a number of local organizations. Their website lists the following reasons why we should seriously consider purchasing more local food, and more details are given on the website listed below:

> You'll get exceptional taste and freshness.
> The average "fresh" food item travels 1,500 to 2,500 miles to get to your dinner table. Local food is fresher and tastes better than food shipped long distances.

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Local farmers can offer produce varieties bred for taste and freshness rather than for shipping and long shelf life.

You'll strengthen your local economy.
Buying local food keeps your hard-earned dollars circulating in your community. Getting to know the farmers who grow your food builds relationships based on understanding and trust, the foundation of strong communities.

You'll support endangered family farms.
Each year in Nebraska we lose 1% of our farms. This means that one out of every ten farms goes out of business each decade! There has never been a more critical time to support your farming neighbors. With each local food purchase, you ensure that more of your money spent on food goes to the farmer.

You'll safeguard your family's health.
Knowing where your food comes from and how it is grown or raised enables you to choose safe food from farmers who avoid or reduce their use of chemicals, pesticides, hormones, antibiotics, or genetically modified seed. Buy food from local farmers you trust.

You'll protect the environment.
Local food doesn't have to travel far. This reduces greenhouse gas emissions, pollution and packaging materials. Also, because local foods are bred for taste and quality rather than durability for transport, local foods encourage biodiversity.

http://www.buylocalnebraska.org/

Cooperative Farm Stores
There is a long history in the U.S. of farm stores carrying local foods and products. However, the success of these small operations dwindled following World War II when demand for a wide variety of products forced them to restructure as private corporations. Recently, Europeans have developed a model for local food farm stores. For example, some French farmers have organized networks of cooperatively owned and operated farm stores to retail fresh local produce and products. Examples of cooperative farm stores can be found at the links below.

St. Albans Cooperative Store: http://www.stalbanscoopstore.com/
Ukraina Cooperative:
http://www.usaid.gov/locations/europe_eurasia/press/success/farm_cooperative_success.html

Produce Auctions
About 25 produce auctions operate in the eastern United States, and are held several times a week. Produce is graded and pre-boxed before it is brought to the auction barn. Buyers include roadside stand or farm store operators, restaurant and grocery store representatives, and families and individuals. Information about produce auctions can be found at the following links.

Monroe County, Ohio:
http://monroe.osu.edu/ag-natural-resources/captina-produce-auction

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University of Kentucky Cooperative Extension:
http://www.uky.edu/Ag/NewCrops/marketing/auctions.pdf
Wisconsin State Journal:
http://host.madison.com/wsj/news/state_and_regional/article_1935ee22-a179-11de-bb4e-001cc4c002e0.html

Food Circles

The Food Circle model was developed by the Food Circle Networking Project at the University of Missouri. A food circle is a network of food production, processing and marketing enterprises, that fosters the growth of local food and agriculture systems. Activities often include organizing speakers for the community, organizing food-related community events, publishing local food information, and other community-centered educational programs.
http://foodcircles.missouri.edu/

Cooperative Marketing

Many farmers have become disenchanted with the idea of co-ops because of their decline and/or consolidation with larger entities. When cooperatives become too large, they lose local relevance and control and begin to behave like large corporations. Some farmers that grow specialty crops, however, may consider co-ops again as viable marketing strategies. There are challenges associated with co-ops, but also real economic and social benefits. **New Generation Cooperatives** are based on value-adding activities and limits to the number of farmers that can participate as stake holders. The new generation co-ops provide further opportunities for group-style marketing.

http://www.sare.org/publications/marketing/market08.htm
http://www.nebraskafood.org

Marketing and Trade Clubs

These clubs consist of small-group, farmer-to-farmer interactions, and sharing of marketing information. The Nebraska Sustainable Agriculture Society (NSAS) is an example of an organization that might include a marketing and trade club. While NSAS has much larger goals and functions, information is freely shared among farmers in the organization. The NSAS website is available:

http://www.nebsusag.org/
http://www.newoga.org.uk/objectives.html

The Internet

As internet sales of agricultural products continue to grow, farmers are finding it useful to expand and diversify sales. There are numerous publications that can assist with internet sales.

http://www.sare.org/publications/marketing/market09.htm
http://agmarketing.extension.psu.edu/Retail/howdrctmrktoninternet.html
http://www.localharvest.org/

Value-added processing

Adding value to products produced on farm is one strategy to increase profitability. It increases the diversity of products sold, increases the number of choices offered to

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customers, and expands sales opportunities. Additionally, value added products can be sold year round and in diverse market outlets.

http://www.sare.org/publications/marketing/market06.htm
http://www.farmsteadfirst.com/our-story.php

Grower Alliances

Grower alliances rely on farmers pooling their resources together to facilitate sales to retailers.

http://www.sare.org/publications/organic/organic09.htm

Organic Grain Buyers in Nebraska

Marketing organic grains may require marketing strategies that are different than some of those listed above. For example, it is impractical for a grain farmer to use a farmers' market or a CSA operation. In this situation, grain can be contracted for market prior to planting time, and a relationship can be forged with grain traders. In Nebraska, there are several options for organic grain producers. The University of Nebraska-Lincoln's CropWatch site keeps an up to date list of organic buyers for both grains and other organic products:

http://cropwatch.unl.edu/web/organic/marketing

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References and Resources

Sustainable Vegetable Production from Start-Up to Market
Vernon P. Grubinger
1999
Copies available: Natural Resource, Agriculture and Engineering Service
http://www.nraes.org/nra_index.taf

Useful Websites

Leopold Center for Sustainable Agriculture. Iowa State University.

"The Leopold Center for Sustainable Agriculture explores and cultivates alternatives that secure healthier people and landscapes in Iowa and the nation."

This website includes links to publications, news and events, newsletter articles, annual reports, and other useful information.
http://www.leopold.iastate.edu

Community Involved in Sustaining Agriculture (CISA). Pioneer Valley, Western Massachusetts.

This website includes information about the "Be a Local Hero" campaign that aims to increase production of locally-grown foods. A multimedia campaign manual is available for purchase: http://www.buylocalfood.com

Robyn Van En Center
"The Robyn Van En Center provides a national resource center about Community Supported Agriculture (CSA) for people across the nation and around the world. The Robyn Van En Center also offers outreach and works to gain publicity about CSA farms in order to benefit community farmers and consumers everywhere."
http://www.csacenter.org

Biodynamic Farming and Gardening Association
This portion of the Biodynamic Farming and Gardening Association provides definitions and explanatory information about CSAs.
http://www.biodynamics.com/csa.html

Appropriate Technology Transfer for Rural Areas (ATTRA)
ATTRA has information about marketing: direct marketing, CSAs, and other marketing techniques.
http://attra.ncat.org/marketing.html#other

North American Farmers' Direct Marketing Association
Contact: Charlie Touchette, Ext. #11
(888) 884-9270, email: nafdma@map.com
http://www.nafdma.com

University of Wisconsin Center for Cooperatives
"The University of Wisconsin Center for Cooperatives seeks to increase understanding and encourage critical thinking about cooperatives by fostering scholarship and mutual learning among academics, the cooperative community, policy makers, and the public."
http://www.uwcc.wisc.edu/

Community Food Security Coalition
"We are dedicated to building strong, sustainable, local and regional food systems that ensure access to affordable, nutritious, and culturally appropriate food to all people at all times. We seek to develop self-reliance among all communities in obtaining their food and to create a system of growing, manufacturing, processing, making available, and selling food that is regionally based and grounded in the principles of justice, democracy, and sustainability."
http://www.foodsecurity.org

USDA Community Food Security Initiative
"The USDA Community Food Security Initiative is seeking to cut hunger in America in half by the year 2015. This initiative is creating and expanding grassroots partnerships that build local food systems and reduce hunger. USDA is joining with States, municipalities, nonprofit groups, and the private sector to strengthen local food systems by replicating best practices of existing efforts and by catalyzing new community commitments to fight hunger."
http://www.usda.gov/news/pubs/fbook99/sections/5h.pdf

Nebraska Sustainable Agriculture Society
"Our mission: To promote agriculture & food systems that build healthy land, people, communities & quality of life, for present & future generations.

Our vision & work: We recognize the essential relationship between healthy local agriculture & a strong local food system; a relationship that benefits from food grown & processed locally. This adds quality & security, as well as social & ecological responsibility & benefits to the our communities. It is this understanding that motivates NSAS's work to strengthen & enhance these systems together. Our work spans across Nebraska."
http://www.nebsusag.org/

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Cornell University
"CaRDI supports communities that are exploring and implementing local food and agriculture initiatives through research-based information, shared learning opportunities, and the application of tools and resources."
http://devsoc.cals.cornell.edu/cals/devsoc/outreach/cardi/programs/afcd/index.cfm

Sustainable Agriculture Research and Education
This section of the SARE website suggests various strategies to improve marketing efforts, and also contains support and resources for those strategies.
http://www.sare.org/publications/marketing/index.htm

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Organic Farming and Local Food Systems: Intimate Connections

Organic farming is the focus of this handbook. The previous sections have outlined history and philosophy, certification, and specific methods for organic systems. The purpose of this chapter is to connect organic farming to local food systems and provide information about the benefits of this partnership for farmers and consumers. Organic farming and local food systems can both result in increased farm profits. The two systems are becoming increasingly connected, as organic farmers often chose to market their food products through local pathways. Both can greatly benefit farmers and rural communities as food dollars are re-circulated in the local economy.

The Conventional Global Food Chain

The food system in the United States is based on a complex global chain of production and distribution. In 2008, U.S. consumers spent 9.6% of their disposable income on food, and nearly half (42%) of this food budget was spent eating out: http://www.ers.usda.gov/briefing/CPIFoodAndExpenditures/Data/Expenditures_tables/table7.htm

The farm value share received by farmers in the U.S. is only a fraction (19% in 2006) of each consumer's food dollar – for some time, we have paid more for packaging and advertising food than we pay farmers to produce it. At the same time, farm production costs are increasing, further depressing farm profits. Click on "Where Does Your Food Dollar Go?" at the USDA's Economic Research Service site for more: http://www.ers.usda.gov/Briefing/FoodMarketingSystem/

Food in this system travels between 1,550 to 2,500 miles from farm to plate, a 25% increase since 1980 (Brian Halweil, 2002). A 2003 study done by Rich Pirog and Andres Benjamin at the Leopold Center for Sustainable Agriculture, Iowa State University compares the transportation pathways of food traveling conventional pathways and food traveling locally (referenced at the end of this section). Figure 1 shows that food going into an "All-Iowa" meal travels an average of 74 kilometers (46 miles), while food from the conventional system travels an average of 2,577 kilometers (1,600 miles). The authors estimate that a meal from the conventional food chain uses 4 to 17 times more petroleum and results in 5 to 17 times more carbon dioxide emissions.

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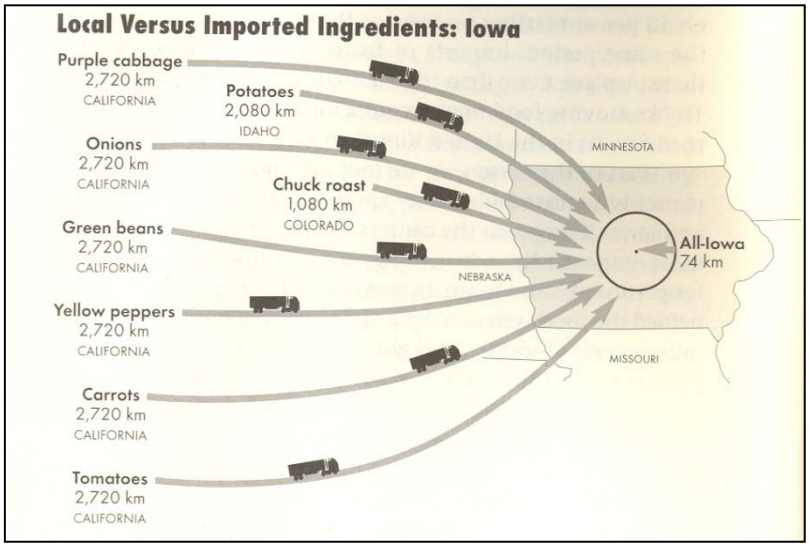

Figure 1. Local versus imported ingredients: Iowa.

Source: Halweil, 2002

Local Food Systems

A young local foods movement is gathering momentum as both farmers and consumers demand a better food system and an alternative to the global food chain. Farmers seek innovations to survive on the farm, and consumers are going out of their way to support local farmers. Local food systems are not intended to replace the conventional food system; rather, they are offered as a means to diversify the global chain. Farmers who sell directly to consumers receive higher net returns, and consumers are rewarded with fresh produce that supports a local farmer and the local community as a whole. A measure of increased food security also accompanies local food production, an issue of growing global importance.

Organic and Local

Organic farming fits directly into local food systems. Consumers are looking for fresh, high quality, good tasting produce. Increasingly, many consumers state that "organic" produce is also important to them:
http://www.ers.usda.gov/publications/VGS/Apr04/vgs30101/vgs30101.pdf

Farmers who grow organically and market locally benefit from these customer preferences that can become market demands. Local food systems are built on relationships of mutual trust between "food growers" and "food eaters". Organic farmers who have such relationships with their customers not only reap the benefits of organic

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market premiums, but can secure a customer base for years into the future. See the earlier **Marketing** section for specific marketing strategies.

A partial list of the benefits of local organic food systems is provided in the box below.

Benefits of Local Organic Food Systems

• Economic Benefits •

- Farmers receive a higher share of the consumer food dollar, especially with organic premiums.
- Costs to the consumer can be lower in some cases, even with organic premiums.
- Farm input costs for fertilizers, herbicides, and pesticides are reduced.
- If transportation is carefully and efficiently designed, its costs are reduced.
- Money is re-circulated locally.
- Consumers pay farmers directly and subvert corporate control of the food system.

• Environmental Benefits •

- Fossil fuel use for transportation and carbon dioxide emissions are reduced with carefully conceived and executed logistics and routing.
- Watersheds are protected from herbicide and pesticide run-off and silt infiltration.
- Wildlife habitat is enhanced, and in some cases, native wildlife species are protected and/or encouraged.
- Biodiversity (crops and otherwise) increases.
- Soil is protected and, in some cases, built up.

• Social Benefits •

- Community connections between farmers and consumers are forged.
- Farmers are recognized as integral components of the community.
- Farmers are able to take on the roles of protectors and stewards of their local environments.
- Small- to moderate-sized farms can remain viable.
- Jobs are created both on farm and in the rural community.
- A strong middle class of independent small businesses is created and supported.
- Diversified farming communities create good environments for families.
- Dedicated and educated consumers champion farmers when government, corporate or other interests threaten their success.

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References and Resources

The following study compares food miles for local produce (Iowa grown) and conventional produce. It includes useful tables with food mile comparisons.

Checking the Food Odometer: Comparing Food Miles for Local versus Conventional Produce Sales to Iowa Institutions.
Rich Pirog and Andrew Benjamin
2003
Leopold Center for Sustainable Agriculture, Iowa State University
http://www.leopold.iastate.edu/pubs/staff/files/food_travel072103.pdf

This next article is about the Local Food Brokering Project in Iowa. The authors are members of Practical Farmers of Iowa (PFI), and share information about the genesis of the project and the "All-Iowa Meal."

Revealing the Secrets of the All-Iowa Meal: The Local Food Brokering Project of Practical Farmers of Iowa
Gary Huber and Andrea Woldridge
2004
Prepared for the North Central Initiative for Small Farm Profitability
http://www.practicalfarmers.org/assets/files/Revealing%20the%20Secrets.pdf

Home Grown: The Case for Local Food in a Global Market
WorldWatch Paper 163
Brian Halweil
2002
http://www.worldwatch.org/pubs/paper/163/

Quality of Agricultural Produce: Consumer Preferences and Perceptions
Ramu Govindasamy, John Italia, and Clare Liptak
1997
Rutgers University Cooperative Extension
http://ideas.repec.org/p/ags/rutdps/36739.html

Local Food Systems and Sustainable Communities
Gail W. Feenstra
1997
American Journal of Alternative Agriculture. Vol. 12, No. 1.

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Organic Produce, Price Premiums, and Eco-Labeling in U.S. Farmers' Markets
Amy Kremen, Catherine Greene, and Jim Hanson
2004
USDA Economic Research Service
http://www.ers.usda.gov/publications/VGS/Apr04/vgs30101/vgs30101.pdf

Fast Food Nation: The Dark Side of the All-American Meal
Eric Schlosser
2002
Perennial (Houghton Mifflin Company), New York, NY.

Useful Websites

This is a very useful website with an easily searchable database.
"A comprehensive clearinghouse of marketing and processing information on **identifying new markets**, learning about **alternative agriculture** opportunities, locating **processing equipment**, understanding **processing requirements** and **ingredients** and finding information on a large variety of other topics."
See specifically the research entitled "Attracting Consumers with Locally Grown Products" by Brad Zumwalt, Food Processing Center, University of Nebraska.
http://www.foodmap.unl.edu/index.asp

Leopold Center for Sustainable Agriculture. Iowa State University.

"The Leopold Center for Sustainable Agriculture explores and cultivates alternatives that secure healthier people and landscapes in Iowa and the nation."

This website includes links to publications, news and events, newsletter articles, annual reports, and other useful information.
http://www.leopold.iastate.edu

Community Involved in Sustaining Agriculture (CISA). Pioneer Valley, Western Massachusetts.

This website includes information about the "Be a Local Hero" campaign that aims to increase production of locally-grown foods. A multimedia campaign manual is available for purchase.
http://www.buylocalfood.com

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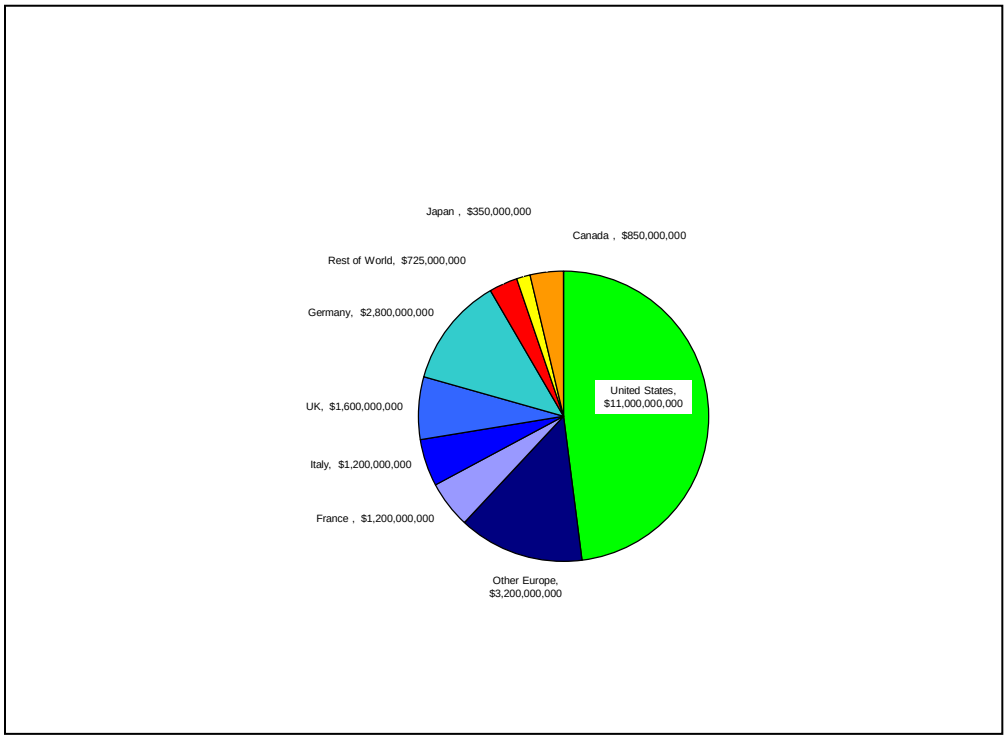
Science-Based Organic Farming 2010: Toward Local and Secure Food Systems

Economics of Organic Agriculture

Organic farming is one of the fastest growing segments of U.S. agriculture. Growth in retail sales has equaled just under to just over 20% annually since 1990, pushing global sales to an estimated $24.6 billion in 2008. Organic consumption in the United States accounts for roughly $11 billion of total global sales (See Figure below).

Figure: Global Sales of Organic Foods, Circa 2002



Fresh produce accounts for 42% of total organic food sales in the United States. Nondairy beverages, breads and grains, packaged foods, and dairy are the other top-selling food categories (Dimitri and Green, 2002). Three main venues are used for the sale of organic food in the U.S. – natural food stores, conventional grocery stores, and direct-to-consumer markets. A small amount of organic food produced in the U.S. is exported. The Marketing section of this handbook provides information about markets in Nebraska, focusing on direct sales and local organic grain buyers.

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Transitioning to Organic Production

Producers transitioning to organic systems will likely experience a decline in yields during the first several years of conversion. However, once that conversion period ends, research shows that yields will rebound to levels approaching conventional levels. More importantly, premiums for organically produced crops and reduced production costs impact net return and profitability.

While more research is needed on the economics of transition, the long-term economic viability of established organic systems is quite positive. A 1999 Wallace Institute review of six Midwestern land-grant university studies found:

- Organic grain and soybean production systems are "competitive with conventional production systems." In fact, with current market premiums, producers of organic grain and soybeans earn higher profits than conventional growers.

- Without a price premium for organic crops, half of organic systems were still more profitable than the conventional systems. Those systems less profitable than conventional quickly surpassed the conventional systems when organic premiums were figured in.

http://www.sare.org/publications/organic/organic07.htm

Organic Versus Conventional

A recent publication by the Economic Research Service (ERS, 2002) of the USDA entitled *Recent Growth Patterns in the U.S. Organic Foods Market*, cites several studies comparing the economics of organic and conventional farming systems. Several recent studies in the U.S. report that organic price premiums are key in giving organic farming systems comparable or higher whole-farm profits than conventional systems. However, other studies indicate that organic systems are more profitable even without organic premiums because of lower input costs. A study of organic soybeans in the Midwest revealed that they were more profitable than conventionally-grown soybeans because of higher yields in dry areas and during periods of drought, and lower associated input costs. *Of particular interest is that NO studies have shown organic systems to be less profitable than conventional systems*.

As shown in Table 1 below, scientific studies across the U.S. have demonstrated the economic viability of organic cropping systems. Full citations for each study are given at the end of this section.

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Table 1. Yield and economic comparison studies of conventional and organic farming systems. Source: Delate et al., 2003

U.S. State	Year	Crops	Yields	Economics
South Dakota (Dobbs and Smolik, 1996)	1985-1992	Corn	No statistical difference between conventional and organic; higher in organic during drought years	Cost of production (COP) similar to conventional; organic premiums were not calculated
South Dakota (Dobbs and Smolik, 1996)	1985-1992	Soybean	No statistical difference between conventional and organic	COP similar to conventional; organic premiums were not calculated
Pennsylvania (Hanson et al., 1997)	1981-1995	Soybean	No statistical difference between conventional and organic after 3 yr. rotation; higher in organic during drought years	COP 12% lower in organic across all rotations; organic premiums were not calculated
California (Clark et al., 1999)	1989-1996	Tomatoes	No statistical difference between conventional and organic	COP 5% higher in organic, but with organic premiums, superior economics with organic
New Jersey (Brumfield et al., 2000)	1991-1993	Tomatoes, pumpkin, sweet corn	Higher in conventional (statistics not shown)	COP higher in organic when previous crop costs (cover crops) and additional management over conventional (staking) included; net return per unit 5-16% higher in organic with organic premiums

Research at the Neely-Kinyon Long-Term Agroecological Research site in Iowa was conducted to examine the agronomic and economic performance of conventional and organic systems. Economic analyses from three years of production (1999-2001) indicate that both corn and soybean returns within the organic corn-soybean-oat and corn-soybean-oat-alfalfa rotations are significantly greater than returns in the conventional corn-soybean rotation.

Table 2 shows the returns per acre for all crops within the three rotations. Both organic premium prices and government loan payments are included in the analysis to reflect the economic reality for Iowa's farmers.

Table 2. Returns to land, labor, and management ($/a), by crop and rotation, 1999-2001. Source: Delate et al., 2003.

Rotation	Corn	Soybean	Oat	Alfalfa	Average
C-SB (conventional)	$51	$95			$73
C-SB-O (organic)	$264	$470	$125		$286
C-SB-O-A (organic)	$272	$505	$112	$272	$290

C = corn, SB = soybean, O = oat, A = alfalfa

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Price Premiums for Organic Grains, Oilseeds, and Legumes

The above comparisons of organic and conventional systems show that even though fresh produce tops organic food sales, grain and soybean farmers can also benefit from organic agriculture. Organic grains, oilseeds, and legumes are used as inputs to manufactured products, as feed grain, and as final food products such as rice and navy beans. Crops include traditional grains and oilseeds such as corn, soybeans, wheat, barley, oats, and rice, as well as nontraditional crops such as millet, buckwheat, rye, and spelt. Many of these crops can be contracted prior to planting.

Table 3 shows the price premiums for organic grains and oilseed for the time period between 1995 and 2001. Premiums are reported as the percent higher than prices for the conventionally produced equivalent.

Table 3. Price premiums for organic grains and oilseed: 1995-2001 [% above conventional crop prices]. Source: Bertramsen and Dobbs, 2002

	1995	1996	1997	1998	1999	2000	2001
Corn	35	43	73	88	98	89	59
Soybeans	114	85	141	202	217	175	177
Spring Wheat	54	59	73	8	87	103	94
Oats	35	59	73	83	77	71	41

What about GMOs?

Most Nebraska farmers currently use several types of GMO seed, the most common being Round-up Ready© soybeans, Round-up Ready© corn or *Bt* corn. Reduced herbicide and insecticide costs are often cited as primary reasons for the use of these technologies. Because GMOs are not allowed in organic production, farmers may be skeptical about the profitability of farming corn and soybeans organically. A study done by Michael Duffy at Iowa State University reveals that Iowa corn and soybean farmers are not benefiting economically from the use of GMO crops. In fact, Duffy states that, “Today the primary benefactors of biotechnology are the seed companies and chemical companies.” Table 4 shows some of the costs of production and returns to labor and management based on 2000 crop price averages.

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Table 4. Comparison of returns to Iowa farmers for GMO and Non-GMO crops for the 2000 crop year. Source: Duffy, 2001.

	Soybeans			**Corn**	
	Herbicide-Tolerant	**Non-Herb. Tolerant**		**Bt**	**Non-Bt**
# of Fields	108	64	# of Fields	46	128
Yield	43.4 b/a	45.0 b/a	Yield	152 b/a	149 b/a
Seed Costs	$25.56/a	$21.21/a	Seed Costs	$33.05/a	$28.74/a
Herbicide Costs	$19.96/a	$26.15/a	Fertilizer Costs	$53.30/a	$48.67/a
Total Weed Mgmt Costs	$27.14/a	$34.80/a	Total Non-land Costs	$207.25/a	$197.00/a
Return to Labor and Mgmt	-$8.87/a	-$0.02/a	Return to Labor and Mgmt	-$28.28/a	-$25.20/a

These results show that the use of GMO seed is not necessarily linked to increased profits. This fact is important for conventional corn and soybean farmers considering the economics of organic production.

Calculating Your Costs for Organic Production

For a farmer to calculate costs of production and returns for an organic system, one method is to start with the annual publication from Cooperative Extension on costs of production of field crops. We all know that each farm differs in actual costs of each operation, but this publication gives a general guide to costs and can be modified according to individual experience and personal circumstances.

2008 Nebraska Farm Custom Rates - Part I
http://www.ianrpubs.unl.edu/sendIt/ec823.pdf

The method is to make a detailed cropping system budget of the current crop rotation along with all associated costs. Then remove those costs that involve fertilizer, chemical materials and applications costs, and add in cover crop seed and planting costs, additional cultivations or whatever else will change in the potential organic system. Most difficult will be calculating projected income, since prices fluctuate widely; it would be best to talk to dealers to find out the most probable estimate of crop prices. Using projected yields from discussions with other organic farmers or from experience, it should be possible to project costs and returns for your farm. The above website with this information on costs of production is available from Cooperative Extension offices, and is updated each year.

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References and Resources

Recent Organic Growth Patterns in the U.S. Organic Foods Market
By Carolyn Dimitri and Catherine Green
Economic Research Service (ERS) Agriculture Information Bulletin
No. AIB777 September, 2002
http://www.ers.usda.gov/publications/aib777/

New Directions in Global Food Markets
By Anita Regmi and Mark Gehlhar
Economic Research Service (ERS) Agriculture Information Bulletin
No. AIB794 February, 2005
http://www.ers.usda.gov/Publications/aib794/

Comparison of Prices for 'Organic' and 'Conventional' Grains and Soybeans in the Northern Great Plains and Upper Midwest: 1995-2000
By Bertramsen and Dobbs, Econ Pamphlet 2001-1. (2002)
South Dakota State University.

An Economic Comparison of Organic and Conventional Grain Crops in a Long-term Agroecological Research (LTAR) Site in Iowa
By Kathleen Delate, Michael Duffy, Craig Chase, Ann Holste, Heather Friedrich, and Noreen Wantate (2003)
American Journal of Alternative Agriculture Vol 18 (2): 59-69.
http://extension.agron.iastate.edu/organicag/researchreports/orgeconomics.pdf

Comparative Cost Analyses of Conventional, Integrated Crop Management, and Organic Methods
By R.G. Brumfield, a. Rimal, and S. Reiners (2000)
HortTechnology Vol 10(4): 785-793

Crop-yield and Economic Comparisons of Organic, Low-input, and Conventional Farming Systems in California's Sacramento Valley
By S. Clark, K. Klonsky, P. Livingston, and S. Temple (1999)
American Journal of Alternative Agriculture Vol 14(3): 345-354

Productivity and profitability of Conventional and Alternative Farming Systems: A Long-term On-farm Paired Comparison
By T.L. Dobbs and J.D. Smolik (1996)
Journal of Sustainable Agriculture Vol 9(1): 63-79

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Organic Versus Conventional Grain Production in the Mid-Atlantic: An Economic and Farming System Overview
By J.C. Hanson, E. Lichtenberg, and S.E. Peters (1997)
American Journal of Alternative Agriculture Vol 12(1): 209

Who Benefits from Biotechnology?
By Michael Duffy
Presented at the American Seed Trade Association Meeting, December 5-7, 2001, Chicago, IL.
http://www.leopold.iastate.edu/pubs/speech/files/120501-who_benefits_from_biotechnology.pdf

Does Plating GMO Seed Boost Farmers' Profits?
By Michael Duffy and Matt Ernst
1999 (Fall) Leopold Center Newsletter, Iowa State University
http://www.leopold.iastate.edu/pubs/nwl/1999/1999-3-leoletter/99-3gmoduffy.htm

Got Organic? Natural Products Expo West Displays Growing Demand for All Things Natural
By Steve Hoffman
http://www.greenmoneyjournal.com/article.mpl?newsletterid=29&articleid=312

Consolidation in Food and Agriculture: Implications for Farmers and Consumers
By Phil Howard (2003-2004 Winter)
CCOF (California Certified Organic Farmers) Magazine Vol. XXI(4): 2-6
http://www.agribusinessaccountability.org/pdfs//264_Consolidation in Food and Ag.pdf

Useful Websites

Sustainable Agriculture Research and Education
This website contains useful information about organic systems in general and the economics of organic agriculture specifically, including links to relevant resources.

http://www.sare.org/publications/organic/organic07.htm

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ADDITIONAL RELATED TOPICS: Resources and References

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Sustainability, biodiversity and earth-friendly cultivation practices are topics related to organic food production. In this new section, a sample of websites and publications is provided to explore sustainable communities, sustainable landscaping, using native plants in the landscape, edible landscaping, wildcrafting, windbreaks, riparian buffers and wildlife habitat. Many of these sources are from research institutions, academics and professionals, while others reflect a growing interest from the general population. We anticipate that this new section will expand as additional sources are identified; we invite your suggestions and additions for these and other related areas.

Sustainable Communities:

U.S. Department of Energy information on Smart Communities Network: energy issues, green buildings, land use and conservation of natural resources
http://www.smartcommunities.ncat.org/

Sustainable Communities Network [International] includes links to a number of sites on organic agriculture and food systems, as well as reference materials and case studies.
http://www.sustainable.org/economy/agriculture.html

Joslyn Castle Institute (Omaha, NE) for sustainable communities
http://www.ecospheres.com

Sustainable Landscapes:

University of Nebraska's Statewide Arboretum on using native plants
http://arboretum.unl.edu/poppages/designplantselection.htm
http://arboretum.unl.edu/greatplants.html

University of Nebraska NebGuides:

Landscape Sustainability
http://www.ianrpubs.unl.edu/sendIt/g1405.pdf

Perennials in Water-Wise Landscapes
http://www.ianrpubs.unl.edu/sendIt/g1214.pdf

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Wildflowers for the Home Landscape
http://www.ianrpubs.unl.edu/sendIt/g1074.pdf

Kansas State Center for Sustainable Agriculture and Alternative Crops: publications on sustainable landscaping, including Maintaining Good Lawns with Less Water, Energy Efficient Landscaping, Low water Use Plants for Kansas Landscapes and Water Conservation in the Home Landscape:
http://www.kansassustainableag.org/Library/S.htm#sustainableagriculture

Kansas State University on naturalistic landscaping
http://www.ksre.ksu.edu/library/hort2/C581.pdf

U.S. Environmental Protection Agency
http://www.epa.gov/greenacres/nativeplants/pub-resor.PDF

ATTRA publication on sustainable turf care
http://www.attra.org/attra-pub/turfcare.html

National Resources Defense Council on native plants in the landscape
http://www.nrdc.org/onearth/02spr/livgreen.asp

Brooklyn (NY) Botanical Gardens publication on native turfgrass
http://www.bbg.org/gar2/topics/sustainable/handbooks/lawns/1.html

How To Get Your Lawn Off Grass : A North American Guide To Turning Off The Water Tap And Going Native, 2002, Carole Rubin, Madeira Park, B.C. : Harbour Pub.

Gray World, Green Heart:Technology, Nature and the Sustainable Landscape, 1994. Robert L. Thayer, Jr , New York: Wiley

The Sustainable Landscape [Videorecording] *: Ecological Design Principles* [Videorecording], 1992, produced by Jora Clokey, Joe Clokey, Jim Harrigan; written and directed by Jora Clokey, Publisher Los Osos, CA: San Luis Video Publishing
http://www.horticulturevideos.com/sustainability.html

Landscaping experts discuss how to design landscapes for increased energy and water efficiency and how to enhance natural biodiversity, increase the overall plant cover with biodiverse plantings, and reduce waste through conservation and reuse of valuable resources.

Sustainable Landscape Construction: A Guide to Green Building Outdoors, 2007, J. William Thompson and Kim Sorvig; drawings by Craig D. Farnsworth, Washington, D.C.: Island Press

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Nature's Heartland: Native Plant Communities of the Great Plains, 1990, William Boon and Harlen Groe; foreword by Charles E. Little, Ames: Iowa State University Press

Edible Landscaping and Wildcrafting:

University of Nebraska-Lincoln Publications

Wholesale Nursery Stock Sources for Plants That Produce Specialty Forestry Products
http://www.nfs.unl.edu/SpecialtyForest/nurserystockmain.asp

Productive Conservation: Growing Specialty Forest Products in Agroforestry Plantings
http://www.unl.edu/nac/morepublications/sfp2.pdf

Marketing Specialty Forest Products
http://www.nfs.unl.edu/SpecialtyForest/marketingsfp.asp

Hybrid Hazelnuts: An Agroforestry Opportunity
http://ruraladvantage.org/pdf/3rdCropOps-Hazelnut.pdf

Edible Woody Landscapes for People and Wildlife
http://conservationbuffers.unl.edu/edible%20wood%20landscapes%20%23592.pdf

The Complete Book of Edible Landscaping, 1982*,* Rosalind Creasy; illustrations by Marcia Kier-Hawthorne, San Francisco: Sierra Club Books

Landscape You Can Eat, 1977, Allan A. Swenson, New York: McKay

Nontimber Forest Products in The United States, 2002, edited by Eric T. Jones, Rebecca J. McLain, and James Weigand, Lawrence, KS: University Press of Kansas

Forestry, Windbreaks, Riparian Buffers and, Wildlife Habitat

University of Nebraska NebGuide/NebFact publications

Windbreaks & Wildlife http://www.ianrpubs.unl.edu/sendIt/ec1771.pdf

Windbreaks in Sustainable Ag Systems
http://www.ianrpubs.unl.edu/sendIt/ec1772.pdf

Backyard Wildlife Planting for Habitat
http://www.ianrpubs.unl.edu/sendIt/g1571.pdf

Landscape Plants for Wildlife http://www.ianrpubs.unl.edu/sendIt/g1572.pdf

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Planning Your Riparian Buffer: Design and Plant Selection
http://www.ianrpubs.unl.edu/sendIt/g1557.pdf

Riparian Buffers for Agricultural Land, 1997, Mike Dosskey, Dick Schultz and Tom Isenhart, Lincoln, NE: National Agroforestry Center
http://www.unl.edu/nac/agroforestrynotes/an03rfb02.pdf

Websites from Europe

The organic farming and food sector is especially well developed in a number of European countries. U.S. farmers are well advised to check out the experiences and the recommendations found on websites in other parts of the world, especially in the EU. Some of the primary sites and examples of programs in specific countries are these:

Research Institute for Organic Farming (FiBL) in Switzerland
http://www.organicfqhresearch.org/research_projects/research_fibl.html

Organic E-Prints from the Research Center in Denmark (DARCOF)
http://orgprints.org/view/projects/1darcof2.html

Danish Research Centre for Organic Food and Farming (DARCOF)
http://www.icrofs.org/

KRAV Organic Certification Agency in Sweden
http://www.krav.se/System/Spraklankar/In-English/KRAV-/

Oikos, the National Producer and Consumer Organization in Norway
http://www.oikos.no/newsread/news.asp?DOCID=10123&wce=dokument

IFOAM is the International Federation of Organic Agriculture Movements
http://www.ifoam.org/

Many other national programs can be accessed through the FiBL site, which has a comprehensive list of activities in most European countries. The site is kept up to date with new information on the certification process, national certifying groups, practices, and notices of meetings.

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