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The Economics of Organic Grain and Soybean Production in the Midwestern United States

RICK WELSH, policy analyst



Henry A. Wallace
Institute for
Alternative Agriculture

POLICY STUDIES *program*
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*“The cause of liberty and the
cause of true science must
always be one and the same.
For science cannot flourish
except in an atmosphere of
freedom, and freedom cannot
survive unless there is an
honest facing of facts...”*

HENRY A. WALLACE

*The Economics of
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Foreword

ORGANIC AGRICULTURE OFFERS expanding market opportunities for many farmers, processors, distributors, and retailers in the food system (Anton Dunn, 1997a; 1997b). The recent launch of an organic breakfast cereal line by General Mills, complete with a multi-million dollar advertizing budget, exemplifies the expansion. Filling those cereal boxes likely means more organic grain and soybeans from U.S. farmers, many of them in the Midwest. But, is organic production a profitable alternative for the region's farmers? A growing body of research sheds new light on the answer.

This report synthesizes and interprets economic studies of organic grain and soybean production by midwestern universities. The central conclusion is that organic production systems are competitive with the most common conventional production systems. Indeed, if farmers obtain current market premiums for organic grains and soybeans, their organic production generally delivers higher profits than non-organic grain and soybean production. The answer for any individual farmer depends, of course, on his or her particular situation. However, the main finding passes the common-sense test. By all accounts, the acreage of organic production is increasing nationwide, as well as in the Midwest.

Will the estimated higher profitability of organic grain and soybean production hold, relative to conventional production, as the industry expands? Farmers who face the decision to invest substantial amounts of time and money need sound information to make careful decisions. While no one can forecast the future of the organic grain and soybean industry with certainty, understanding the forces that drive costs and prices is a key factor for anticipating likely trends in profits.

Anecdotal evidence suggests that the costs of growing and delivering organic food are falling as the industry expands. This downward trend in per unit costs should not be a surprise. Business analysts and economists often expect that industry expansions are subject to “economies of size,” from the savings that attend such growth. Examples range from economies in production systems, e.g., more effective pest control, to increased efficiencies in transport, e.g., full rail car loads, and to more efficient use of processing plants from larger volumes. If organic agriculture growth is similar to other food industry segments, we should expect to see the production, processing, delivery, and retail costs per bushel, gallon, crate, and box decrease over time. The rate of decline is not yet known, as it depends on a number of factors, such as public and private investments in research and development (R&D) in organic systems. To date, such investments have been low compared to investments in conventional production (Lipson, 1997). The key to increasing organic yields, for example, is more R&D for developing and improving organic plant germplasm, pest control, fertilization, and other system inputs.

Regarding prices, a key question is whether the price premiums and the relative profitability of organic crops will hold as supplies expand. The simple answer is that it depends upon the growth in consumer demand, as well as the resultant upward price pressure on organic foods in comparison to the likely decline in production costs. Even if the prices of organic products fall, the current profit margin will remain if the prices do not fall more than decreases in per unit production costs. In the long term, we should expect the profits for organic production to settle at levels for comparable investments. What are those comparable food production activities?

The rise in importance of organic agriculture mirrors other changes in the structure of U.S. agriculture. Increasingly, agricultural products (such as Dupont’s high-sucrose soybeans and high-oil corn, and Pioneer’s low saturated-fat soybeans) are designed or bred to exhibit particular qualities that link production with end-uses of the product. And growers of these types of specialty grains often receive price premiums (Looker, 1998). Although current adoption rates for specialty grain varieties are relatively low (Muirhead, 1999), this type of coordinated agriculture is considered by many to be the future of grain agriculture (Kalaitzandonakes and Maltzbarger, 1998; Kiplinger Washington Editors, 1998; Urban, 1999). Organic agriculture parallels these trends because organic markets are differentiated markets where products have particular traits demanded by end-users. In this case the traits originate from being produced in specific ways. Production is coordinated with processing and distribution, since organically produced raw products must remain separate from non-organic products. If a raw organic product is mixed with non-organic products of the same

type, its uniqueness evaporates along with product demand. As noted, organic farmers receive price premiums for certain products.

An important difference between organic agriculture and some of the coordinated systems mentioned above is that organic agriculture is not based on proprietary technology. That is, organic farmers are not “growing out” a particular seed variety. Rather, organic farmers are agreeing to a production process that proscribes certain inputs and emphasizes particular stewardship strategies, such as crop rotations and farm planning. Also, whereas the qualities of many non-organic specialty varieties can be discerned through laboratory testing, organic attributes are determined through record-keeping and certification (Lohr, 1998).

If current structural trends persist, farmers will be increasingly required to choose from among a variety of coordinated production “strands” in order to produce commercially. Farmers will weigh the costs, benefits and feasibility of producing for strands based on a number of “designer” crop varieties, including an organic strand. The undifferentiated conventional markets will shrink in size and importance. Given the complex decisions facing farmers, reliable data and other information on viable options are needed. With this report, the Wallace Institute hopes to assist producers, consumers, policy-makers, agribusiness decision-makers, and other interested parties in assessing the potential of organic production as an economically viable production and marketing strategy.

Surely, the evidence assembled here suggests that such an assessment is timely, appropriate, and fully warranted.

David E. Ervin
Director, Policy Studies Program

Rick Welsh
Policy Analyst

Executive Summary

aT THE REQUEST OF THE PEW CHARITABLE TRUSTS, the Henry A. Wallace Institute for Alternative Agriculture has investigated the profitability of producing organic grains and soybeans in the midwestern United States. This report reviews past and current research on the conditions under which growing organic crops is profitable, as well as studies that have compared organic grain and soybean production with conventional production. Drawing on a variety of sources—including literature reviews, case studies, and university-sponsored studies—this report aims to provide a summary and assessment of the “best science” available on this topic. With this information, farmers, policy-makers, and other interested parties can assess how a switch to organic production might affect a farm’s productivity and profitability. Organic farming’s impacts on the environment and farmworker health are also discussed.

There has been dramatic worldwide growth in the production of, and demand for, organically produced agricultural products. In the United States and Europe, organic demand has increased 20 to 30 percent annually over the past several years. In 1997, the organic market in the U.S. totaled \$4.5 billion. Europe’s market was about the same size and Japan’s market has been estimated at almost \$2 billion. U.S. markets for organic grains and soybeans have also grown dramatically, averaging 10 to 20 percent annual increases in recent years, which are expected to continue. Part of this expansion has entailed growth in markets for organic corn syrup, alcohol, germ and bran, and livestock feed. U.S. Secretary of Agriculture Dan Glickman’s recent announcement that meat and poultry outlets can begin labeling their products as organic as soon as they are certified to do

so could substantially boost the size of the organic market in the next few years.

In addition, consumers worldwide have consistently been willing to pay premium prices for organic products. Surveys and other studies indicate that consumers buy organic products because they believe that in doing so they help to protect the environment, while safeguarding their own health and that of farmworkers. Consequently, food manufacturers have readily paid farmers premiums for organically produced commodities such as wheat, soybeans, and corn.

Recently collected information on the premiums paid for organic corn, soybeans, wheat, and oats has shown that prices for these products have been consistently higher than the prices for their conventionally grown counterparts. For example, farm prices for organic corn were on average 35 percent higher than U.S. cash prices for conventionally grown corn in 1995, 44 percent higher in 1996, and 73 percent higher in 1997. In addition, prices for organic, cleaned Clear Hulum soybeans were more than twice the U.S. cash and nearby futures prices for conventionally grown soybeans in 1995 and 1997, and almost twice those levels in 1996. Given the size of organic price premiums, and the increase in the size of the organic market, organic production appears to be an attractive option. To better understand this option, interested farmers should be aware of existing scientific findings on the profitability of organic agriculture.

Since 1978, there have been six land-grant university studies comparing organic and conventional grain cropping systems in the midwestern United States. These have taken place in Iowa, Kansas, Minnesota, Nebraska, and two in South Dakota. A review of the results of these land-grant university studies indicates that, *without price premiums*, the organic cropping systems were more profitable than the most common conventional system (generally a corn-soybean system) in three studies (Kansas, Minnesota, and one of the South Dakota studies); and less profitable than the most common conventional system in three studies (Iowa, Nebraska, and the other South Dakota study). Also, the organic systems were always more profitable than the continuous corn systems, even without price premiums.

When the organic systems were *more profitable* without price premiums, it was due to one or more factors, including:

1. lower production costs;
2. the net returns for the types of crops in the organic rotation were higher than the net returns for the types of crops in the conventional rotation (organic rotations tend to be longer and have more crops); and
3. organic systems are drought hardy and can outperform conventional systems in drier areas or during drier periods.

For those studies where the organic systems without price premiums were *less profitable* than the most common conventional system, and where data were available (Iowa and Nebraska), the premiums required for the organic systems to match the profitability of the conventional system were calculated. These “break-even” premiums were found to be much lower than the average premiums available on the market for the last few years. When one takes into account organic price premiums, the profitability of organic production—compared to conventional production—looks very attractive. Based on the results of these university studies, and given current levels of organic price premiums, the profitability of organic cropping systems in the midwestern United States can be consistently equal to or greater than the profitability of the most common conventional rotations.

In addition to the economic benefits of organic grain and soybean production in the midwestern United States, there are potential health benefits to farm-level workers and the natural environment from organic production. For example, Alavanja and colleagues (1996:362) have found that although a number of factors may contribute to the high incidence of certain types of cancer among farmers, “to date...the strongest links of exposures and malignancies have been with pesticides.” In addition, Alavanja and colleagues asserted that “potential noncancer health outcomes that may be influenced by agents found in the farm environment, particularly pesticides, include deleterious effects on the nervous, renal, respiratory, and reproductive systems of both men and women.” Other studies have found that organic methods can reduce soil loss and increase soil quality through increases in soil organic matter and residue cover of highly erodible land; reduce movement of nutrients off-the-farm; and benefit wildlife because of the dearth of synthetic pesticides and increased crop diversity associated with organic systems.

Given the potential economic, health, and environmental benefits of organic production, a greater public policy commitment in research, investment, and education is needed. Such commitments could mirror the efforts of several European governments. For example, Denmark has enacted financial support policies for organic farming, including information and marketing support and financial assistance, during the conversion period from conventional to organic farming. Other countries soon followed Denmark’s lead, including Sweden (which, through taxes and other charges on fertilizers and pesticides, funds research into reducing and eliminating synthetic chemicals in agricultural production), Germany, Norway, Finland, Austria, and Switzerland. These efforts have paid off: the organic farming sector has increased dramatically since such programs were initiated.

The United States, too, has provided support for organic agriculture. On the state level, for instance, a number of programs have appeared. A prime example is Iowa, which supports organic farming through the

Environmental Quality Incentive Program (EQIP), a program that provides targeted financial incentives to farmers. EQIP is administered by the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture (USDA) and is designed to promote the adoption of particular conservation management practices. EQIP is a cost-share program through which states design the list of conservation management practices. If EQIP funding can be increased and environmental, consumer, and sustainable agriculture groups can persuade state legislatures to designate certified organic production as a conservation practice, EQIP could play a role in significantly increasing the acreage under organic management.

Public policy commitment should extend to increased research funds and efforts. A recent survey by the Organic Farming Research Foundation (OFRF) found that the top production-related research needs identified by organic field crop farmers are, in order of importance, weed management, crop rotations for fertility and pest management, the relationship between fertility management and crop health, pest and disease resistance, the relationship between organic growing practices and nutritional value of the product, and cover cropping and green manures. In addition, more research is needed in planning conversions from conventional to organic production. Recent research from Europe indicates that even in the absence of conversion subsidies or cost-sharing payments, information and expertise on developing conversion plans are critical for farmers who are considering making the transition to organic farming.

Turning from production to marketing, quite a bit of work on the marketing aspects of organic agriculture is needed. Specifically, state departments of agriculture, as well as other interested parties that view organic agriculture as a potentially fruitful area for environmental management and rural development, might invest resources to develop price reporting services and other marketing information useful to organic farmers. In addition, extension services could assist organic farmers in developing or locating market outlets or developing individual or cooperative marketing strategies. OFRF recently found that organic farmers who identified market-related issues as important tended to want information on consumer demand and education, alternative marketing systems, farm processing, and value-added markets.

Given the large current demand for organic products and its projected growth, relatively minor adjustments in agricultural policy could result in significant shifts in acreage under organic production. The literature reviewed for this report indicates that such a shift could have substantial benefits not only for farm-level workers, but for the continued well-being of our natural world as well.

1 Introduction

i NTEREST IN ORGANIC AGRICULTURE is increasing dramatically in the United States, Europe, Japan, and elsewhere. Agribusiness firms, farmers, consumers, retailers, farm groups, environmental organizations, academics, and policy-makers, among others, have increasingly taken notice of the potential for organic agriculture in a number of areas. These interests range from rural economic development, to increasing farm-gate prices and enhancing environmental protection (Blobaum, 1997). Even with the growing attention paid to organic agriculture by such a broad constituency, there is a surprising lack of research regarding a variety of aspects of organic agriculture (Lipson, 1997).



Dobbs (1995) found that organic cropping systems are more competitive in drier small grain areas.

Photo courtesy of the Agricultural Research Service, USDA.

At the request of The Pew Charitable Trusts, the Henry A. Wallace Institute for Alternative Agriculture has investigated the profitability of producing organic grains and soybeans in the midwestern United States. This report presents and interprets current and past research on the conditions under which growing organic crops is profitable, as well as studies that have compared organic production with conventional grain and soybean production. Drawing on a variety of sources—including literature reviews, case studies, and land-grant university-sponsored studies in Iowa, Kansas, Minnesota, Nebraska, and South Dakota—the report aims to provide a summary and assessment of the “best science” available on this topic. With this information, farmers, policy-makers, and other interested parties can determine how a switch to organic production might affect a farm’s productivity and profitability. Organic farming’s impacts on the environment and farmworker health are also discussed.

2 *The Growing Organic Industry*

The United States and Abroad

gROWTH IN THE PRODUCTION OF, and the demand for, organically produced food and other agricultural products is a genuinely global phenomenon. The amount of land used to grow organic crops in Europe increased from approximately 29,000 acres in 1986 to more than 2.4 million in 1996, while the number of organic farms jumped from 7,800 to 55,000 during the same time period (Blobaum, 1997). Organic farms are also becoming more prevalent in Latin American countries such as Costa Rica and Argentina.

Demand for organic products in the U.S. and the European Union has increased annually between 20 and 30 percent for the past several years (Blobaum, 1997; Lohr, 1998; OTA, 1998b). The U.S. and the European Union are the world's largest markets for organic products, each with between \$4 billion and \$5 billion in sales in 1997. Japan's market has been estimated at almost \$2 billion (Lohr, 1998). Most estimates project annual increases in the U.S. market of 15 to 25 percent until the middle of the next decade (Richman, 1999).

Consumers worldwide have consistently been willing to pay premium prices for organic products (Lohr, 1998). Surveys and studies indicate that consumers buy organic products because they believe that in doing so they help to protect the environment, while safeguarding their own health and that of farmworkers (Blobaum, 1997; Tate, 1994). Consequently, food manufacturers have readily paid farmers premiums for organically produced commodities such as wheat, soybeans, and corn (Dobbs, 1998b). International bodies such as the United Nations, Codex

Alimentarius Commission, and European Union (Blobsaum, 1997; Tate, 1994), national governments, especially in Europe (Lampkin and Padel, 1994; Lohr and Salomonsson, 1998), and even state governments (Anton Dunn, 1997a; Swoboda, 1998) have enacted policy agendas that explicitly accept or actively promote organic agriculture (Tate, 1994). Organic agriculture has been promoted as a means of increasing farm incomes, because farmers can earn premiums for organic products while lowering their production costs through elimination of synthetic pesticides and fertilizers.

As the interest in, and practice of, organic agriculture grows, public agencies and private institutions have begun concerted efforts to gather more information about where and how it is practiced. The sketch that emerges from current research shows a diverse and rapidly expanding industry. At this writing, U.S. organic farms are concentrated on the West Coast, in the Northeast, in Texas, and in the Midwest (Anton Dunn, 1997a). According to a recent survey by the Organic Farming Research Foundation (OFRF, 1999), 57 percent of certified organic producers are vegetable, flower, and ornamental crop producers; 52 percent produce field crops; 40 percent produce fruit, nut, and tree crops; and 27 percent produce livestock or livestock products. OFRF also found that 80 percent of organic producers sell their products to wholesale markets; 13 percent sell directly to consumers; and 7 percent sell directly to retail markets. Sixty-three percent of those surveyed said that their products "did not reach foreign markets." Nonetheless, according to a report by Anton Dunn (1997a), organic suppliers report that substantial increases in U.S. export sales can be largely attributed to growing demand for organic grains by the European Union and for organic soybeans by Japan.

The amount of U.S. certified organic agricultural land increased from 914,800 acres in 1995 to almost 1.5 million in 1997, a jump of 63 percent in only two years (AgriSystems International, 1999). In Iowa alone, organic acreage increased from 10,000 in 1993 to more than 62,000 in 1997 (Swoboda, 1998). North Dakota has more certified organic cropland than any other state, and in 1995 was number one in the cultivation of total organic crops. North Dakota also produces the most organic grain of any state (Anton Dunn, 1997a).

Grains and Soybeans

O'Neil (1997) interviewed nine grain millers and eight manufacturers of grain- and soy-based foods to discern the potential for organic grains as an economic opportunity for U.S. farmers. She found that the organic grain market has been growing 10 to 20 percent annually and should continue to do so. Some of those she interviewed believed that demand for organic grain would double or triple in the next few years. O'Neil contended that organic soybean markets will continue to grow,

fueled by medical research into the benefits of soy-based foods. She also determined that markets are developing for organic grain by-products such as corn syrup, alcohol, germ, and bran, and that demand is increasing for organic livestock feed. U.S. Secretary of Agriculture Dan Glickman's recent announcement that meat and poultry outlets can begin labeling their products as organic as soon as they are certified to do so could substantially boost the size of the organic market in the next few years (U.S. Dept. of Agriculture, 1999; see also Maixner, 1999).



Price premiums are available for certified organic corn.

Photo courtesy of the Agricultural Research Service, USDA.

Dobbs (1998a; 1998b) recently collected information on the premiums paid for organic corn, soybeans, wheat, and oats. He found that the prices for these commodities were consistently higher than their conventionally grown counterparts. For example, farm prices for organic corn were on average 35 percent higher than U.S. cash prices for conventionally grown corn in 1995, 44 percent higher in 1996, and 73 percent higher in 1997 (Table 1). Dobbs found also that, unlike the other commodities, changes in organic soybean prices did not tend to mirror changes in conventional soybean prices. He attributed this lack of correlation to the strong influence of the Japanese market on the demand for organic soybeans. The organic soybean prices in Table 1 are for cleaned Clear Hilum varieties, the only kinds of soybeans the Japanese tofu market demands. The Clear Hilum price averages were more than twice the U.S. cash and nearby futures prices for conventionally grown soybeans in 1995 and 1997, and almost twice that amount in 1996.

Dobbs cautioned that farmers cannot always sell all their organic products at premium prices, that these prices can vary widely from one year to the next, and that a rapid and substantial expansion in organic acreage of particular crops could cause prices to decline. Park and Lohr (1996), however, noted that the stability of prices for organic products depends not only on the relative supply of those products, but also on whether growth in demand keeps pace with increases in supply.

In addition, "clean out"—the amount of unwanted material such as split beans, immature beans, or weed seeds that is removed during the

TABLE 1
Comparison of
Organic and
Conventional
Prices, U.S.

Crop commodity and year	Prices (\$/bu) ^a			Price Ratios ^a	
	Organic-Farm ^b	Conventional-CBOT or MGE ^c	Conventional-U.S. Cash	Organic-Farm/Conventional-CBOT or MGE	Organic-Farm/Conventional-U.S. Cash
Corn, 1995	3.46	2.83	2.56	1.22	1.35
Corn, 1996	5.12	3.86	3.55	1.33	1.44
Corn, 1997	4.50	2.77	2.60	1.62	1.73
Soybeans, 1995	12.52	6.16	5.85	2.03	2.14
Soybeans, 1996	13.41	7.54	7.23	1.78	1.85
Soybeans, 1997	17.80	7.66	7.40	2.32	2.41
Spring wheat, 1995	6.09	4.33	3.95	1.41	1.54
Spring wheat, 1996	7.63	5.07	4.78	1.50	1.60
Spring wheat, 1997	6.49	4.00	3.74	1.62	1.74
Oats, 1995	1.97	1.64	1.46	1.20	1.35
Oats, 1996	3.17	2.06	2.00	1.54	1.59
Oats, 1997	2.96	1.64	1.71	1.80	1.73

Source:
 Adapted from
 Dobbs (1998b).

^aAverage prices and ratios computed on basis only of months for which organic price data were available.

^bOrganic soybeans refer to Clear Hilum, cleaned.

^cChicago Board of Trade (CBOT) for corn, soybeans, and oats; Minneapolis Grain Exchange (MGE) for spring wheat.

process of cleaning crops—can be higher for certain organically grown commodities than for their conventionally grown counterparts. For example, the clean out for food-grade soybeans may be as much as 3 to 5 percent higher for organic soybeans. Nonetheless, organic growers can have clean outs similar to those of conventional growers, depending on the organic growers' management expertise and years of organic farming experience, among other factors.¹ Losing volume to a higher clean out essentially lowers the value of the price premium. Farmers considering a shift to organic production so that they can earn premiums should carefully estimate the actual size of the premiums they can expect.

Given the rise in the number of organic farms and in the acreage under organic management, organic production appears to be an attractive option. The next chapter reviews studies that broadly compare economic aspects of organic and conventional agriculture.

¹Personal interviews with Doug Stengel of Stengel Seed and Grain in Milbank, South Dakota; David Springer of Pacific Soybean and Grain in Story City, Iowa; Ray Berry (South Dakota organic farmer); and Fred Kirschenmann (North Dakota organic farmer).

3 *Is Organic Agriculture Productive and Profitable?*

a NUMBER OF STUDIES have reviewed the literature on organic production and its economic viability. Some analysts have found that organic agriculture is competitive both in yields and profits, while others have come to less favorable conclusions. Although most analysts agree that more research is necessary before definitive lessons can be drawn, their studies provide a useful guide to the circumstances under which organic agriculture may or may not be as profitable as conventional agriculture.

According to Cacek and Langner (1986), experimental plot data have suggested that organic farming is economically feasible and competitive with conventional farming. The only studies to consistently find that organic farming results in lower returns, they argued, are those that base their results on simulations using economic models. They criticized the unstated assumptions of these studies, which they believed tended to understate the benefits of organic production.

Lampkin (1990) maintained that, based on available information, switching to an organic system would lower a farmer's variable and fixed costs and thereby make up for any yield decreases. He concluded that an organic farmer's net income would be comparable to or somewhat lower than that of a conventional farmer. Writing about the economics of organic farming in Canada, Henning (1994) found that, based on survey and case study data, organic production is as profitable for farmers as conventional production.

Crosson and Ostrov (1990:36) had a very different view. As they put it:

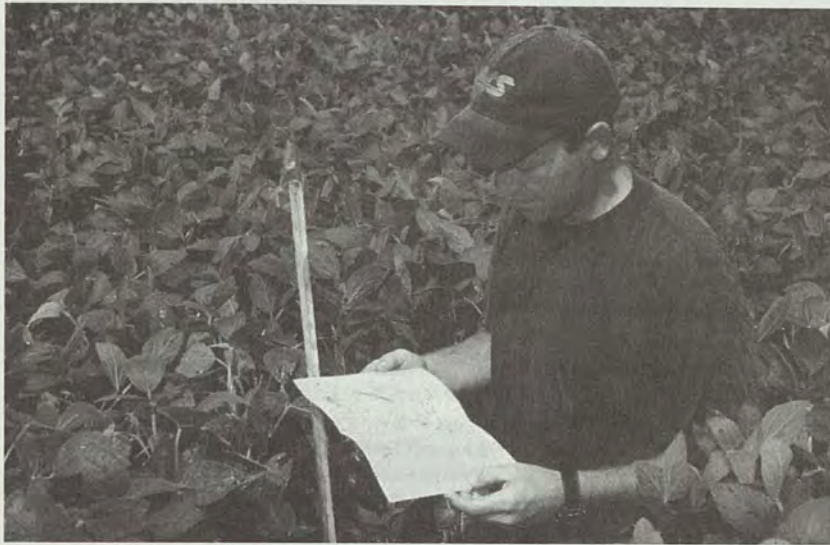
"...the literature reviewed leaves little doubt that at the farm level, alternative agriculture is less profitable than conventional agriculture. It is less profitable because what it saves in fertilizer and pesticide costs is not enough to compensate for the additional labor required and for the yield penalty it suffers. The main reasons for the yield penalty appear to be the necessary rotation of main crops with low-value legumes and the difficulty of controlling weeds without herbicides."

After reviewing field and case studies of organic production, Lee (1992) concluded that reported net returns are usually lower for organic systems, yet the systems seem to work for some farmers. She also found that government support programs tended to favor conventional over organic production. Anderson (1994:181) also reviewed a number of different studies and concluded that:

"...the lower variable costs of reduced-chemical systems may not offset lower yields and the necessity to include lower-value crops in rotations. Under current government policies, organic farming enterprises generally are slightly less profitable than conventional enterprises."

Taking a different tack, Knoblauch and colleagues (1990) found that comparing organic and conventional farming was somewhat problematic. They concluded from a review of the literature that the differences among organic systems, and among conventional systems, can be just as profound as the differences between organic and conventional systems. Fox and colleagues (1991) echoed these findings by determining that the results of comparison studies between organic and conventional systems have yielded no consistent winner. Rather, those results have depended on a host of factors, such as variations in the production system studied, crops produced, weather, and soil types, and assumptions about financial aspects. Dobbs (1994a; 1994b) agreed with Fox and colleagues but took the argument a step further by offering some questions to consider when assessing studies on the relative profitability of organic and conventional farming.

1. Are the sustainable systems studied still in transition, or are they well established?
2. Are federal farm program provisions accounted for in the models for the farms or are they ignored (or greatly simplified)?
3. Is family labor included as a cost in the enterprise budgets?



Certified organic Clear Hilum soybeans command substantial price premiums in the Japanese market.

Photo courtesy of the Agricultural Research Service, USDA.

4. Are costs external to the farming systems (e.g., environmental costs) included?
5. Is the focus of the study on practice changes or on whole-farm system changes?
6. Are conventional systems being compared to organic systems or to low-chemical input systems? If the former, are organic price premiums taken into account?
7. What is the agro-climatic area under consideration?

Dobbs found the last three questions to be particularly salient. In fact, in a 1995 study, he argued that a pattern is emerging whereby organic or near organic systems become more competitive with conventional systems as they move outside the Corn Belt and into areas dominated by small grain production, or into “transition” areas between the Corn Belt and the small grain areas. Diebel and colleagues (1995:323) reviewed Great Plains studies indicating that organic system yields are generally equal to or better than those of conventional systems, because the organic systems tend to be resistant to drought. Studies carried out in the Corn Belt, which has higher precipitation, generally find that organic systems result in lower yields and lower profitability. Diebel and colleagues concluded that “in general, the literature suggests that organic systems are more competitive in the drier areas of the United States.”

As a result of such studies, researchers have been moving away from overly broad, either/or comparisons of the economics of organic versus conventional production systems. Currently, they are more likely to investigate the particular conditions under which an organic system outperforms or simply keeps pace with conventional systems. This shift has come about as organic agriculture has grown from a strictly niche, alternative

BOX 1: Ideal Components of Studies Evaluating the Profitability of Organic Cropping Systems

Involve organic and conventional farm-level workers in the study design, implementation, and evaluation.

The input of farmworkers (primary operators, spouses, and hired labor) adds additional realism and accuracy to research. Including these individuals would provide researchers with valuable information regarding the appropriateness of their assumptions, such as the most common organic rotations in an area.

If an experimental design is used, it should enable the statistical comparison of rotations of varying lengths.

Conventional rotations are often shorter than organic rotations. In the Midwest, the conventional corn-soybean rotation is the dominant cropping system. It is important to have information regarding crop yields and net returns, when comparing 3- or 4-year organic rotations with corn-soybean (or other conventional) rotations. In this way farmers can more accurately evaluate their options.

Design experiments as multi-year comparisons of systems.

In order for the rotations to reach their full potential in a number of areas, the experiments should last more than a few years. This is especially important for evaluating systems with longer crop rotations so any benefits from "rotation effects" can manifest themselves. For example, in response to these concerns, Posner and colleagues (1995) established a 12-year trial.

Include realistic organic price premiums in the calculations of economic returns.

Farmers can receive premiums for a number of organic commodities, including corn, oats, and soybeans. The premiums vary and farmers may not always be able to sell all of their organic crops at a premium (Dobbs, 1998b). However, in order to fully account for the economic potential of organic cropping systems, analysts should account for possible price premiums awarded for organic commodities.

Include eligible payments from government farm and conservation programs in the calculations of farm economic returns. Account for policy changes over time.

Payments to organic farmers and conventional farmers may differ because of the difference in the crops they grow. Also, some federal and state conservation payments may differ because of different production practices. Calculating any differences due to differential payments will accurately portray the relative profitability of organic or conventional systems.

In addition to average annual profitability, calculate the net present value of economic returns over time.

The conversion to organic production may require investments in several assets that entail up-front expenses in early years, but may not yield full benefits until later years. Examples include mastering biological pest control, building up soil organic matter, and waiting through a 3-year transition period until the farm is eligible for organic price premiums. This phenomenon may cause net returns from an organic system to be skewed higher in later years. To account for possible skewed returns over time, an investment framework, such as the net present value of returns or annualized returns, is the appropriate method of analysis (Hewitt and Lohr, 1995).

BOX 1: Ideal Components of Studies Evaluating the Profitability of Organic Cropping Systems, *continued*

Include measurements of risk, such as variability of net returns from year to year.

It is often argued that farm households tend to be averse to “downside” risk—that is, the risk of having a bad year financially. Therefore, measures of net return variability (e.g., coefficient of variation or standard deviation) should be included in comparison analyses of organic and conventional systems since they can provide critical information to farm households considering a switch to organic systems.

Whenever possible, use actual yield data from surveys or experimental plots.

If yield data from operating farms or controlled experiments can be obtained, this strengthens conclusions drawn from the analysis. Due to the lack of organic agricultural research, modeling yields based on expert opinion or other techniques is less reliable.

Specify the agroecosystem or region where the data for the study were obtained.

The review of studies indicates that the climatic characteristics of certain regions may be important determinants of the relative profitability of organic and conventional systems.

Provide estimates of differences between organic and conventional systems regarding the amount of labor required and how any differences in labor might be allocated among farm household members and hired workers.

Hanson and colleagues (1997) found that organic systems may require greater amounts of family labor. How this additional labor is allocated among family members is important to understanding whether a farm household’s goals dovetail with the requirements of an organic production system.

Provide an estimate of possible differences in managerial requirements among the systems under comparison.

Organic systems tend to replace synthetic pesticides and fertilizers with mechanical tillage, crop rotations, and other production techniques for which there may be no readily available information. A conventional farmer may have access to information from an extension service, input supply sales representatives, and a wide range of university researchers. An organic farmer may spend more time and money locating information sources such as other organic farmers, specialized publications, or conferences and seminars (OFRF, 1999). Consequently, it is often asserted that organic systems require a more managerially intensive approach than conventional systems. For these reasons, standard measures of returns to management may not accurately reflect the profitability of an organic system when it is compared to a conventional system. Such speculation needs to be systematically researched and evaluated.

Estimate the economic value of any differences in environmental costs, and health costs of farmworkers, among the systems under comparison.

One of the central criticisms of conventional agriculture and the evaluation of its benefits is that the environmental and health effects of conventional agriculture are not often included in the calculus. Organic systems are often said to be less costly in these areas. Accounting for differences in environmental and farmworker health, and translating these differences into costs and benefits for different farming systems, communities, or society would greatly enhance our understanding of the on-farm and/or social profitability of different production systems.

industry, to an industry of considerable size and enjoying the support of a wide range of constituencies.

There is as yet no “ideal” analysis of the economics of organic agriculture. Some of the issues that might inform such a study are reviewed in Box 1. An optimal study would explore the issues of reconciling environmental protection and farm-level safety goals with economic viability and societal expectations of safe, nutritious, and satisfying food. At present, studies examining the financial viability of organic agriculture are perforce more limited. They can, however, provide valuable insights into the economics of current organic production.

4 *Review of Midwestern Organic Grain and Soybean Studies*

RESULTS FROM A NUMBER OF LAND-GRANT university long-term cropping system research trials, as well as a variety of other sources, are presented and summarized in this chapter. Where data were available, I calculated the net present value (NPV) of economic returns² and the organic price premium required (if any) for the organic system to break even with the most profitable conventional cropping system. At the end of this chapter, Table 10 summarizes both the study data and the subsidiary calculations for the university studies.

Early Corn Belt Studies

Two of the best known early studies comparing conventional and organic systems in the U.S. Corn Belt were published by Lockeretz and colleagues (1978) and Shearer and colleagues (1981). The results of these studies were a touchstone for subsequent research on comparisons between organic and conventional farming.

LOCKERETZ AND COLLEAGUES (1978). Data were gathered from 14 organic and 14 conventional crop-livestock farms in eastern Nebraska, southern Minnesota, Iowa, Illinois, and northern Missouri. The organic farms had been managed organically since 1971 and the study period ran from 1974 through 1976.

Researchers paired each organic farm with a nearby crop-livestock farm on which conventional fertilizers and pesticides were used, and on which the soils were comparable with the organic farms. The conventional

²For NPV calculations, a discount rate of 5 percent was used when a study adjusted figures for inflation. When a study presented unadjusted (nominal) figures, discount rates of 7 and 10 percent were used.

Research has shown that organic cropping systems can help reduce soil erosion.

Photo courtesy of the Agricultural Research Service, USDA.



farmers in the study had all been identified as above-average managers by the U.S. Department of Agriculture's Agricultural Stabilization and Conservation Service (now the Farm Service Administration) and the Soil Conservation Service (now the Natural Resources Conservation Service).

Using the farmers' reported crop yields (livestock enterprises were ignored), statewide seasonal crop prices, and statewide average production input prices (and not taking into account possible premiums paid for organic products), they calculated that the average market

value of crops produced on the organic farms was 11 percent lower per hectare (2.47 acres) of cropland than the value of crops produced on conventional farms. This difference was due to yield variations as well as to differences in the relative amount of land devoted to each crop.

Regarding yields, both groups were compared to all farmers in their county. On average, the conventional farms had higher average yields for all of their crops (corn, soybeans, wheat, and oats) than all farmers in their counties. The organic farmers had higher oat and soybean yields than all farmers in their counties, but lower yields for corn and wheat.

Looking at costs, on average, operating expenses were substantially lower on the organic farms. Over the 3-year study period, the organic and conventional farmers had the same net returns. Lockeretz and colleagues concluded that the organic farms' financial performances compared well with that of the conventional farms. In addition, they found that organic methods appeared to offer considerable benefits in other areas: organic farmers relied less heavily on purchased inputs and external energy, they suffered less soil loss, and their soils contained more organic matter.

SHEARER AND COLLEAGUES (1981). In their comparison study, Shearer and colleagues drew a sample from a survey of 250 organic field crop farmers, each with farms at least 40 hectares (roughly 100 acres) in size. The sampling included 23 organic farms in 1977 and 19 organic farms in 1978, all of them soil-mapped farms in northern Illinois, Iowa, and southern Minnesota. These organic farms were compared with all similar conventional farms in each of the counties where the organic farms were located. The organic farms had about the same proportion of "prime" cropland as all farms in the counties. Organic price premiums were not considered.

Corn yields on the organic farms were 8 percent lower in 1977 (reported as a “poor year” for growing crops) and 18 percent lower in 1978 (reported as “a very good growing year”). In 1977 organic soybean yields nearly equaled those on all farms and organic oat yields were 10 percent higher. In 1978 soybean yields were approximately 7 percent lower and oat yields 6 percent higher on organic farms. On average, all farms contained more land planted in corn for grain and less land planted in hay and oats than organic farms.

For net returns for *all crops*, there was no significant difference between the two groups in 1977. However, in 1978 the difference in the value of production was too great to be offset by lower production costs, and net returns were 13 percent lower on the organic farms. The authors concluded that when growing conditions are favorable, conventional farms outperform organic farms. Conversely, under unfavorable conditions (in this case, during 1977), the profitability of crop production on organic farms compares well with conventional farms. Furthermore, as the authors argued:

“...an alternative agricultural system characterized by a different crop mix and markedly less chemical input, produced crop yields and net farm income which were close to those achieved on conventionally managed, commercial-sized midwestern Corn Belt mixed crop/live-stock enterprises.”

Iowa State University Study

In 1978, Iowa State University began to sponsor experimental comparison trials on plots at the Northeast Research Center in Floyd County, Iowa (Chase and Duffy, 1991; Duffy, 1991). The ongoing trials compare three cropping systems: two are conventional and one is alternative. The conventional systems consist of the two most common systems for growing crops in Iowa: a 2-year system in which corn and soybeans are rotated, and a system in which corn is grown without any rotation to another crop (“continuous corn”). The farmers using both conventional systems apply synthetic pesticides and fertilizers at recommended rates. The alternative system consists of a 3-year corn-oats-alfalfa (referred to as “meadow” in the Chase and Duffy study) rotation. The oats are planted as a nurse crop for the alfalfa. The farmers using the alternative system apply no synthetic fertilizers, only green³ and animal manures, and have used pesticides only 3 times in 12 years: in 1986, 1987, and 1988. The alternative system has been managed organically since 1989.

Chase and Duffy reported results from 1978 through 1989 for the Iowa study. Table 2 presents data from 1988 to 1997, with crop yields and net returns by year and 10-year and 20-year averages. Over this time

³Green manure refers to a crop planted to provide organic matter and nitrogen for subsequent crops.

TABLE 2 Crop Yields* and Net Returns from Long-Term Cropping System Comparison, Iowa State University Study, 1988-1997

Source: Original data provided by M. Duffy, Department of Agricultural Economics, Iowa State University.

System	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Means	
											10 yr	20 yr
Continuous corn												
Corn yield	78.6	95.4	162.8	126.4	117.6	73.5	141.0	110.8	123.4	151.3	118.2	121.1
Returns to land and management for system (\$/a)	-34.06	-20.45	116.13	34.15	35.53	-76.86	75.47	62.86	91.80	123.08	40.77	50.84
Corn-oats-alfalfa												
Corn yield	91.5	72.0	130.9	143.2	146.1	91.3	149.0	112.0	92.7	160.6	118.9	108.6
Oat yield	74.4	93.9	87.8	26.9	86.9	22.8	58.0	61.0	63.9	53.9	63.0	59.8
Alfalfa yield	2.5	0.9	3.64	2.78	3.29	5.02	3.17	4.66	4.19	4.43	3.46	3.26
Returns to land and management for system (\$/a)	92.22	26.09	114.19	49.58	118.24	102.56	114.95	122.40	100.48	195.18	103.59	78.28
Corn-soybean												
Corn yield	95.1	109.6	176.9	156.3	164.7	123.5	161.0	138.9	155.6	186.3	146.8	145.1
Soybean yield	27.9	34.6	33.4	48.0	52.9	43.5	57.0	54.8	46.7	50.4	44.9	41.0
Returns to land and management for system (\$/a)	33.49	53.31	99.25	103.32	136.90	74.20	172.60	176.34	199.89	193.90	124.32	113.01

*All yields in bushels per acre, except alfalfa in metric tons per acre.

period, average corn yields were highest for the conventional corn-soybean system; organic corn yields came in second. In terms of profits (without taking into account price premiums or government programs), the corn-soybean system outperformed the organic system, which in turn outperformed the continuous corn system. Table 3 presents data from 1989 to 1997, which compare the corn-soybean system to the organic system, and which indicate the NPV of the two systems for assumed nominal interest rates of 7 percent and 10 percent. I calculated the price premium needed for the NPV, with a 7 percent discount rate, of the longer rotation to match the NPV of the corn-soybean system, and this is also presented. As farms are not usually eligible for price premiums until their land has been managed organically for three years (FVO, 1996; OCLA, 1999), a transition period of that length is assumed. Since pesticides were last used on the longer rotation in 1988, that rotation would have been eligible for organic price premiums in 1992. Assuming premiums are available for corn, oats, and alfalfa, the break-even premium—that is, the amount of the premium the organic farm needed to break even with the conventional farm—was approximately 19 percent per crop per year. If premiums are assumed only for corn and oats, an annual premium of about 35.4 percent for each crop is required for the organic system to break even. Both calculated break-even premiums are less than the average premiums of 54 percent for oats and 45 percent for corn for 1995, 1996, and 1997, as reported by Dobbs (1998b).

The fact that the organic break-even premium is below recent averages is somewhat surprising since the organic rotation did not include soybeans. Growing soybeans in an organic rotation is not an unusual practice among Iowa's organic farmers (Swoboda, 1998), especially given the price premiums that Dobbs reported (1998a; 1998b). Including soybeans in the organic rotation experimental trials would have provided useful information to producers and other parties interested in midwestern organic production.⁴ However, the fact that below-average organic premiums enabled the unlikely corn-oats-alfalfa rotation to bring in as much money as the conventional corn-soybean rotation suggests that organic production would have been economically viable over the study period.

Kansas State University Study

DIEBEL AND COLLEAGUES (1995). Diebel and colleagues used data taken from the Kansas Farm Management Association's (KFMA) database of 332 farms in 14 northeast Kansas counties from 1986 to 1990, as well as personal interviews with farmers using alternative methods, to compare conventional and alternative farming systems. They also looked at systems that were making the transition from conventional practices to each of the alternative systems. They considered seven systems in all: one

⁴M. Duffy of the Department of Agricultural Economics at Iowa State University reports that plans are under way to include soybeans in the organic rotation of the cropping systems trials. Also, K. Delate of the Departments of Agronomy and Horticulture reports that additional cropping systems trials have begun that include soybeans in the rotation. First-year results from the new study show the organic rotation outperforming the conventional corn-soybean rotation in terms of profitability (Delate et al., 1998).

TABLE 3 Comparison of Corn-Soybean and Transitional/Organic Systems, Iowa State University Study, 1989-1997

Source: Original data provided by M. Duffy, Department of Agricultural Economics, Iowa State University.

Net Present Value and Price Premium Sensitivity Analysis												
System	1989	1990	1991	1992*	1993	1994	1995	1996	1997	Mean	NPV	
											7%	10%
Organic, corn-oats-alfalfa												
Returns to land and management for system (\$/a)												
without price premiums	26.09	114.19	49.58	118.24	102.56	114.95	122.40	100.48	195.18	104.85	645.39	557.13
with average price premiums for corn, oat grain, and alfalfa of 18.929%	26.09	114.19	49.58	162.05	145.06	159.78	171.63	140.36	253.97	135.86	824.83	707.54
with average price premiums for corn and oat grain of 35.387%	26.09	114.19	49.58	171.16	129.75	165.72	169.32	143.90	252.84	135.84	824.83	707.60
Corn-soybean												
Returns to land and management for system (\$/a)	53.31	99.25	103.32	136.90	74.20	172.60	176.34	199.89	193.90	134.41	824.83	711.09

*First year eligible for organic price premiums.

Cropping system	With government programs	Without government programs
Conventional	\$27.04	\$9.93
Organic	\$34.75	\$26.99
Transition	\$27.16	\$12.38

TABLE 4
Net Returns
per Acre with
and without
Government
Programs,
Kansas State
University Study,
1986-1990

Source:
 Diebel and
 colleagues
 (1995).

conventional, three alternative (one of which was organic), and three transitional. The comparisons were made using an economic simulation model.

Diebel and colleagues labeled a system "conventional" or "alternative" based on the crops grown in it and the kind of crop rotation used. The conventional system contained four major crops (corn, soybean, grain sorghum, and wheat), which were rotated according to traditional practice: corn-soybean, corn only, sorghum-soybean, wheat-sorghum, or wheat-soybean. "Alternative" systems had longer rotations, and included clover or alfalfa with oats. The organic rotation was corn-soybean-corn-soybean-alfalfa with oats-alfalfa-alfalfa.

Yields of wheat, corn, sorghum, soybeans, and alfalfa were the weighted average yields from the KFMA database. Based on their review of the literature for Great Plains farms, and the paucity of available data on alternative system yields, the authors assumed initially that all of the systems had equal yields. However, the impact of possibly lower yields in the organic system was also taken into account. Due to the importance of alfalfa in the organic system, an alfalfa price sensitivity analysis was performed. Organic price premiums were not included in the analysis, but government commodity programs were taken into account.

Assuming equal yields, the organic system ranked second overall (with or without government program payments) in net returns, behind one of the near-organic alternative systems. The conventional system, which reflected the more common cropping practices of northeastern Kansas, ranked fourth with program payments and sixth without program payments. The system in transition from conventional to organic practices ranked fifth with or without government payments. Table 4 presents the financial information for the organic and conventional systems, and for the system in transition from conventional to organic practices.

If a large number of farmers were to adopt the organic system, alfalfa prices might be depressed. Results from the alfalfa price sensitivity analysis showed that with government payments, alfalfa prices needed to fall close to 20 percent before the organic system's net returns equaled those of the conventional system. This "break-even" price was well above

TABLE 5 Net Cash Returns, Cropping System (2-yr vs 4-yr), and Management Strategy (\$/acre), University of Minnesota Study, 1990-1996

Source: Original data supplied by K. Olson and P. Mahoney, Department of Applied Economics, University of Minnesota.

Rotation/ Strategy	1990	1991	1992	1993	1994	1995	1996	Mean	NPV	
									7%	10%
Corn-soybean										
Low input	181.31	133.13	113.12	63.32	145.58	66.96	247.58	135.86	\$728.97	\$658.32
High input	190.45	198.57	124.69	67.12	122.49	141.87	245.80	155.86	\$839.37	\$759.05
Corn-soybean-oats-alfalfa										
Low input	149.13	131.16	147.45	131.11	168.65	215.99	209.86	164.76	\$869.18	\$778.63
High input	133.40	169.63	150.68	133.72	169.97	214.66	194.32	166.63	\$883.09	\$792.43
Organic	159.82	156.33	151.55	141.56	169.71	220.23	202.95	171.74	\$911.75	\$818.87

the lowest price offered during the 5-year period used to calculate average prices for the study. Without government payments, alfalfa prices would have had to decline by almost 44 percent for the organic system to break even with the conventional system.

An additional analysis by Diebel and colleagues looked at what would happen if nitrogen uptake was lower under the organic system, thus causing the organic system's crop yields to fall. It showed that with government payments, the organic system's yields would need to drop by 19 percent for its net returns to equal those of the conventional system. Without government payments, the yield reduction required would be 40 percent.

Diebel and colleagues concluded that changes in alfalfa prices might affect the profits of an organic system. However, if organic farmers use alfalfa as feed for their own livestock, their farms might not suffer from drops in alfalfa prices. Further, composted livestock manure can provide an alternative source for nitrogen, making the planting of alfalfa less critical. They noted that the organic system benefited less than its conventional counterpart from government commodity programs. As a result, organic systems may have been exposed to additional risk. The authors cited the need for additional yield data for alternative cropping systems.

University of Minnesota Study

The University of Minnesota Variable Input Crop Management Systems Trials, known as VICMS I and VICMS II, began in 1989 (Olson et al., 1996). The VICMS trials have been held on two study sites. One site, VICMS II, has been managed conventionally for a number of years. It has very fertile soil and few weeds. The other site, VICMS I, has not been actively managed.⁵ Data presented in this report were obtained from Olson and Mahoney (1999) and pertain to the actively managed VICMS II site, from 1990 to 1996. Data for VICMS I were not presented by Olson and Mahoney (1999:4-5) since, as they argued, "the common soil condition in this part of Minnesota is high fertility and low weed pressure, VICMS II is important for producers interested in the transition from conventional practices to low-purchased inputs or organic practices."

Two crop rotations were tested under four different management strategies. The rotations were corn-soybean (2-year) and corn-soybean-oats-alfalfa (4-year). Management strategies were minimal inputs, low purchased inputs, high purchased inputs, and organic inputs. Olson and Mahoney did not include the minimal input strategy in their analysis because it is currently not a common approach to farming in this region. Organic price premiums, but not government payments, were included in the analysis. For this review, I omitted the 2-year rotation under organic management, since such a rotation would likely not be certified (FVO, 1996:16-17; OCLA, 1999:7).

⁵K. Olson, Department of Applied Economics at the University of Minnesota, indicates that the VICMS I site was composed of fields that had not been cultivated for a number of years.

Production costs were estimated for each year using actual cultural operations and equipment. Costs were calculated based on estimates of machinery costs including fuel, maintenance, repairs, labor, and overhead. Market prices of inputs were used except for herbicides, which were obtained from the university's extension service. Product prices came from the average annual cash prices received by the Southwestern Minnesota Farm Business Management Association. Average net returns reflect gross returns less total production costs. Production costs for each management strategy and rotation included tillage, planting, fertilizer, pest control, and harvesting costs.

The high-input management strategy produced the highest yields for all crops in both the 2-year and 4-year rotations. The high-input strategy also had the highest production costs and the organic strategy the lowest. Regarding net returns, without taking into account organic price premiums, the organic rotation was the most profitable in terms of mean net returns and net present value (Table 5). Interestingly, in general the 4-year rotations outperformed the 2-year rotations. The most profitable non-organic strategy was the high-input strategy using a 4-year rotation. Olson and Mahoney report that high net returns for oats and alfalfa resulted in the 4-year rotations outperforming the 2-year rotations. They also factored in potentially available organic price premiums for oats, corn, and soybeans. Price premiums made the very competitive organic rotation substantially more profitable than the non-organic strategies for the 2-year and 4-year rotations.

Olson and Mahoney (1999:9) advised that, although organic strategies can compete with conventional systems, "...the potential market impacts of a large shift to other crops for a 4-year sequence are of concern." That is, shifting substantial acreage from the popular corn-soybean rotation to corn-soybean-oat-alfalfa could have significant price impacts on a number of commodity markets. This potential impact underscores the need for researchers to investigate the viability of a number of different organic rotations and cropping systems in order to provide farmers with a variety of options, depending on market conditions.

University of Nebraska Study

Helmers and colleagues (1986) estimated net returns (adjusted for inflation) for the crop yields produced at the University of Nebraska's Research and Development Center in east-central Nebraska between 1978 and 1986. The study involved three rotations and three crops grown on a continuous basis. The three conventional continuous cropping systems were corn (ContC), grain sorghum (ContGS), and soybeans (ContSB).

The three rotations were: corn-soybean-corn-oats with sweetclover (C-SB-C-O/SCL), corn-soybean (C-SB), and grain sorghum-soybean (GS-SB).

The first rotation was grown using three methods: two conventional and one organic. One conventional method entailed treating the crops with herbicides and non-organic fertilizer; the other involved non-organic fertilizer and no herbicides. The organic systems had two parts: one where the costs of applying manure were assumed to be the only relevant costs, and one where manure was assumed to cost the same as commercial organic fertilizer. In the organic system and other systems that avoided herbicides, increased mechanical cultivation was assumed. The organic system was charged with additional labor from assumed weed problems associated with the use of animal manure as fertilizer.

With regard to yields, the organic rotation was fourth in corn yields, behind (from highest to lowest) the corn-soybean rotation, the long rotation with herbicides and non-organic fertilizer, and the long rotation with non-organic fertilizer only. The continuous corn yields were the lowest. For soybean yields, the organic rotation was sixth, with the grain sorghum-soybean rotation the highest. Oat yields from the organic rotation were highest. From the yield data, Helmers and colleagues concluded that the yields from crop rotations were generally higher than those from continuous planting without any rotation. Yields from selected cropping systems are presented in Table 6.

Turning to average inflation-adjusted net returns (Table 6)⁶, Helmers' team noted that during the study period, soybean crops earned high net returns. Consequently, systems with a high proportion of soybean (corn-soybean, continuous soybean, and grain sorghum-soybean) tended to have higher net returns. The 4-year rotations were the next highest in net returns. There was very little difference between net returns for the three different types of long rotations, although it is worth noting that the organic system in which manure was charged at application rates finished first. This system had lower net returns and a lower NPV than the conventional corn-soybean system, but performed better in both categories than the continuous corn system.

I performed a break-even analysis to discern the effects of organic price premiums, and concluded that in order to have the same net returns as the conventional corn-soybean rotation, the organic rotation would have had to earn a 13.358 percent annual price premium for corn, soybeans, and oats. The assumption was that all of the organic crops would be sold in the organic market. These price premiums, which are very low compared with those currently available, illustrate the importance of being able to obtain premiums for all the crops in an organic rotation. This information is critical for farmers considering switching to an organic system. If an

⁶Because the net returns were adjusted for inflation, an estimate for the assumed "real" interest rate of 5 percent is used in place of the nominal rate estimates of 7 percent and 10 percent.

TABLE 6 Crop Yields^a, Net Returns, and Net Present Value for Selected Cropping Systems, University of Nebraska Study, 1978-1985

Source: Adapted from Helmers and colleagues (1986).

System	1978^b	1979	1980	1981	1982	1983	1984	1985	Mean	NPV (5%)
Corn-soybean										
Corn yield	134	106	60	106	76	74	55	154	96	
Soybean yield	38	38	27	50	36	36	33	46	38	
Returns to land, overhead labor, machinery investment, and management (\$/a)	299.85	228.85	146.14	209.29	94.28	168.75	72.12	181.91	175.15	1165.74
Organic, corn-soybean-corn-oats/sweetclover										
Corn yield	133	27	77	97	93	46	63	117	82	
Soybean yield	24	24	40	49	42	25	16	39	32	
Oat yield	6	75	30	44	71	53	67	104	56	
Returns to land, overhead labor, machinery investment, and management (\$/a) ^c	194.66	46.11	180.98	153.25	115.96	60.73	47.32	120.00	114.88	760.66
Returns with annual premium for corn, soybean, and oats of 13.358%	250.73	85.48	261.48	233.01	186.86	115.05	95.13	194.98	177.84	1165.74
Continuous corn										
Corn yield	128	37	61	113	89	27	20	103	72	
Returns to land, overhead labor, machinery investment, and management (\$/a)	272.59	-17.35	96.74	176.12	85.57	-43.16	-80.12	98.71	73.64	517.05

^aAll yields in bushels per acre, except alfalfa in metric tons per acre.^bFirst year eligible for organic price premiums.^cManure charged at application rates.

organic system needs to earn premium prices to break even with a conventional corn-soybean system, then the greater the number of crops commanding premiums in the organic rotation, the smaller the size of the premiums required to break even with the conventional corn-soybean system.

Helmets and colleagues also used a number of measures to assess the relative level of risk associated with the different rotations and treatments. In general, the longer rotations reduced risk: the net returns were less variable and there was less risk of having a poor year financially. They also found that the longer rotation, not the organic regimen itself, was responsible for lowering risk. They concluded that crop rotations earned higher net returns than continuously grown crops; and that when it came to 4-year rotations, different types of regimens had little influence on net returns. They also argued that organic agriculture is a “treatment,” not a particular sequence of crops, and as a result:

“...the competitiveness of organic methods should not be assessed by comparing returns from [the organic systems] to those of nonorganic systems that use different crop sequences.”

Rather, they maintained, analysts should compare the returns earned by the three longer rotations that used different treatments. Their recommendation is problematic, however, since a substantial shift from conventional to organic production would induce large numbers of farmers who currently use corn-soybean rotations to switch to longer rotations.

South Dakota State University Studies

South Dakota State University sponsors two sets of ongoing studies. One set is composed of experiment station trials, the results found in Smolik and Dobbs (1991) and Smolik and colleagues (1995). The second is a comparison of two working farms, one organic and the other conventional. A published description of the latter study can be found in Dobbs and Smolik (1996).

SMOLIK AND COLLEAGUES (1995): EXPERIMENT STATION STUDIES. The experiment station trials are composed of two separate studies initiated in 1985 at the Northeast Research Station near Watertown, South Dakota (Codington County). Study 1 looks at row crops in three rotation systems:

- organic (no synthetic fertilizer or herbicides): oats with alfalfa-alfalfa-soybean-corn,
- conventional: corn-soybean-spring wheat, and
- ridge-till: corn-soybean-spring wheat.

TABLE 7
Crop Yields* by
Study and
Cropping System,
South Dakota
State University
Experiment
Station Trials,
1986-1992

Source:
 Smolik and
 colleagues (1995).

	Organic	Conventional
Study 1		
Corn	76.2	91.2
Soybeans	26.6	27.0
Spring wheat	—	39.8
Oats	55.1	—
Alfalfa	4.6	—
Acres per crop (mean)	127	162
Study 2		
Soybeans	29.6	28.6
Spring wheat	41.5	39.5
Barley	—	63.0
Oats	58.5	—
Acres per crop (mean)	135	162

*All yields in bushels per acre, except alfalfa in metric tons per acre.

Study 2 emphasizes small grains in three systems:

- organic: oats with clover-clover (green manure)-soybean-spring wheat-barley,
- conventional: soybean-spring wheat-barley, and
- minimum-till: soybean-spring wheat-barley.

The crop mix in Study 2 was designed to need less moisture than the Study 1 crop mix. All crops were present in each year in all systems. Only the organic and conventional results are presented here.⁷

The organic rotation in Study 1 was patterned after rotations used by organic crop-livestock system farmers in east-central South Dakota. All of the systems examined in Study 2 were assumed to be cash grain operations (i.e., the crops grown were assumed to have been sold and not fed to the farm's livestock). Overall, the crops harvested in these studies are the dominant crops produced in northeastern South Dakota and throughout much of the Northern Plains. Crop yields in the two studies under the different systems are presented in Table 7. The organic system had the lowest yields of corn, soybeans, and spring wheat. However, spring wheat yields in Study 2 were highest for the organic system during the last two years of the study.

⁷Smolik and colleagues (1995) found that, in terms of profitability, the conventional and organic systems outperformed the ridge-till and minimum tillage systems.

In comparing the economics of the various systems (see Table 8), federal farm program payments were taken into account as well as market prices. Possible organic price premiums were, however, not included in the calculations. The results indicate that direct costs other than labor were, on average, lower for the organic systems. In Study 1, gross income was

TABLE 8
Mean Economic
Results by Study
and Cropping
System, South
Dakota State
University
Experiment
Station Trials,
1986-1992

Source:
 Smolik and
 colleagues (1995).

System	Rotation	Annual net income over all costs except management	NPV	
			7%	10%
Study 1				
Organic	Oats-alfalfa-soybean-corn	\$20,139	\$104,194	\$92,632
Conventional	Corn-soybean-spring wheat	\$12,328	\$65,207	\$58,553
Study 2				
Organic	Oats-clover-soybean-spring wheat	\$6,443	\$34,137	\$30,678
Conventional	Soybean-spring wheat-barley	\$6,803	\$33,946	\$29,826

highest, on average, for the organic system, followed closely by the conventional system. In Study 2, the conventional system had the highest average gross income. Regarding net income, the organic system in Study 1 was the most profitable. In Study 2, the organic and conventional systems were almost equal. However, while the average profitability of the conventional system was slightly higher than that of the organic system, the NPV (using a 7 percent or 10 percent nominal interest rate) of the organic system was slightly higher than the NPV of the conventional system. The reason: the organic system's returns were higher in the earlier years. Although this result seems counter-intuitive, a closer look at the data shows that the earlier years of the study were drier than the later years and, as noted earlier in this report, organic systems tend to outperform conventional systems in dry conditions (see also Diebel and colleagues, 1995).

Study 1's organic system profits were boosted by a high alfalfa price. In fact, the average price of alfalfa during the study period was 10 percent higher than the 20-year average. The authors performed an alfalfa price sensitivity analysis and found that the organic system in Study 1 would have been the most profitable even with a 20 percent drop in alfalfa prices. With regard to federal farm programs, Smolik and colleagues determined that they affected the net income of the various systems differently. The organic system received an average of \$9 per acre per year less in government payments than the other systems in Study 1; the organic system in Study 2 received an average of \$4 per acre per year less.

In addition, the authors reported that net returns over all costs except management were much less variable for the organic system than for the conventional system in Study 1—that is, the organic system never had negative net returns. The variability of net returns was about the same for all systems in Study 2. The authors concluded that:

“...certain organic systems are attractive from agronomic, economic, and ecological perspectives in the transition zone between the mesic region of corn, soybeans, and hogs and the drier region of cattle, wheat and sorghum. Perhaps these results suggest what may occur in other regions, such as the Corn Belt, as public policies and sustainable agriculture technologies evolve further.”

DOBBS AND SMOLIK (1996): ON-FARM STUDY. This study was conducted on two operating farms in Lake County, South Dakota. Lake County is located in east-central South Dakota and is closer to the western edge of the Corn Belt than is Codington County, where the experiment station trials are located. The study compared an organic and conventional farm that were close to each other and had similar soil resources. The comparison presented here took place from 1985 to 1992.

The organic farm had 750 acres of cropland. The farm household members used a 4-year crop rotation consisting of a small grain planted with alfalfa-alfalfa-soybean-corn. The conventional farm had 830 acres of cropland and used a 2-year corn-soybean rotation. On average, 84 percent of the conventional farm's cropland was devoted to growing corn and soybeans over the 8-year study period, compared with 50 percent on the organic farm. Both farms maintained livestock operations (which for the purposes of the study were ignored) and market values were placed on the harvested crops.

Corn yields did not differ significantly between the two systems; however, soybean yields were substantially higher on the conventional farm. Table 9 presents the results of the economic analysis. The analysis took into account then-current federal farm program payments, but price premiums for organic products were ignored initially. Direct costs other than labor were about twice as high on the conventional farm as on the organic farm. However, the conventional farm's net income was substantially higher than that of the organic farm: \$68 per acre compared with \$40 per acre. In addition, the conventional farm's income was less variable. Between 1989 and 1992, the organic farm received some price premiums for portions of its soybean, oat, wheat, and corn crops, but these premiums were not included in the analysis presented in Table 9. With the premiums included, the net income gap was narrowed but not eliminated. Organic price premiums on the organic farm added \$11 per acre to the net income over all costs except management. A break-even organic premium was not calculated because of insufficient data.

The authors found that higher soybean yields, coupled with substantial portions of cropland dedicated to corn and soybeans on the conventional farm, largely accounted for its higher profitability. Indeed, they

TABLE 9
Economic Analysis
of Lake County
Farming Systems
Paired-Comparison
Study, South
Dakota State
University,
1985-1992

Source:
 Adapted from
 Dobbs and Smolik
 (1996).

System	Primary rotation	Annual net income per acre over all costs except management	NPV	
			7%	10%
Organic	Small grain with alfalfa-alfalfa-soybean-corn	\$40 (\$51/a with premiums)	\$232	\$205
Conventional	Corn-soybean	\$68	\$394	\$347

found that the alfalfa and small grains crop on the organic farm actually lost \$2 per acre. In addition, government payments contributed to the net income advantage of the conventional farm in the first four years of the study period (but not the last four).

Dobbs and Smolik concluded that the organic farm earned what they labeled as “acceptable” profits over the course of the study period—that is, revenues high enough to cover all costs, including land charges and family labor wages—and still left a return to management. The authors believed that these results, combined with the experimental trials and other studies, add credence to an emerging theory that organic systems are less competitive in areas dominated by corn-soybean production, but do better in areas where small grain and mixed row-crop-small grains systems are more prevalent.

What Have We Learned?

Table 10 summarizes the profitability comparisons of the land-grant university cropping system studies. The early Corn Belt studies are not included because of their short duration and because the data were collected before 1980. What is most surprising is how well the organic systems performed despite the minimal amount of research that traditional agricultural research institutions have devoted to them. The organic rotations were more profitable than the most common conventional rotation (generally a high-purchased input corn-soybean rotation) without price premiums in the Kansas State University study, the University of Minnesota study, and the South Dakota State University cropping system study in central South Dakota. The conventional corn-soybean system was more profitable than the organic system without price premiums in the Iowa State University and Nebraska studies, and with available price premiums in the South Dakota State University paired-farm comparison study in southeastern South Dakota. The paired-farm study took place from 1985 to 1992 and therefore organic price premiums may have been lower or less readily available than in the last few years. Also, where data were available (Iowa and Nebraska), the break-even annual average organic price

TABLE 10 Summary of Land-grant University Studies

University	Years ^a	Organic premiums	Government payments	Study type	Mean net returns (\$)	NPV (\$)		Annual break-even organic premium ^b
						7%	10%	
Iowa State Conv: corn-soybean	1989-1997	No	No	Experiment	134.41/a	824.83	711.09	
Org: corn-oats-alfalfa					104.85/a	645.39	557.13	35.4% (corn, oats) 18.9% (corn, oats, alfalfa)
Kansas State Conv: corn-soybean	1986-1990	No	Yes	Simulation	27.04/a	not applicable		
Org: corn-soybean-corn-soybean-alfalfa with oats-alfalfa-alfalfa					34.75/a	not applicable		none required
Minnesota Conv: high-input corn-soybean	1990-1996	Yes	No	Experiment	155.86/a	839.37		
Org: corn-soybean-oats-alfalfa					171.74/a	911.75		none required

TABLE 10 Summary of Land-grant University Studies, continued

Nebraska	1978-1985	No	No	Experiment				
Conv: corn-soybean					175.15/a	1166 ^c		
Org: corn-soybean-corn-oats with sweetclover					114.88/a	761		13.358% (corn, soybean, oats)
<hr/>								
South Dakota State Cropping Trials	1986-1992	No	Yes	Experiment				
Study 1								
Conv: corn-soybean-spring wheat					12,328/farm	65,207	58,553	
Org: oat-alfalfa-soybean-corn					20,139/farm	104,194	92,632	none required
Study 2								
Conv: soybean-spring wheat-barley					6,803/farm	33,946	29,826	
Org: oats-clover-soybean-spring wheat					6,443/farm	34,137	30,678	none required
<hr/>								
South Dakota State Paired Farm Study	1985-1992	Yes	Yes	Paired case study				
Conv: corn-soybean					68/a	394	347	
Org: small grain with alfalfa- alfalfa-soybean-corn					40/a (no prem) (51/a with prem)	232	205	no data

^aRefers to the data years used for this summary table, not necessarily the length of the study.

^bBreak-even premium calculated for NPV with 7% discount rate, except for Nebraska where 5% was used.

^cA 5% "real" discount rate was used since the authors adjusted their figures for inflation.

premiums were calculated and found to be below the recent averages (for corn, oats, and soybeans) reported by Dobbs (1998b).

The results of the university studies reviewed for this report indicate that midwestern farmers who grow organic grains and soybeans are capable of earning profits on their crops. In fact, the price premiums paid for organic products, although they increase profitability, are not always necessary for organic systems to be competitive with or outperform conventional farming systems. However, growing organic grains and soybeans in a longer rotation may not always be *the most profitable* alternative for farmers. Along with a number of agronomic and climatic factors, profitability depends on:

- crop choices;
- future demand for organic grain and soybean products;
- future demand for other organic crops grown in rotation with grains and soybeans;
- federal farm programs;
- kinds of premiums offered;
- future costs of synthetic pesticides and fertilizers;
- costs of organic fertilizers and pesticides;
- price impacts on commodity markets from shifts from corn-soybean rotations to longer rotations;
- transition period; and
- government environmental protection regulations and programs.

Two central issues associated with organic production are the transition period from conventional to organic production, and the environmental benefits from organic production. These two topics are discussed in the next chapter.

5 *Additional Considerations*

The Transition

ONE OF THE MORE IMPORTANT ISSUES for farmers to consider before attempting to grow organic products is how to handle the transition period, when they discontinue the use of synthetic chemicals. The transition has two parts: bureaucratic and ecological. During the bureaucratic transition (usually three years), organic farmers cannot earn price premiums (Blobaum, 1997; FVO, 1996; Lohr and Salomonsson, 1998). The ecological transition, which may be longer than three years, refers to the biological and managerial transition before long-term yield equilibrium is achieved (Posner et al., 1995), when farmers learn and adjust to organic farming practices and techniques (Hanson et al., 1997).

Beyond the lack of premiums, potential transition constraints include lack of available information, lack of available credit for organic operations, an incomplete or poorly constructed conversion plan (Padel and Lampkin, 1994), the cost of learning a new enterprise, the need to buy additional or different equipment, increased paperwork for certification and bookkeeping requirements (especially if the farm is operated as part organic and part conventional) (Blobaum, 1997), and the need to think about farming differently and experiment with new techniques. Lohr and Salomonsson (1998) reported that, according to the U.S. General Accounting Office, farmers do not convert to organic or alternative farming chiefly because they do not want to face the costs of changing management practices and possible lower yields. Smolik and Dobbs (1991) argued that research trials at least partially confirm some farmers' experiences, whereby a transition period of a few years is often required before organic systems are competitive. OFRF (1999) found that weed control was a major concern, followed by lack of information and experience regarding organic production, and an inability to identify markets for organic products.

Padel and Lampkin (1994) wrote that farmers can choose to take either a “staged” or a “single-step” approach to adopting an organic system. The staged approach entails converting an ever-increasing proportion of the farm to organic production. The single-step approach requires farmers to switch the entire farm over to organic production at one time. Padel and Lampkin, as well as Duffy and colleagues (1989), argued that the choice of the first crop planted during the transition has a substantial influence on the yield and financial return of the whole management system. Since the choice of the first crop is a decision based largely on a conversion plan, household resources and constraints, local agronomic factors, climatic conditions, and current market conditions, conventional farmers seeking to convert to organic production should consult with nearby organic farmers and others with relevant expertise.

Padel and Lampkin maintained that would-be organic farmers should develop a full conversion plan with the help of a knowledgeable adviser, perhaps a professional agricultural consultant. Such consultants can potentially speed up the process of learning to farm organically, as well as assist farmers in obtaining organic certification. Glen Borgerding of Agriculture Resource Consulting, Inc., has found that transitioning farmers, as well as those currently farming organically, tend to seek out professional help for planning and implementing appropriate rotations and for mastering nonchemical weed control.⁸

Environmental Implications

Although this report is concerned primarily with the profitability of organic farming, a number of scientific studies have illustrated the potential for organic farming to improve farmworker safety and enhance agricultural pollution control. Alavanja and colleagues (1996:362) found that although a number of factors may contribute to the high incidence of certain types of cancer among farmers, “[t]o date...the strongest links of exposures and malignancies have been with pesticides...” (see Box 2). In addition, Alavanja and colleagues asserted that “[p]otential noncancer health outcomes that may be influenced by agents found in the farm environment, particularly pesticides, include deleterious effects on the nervous, renal, respiratory, and reproductive systems of both men and women... [see also Blair and Zahm, 1995].” Garry and colleagues (1996:abstract) found in their Minnesota study that “...the birth defect rate for all birth anomalies was significantly increased in children born to private [pesticide] applicators.”

Regarding agricultural pollution control, Lockeretz and colleagues (1978), in their study of Corn Belt farms, found that organic methods offered benefits such as reduced soil loss and increased soil quality through increases in soil organic matter.⁹ Sahs and Lesoing (1985:515), writing about results from the University of Nebraska’s cropping system study,

⁸Personal interview with Glen Borgerding of Agriculture Resource Consulting in Freeport, Minnesota.

⁹See Jaenicke (1998) for an analysis of the importance of soil quality for environmental health.

BOX 2: Pesticides and the Health of Farm-level Workers

Alavanja and colleagues (1996:362) found that studies from North America, Europe, Australia, and New Zealand have established that farmers have **lower** mortality rates than the general population overall, and for heart disease, and cancers of the lung, esophagus, bladder, and colon. These lower rates are attributed to lower smoking rates among farmers, with possible additional contributions from diet and active lifestyles. Higher rates of cancer for farmers than the general population were found for Hodgkin's disease, leukemia, multiple myeloma, non-Hodgkin's lymphoma, and cancers of the lip, stomach, prostate, skin (melanotic, nonmelanotic), brain, and connective tissue. The authors go on to cite possible contributing factors for the higher rates, which include prolonged occupational exposure to sunlight, diet, and contaminated drinking water, as well as a number of chemicals and biological agents. However, they conclude that the strongest link between exposure and malignancies has been with pesticides.

noted that “[the] organic treatment, through the use of beef feedlot manure and rotation with legumes, increased soil organic matter.” In addition, Smolik and colleagues (1995) determined from the results of South Dakota's cropping system studies that conventional systems, using conventional tilling methods, did not meet then-current conservation compliance regulations for residue cover on highly erodible land. Organic systems, along with the reduced tillage systems, did meet current compliance regulations—and the potential for nitrate pollution was lower for organic systems than for conventional systems.

In a study measuring nitrate in water draining from three neighboring fields in central Illinois from 1970 to 1992, Goldstein and colleagues (1998) concluded that a conventionally managed corn-soybean rotation resulted in high nitrate concentrations in drainage waters, while an alternative system prevented potential problems with nitrates. Drinkwater and colleagues (1998) found that organic systems maintain yields, increase soil fertility, and decrease losses of nitrogen by leaching (see also Tilman, 1998). Robinson (1991) asserted that the reduced soil erosion, increased crop diversity, and dearth of synthetic pesticides associated with organic systems have significant positive impacts on wildlife.

Faeth (1993) argued that conventional accounting systems in agriculture often understate agricultural production's potentially negative impacts on natural resources, despite the importance of these natural resources to farmers and society. If soil erodes from farm operations and costs are incurred—either through the transport of farm chemicals to bodies of water, or through sediment build-up in reservoirs, or shipping channels and harbors—no attempt is made to allocate these costs to the agricultural

Pesticides have been linked to a number of health problems for farm-level workers (Alavanja et al., 1996).

Photo courtesy of the Agricultural Research Service, USDA.



production operations from which they originated. Faeth maintained that this lack of accountability could mask a decline in overall societal wealth—and that the costs of dredging waterways or restoring fisheries damaged by farmland erosion represented a kind of agricultural subsidy. From this perspective, if the costs of farmland soil erosion or other negative impacts can be accounted for, then the social profitability of organic agriculture may be enhanced relative to that of conventional agriculture, depending on a number of factors. If the current downturn in the numbers of Iowa farmers employing conservation tillage is an indicator of future trends, the importance of organic agriculture as a profitable and environmentally friendly alternative could increase significantly. Indeed, by including organic production in the Environmental Quality Incentive Program (EQIP), Iowa has recognized the environmental benefits of organic farming (Anton Dunn, 1997a).

6 *Policy Implications*

ORGANIC FARMING can be a productive, profitable, and environmentally benign alternative to conventional, chemically intensive agriculture. It has the potential to reconcile the too-often competing goals of economic profitability and environmental sustainability. However, if organic farming in the United States is to reach its full potential, private institutions and government agencies at all levels should be prepared to undertake more concerted efforts on its behalf. Although there is currently some government support for organic agriculture in the U.S., it is fair to say that a number of European governments, and the European Union itself, have more completely embraced the concept of organic agriculture. This embrace goes beyond providing certification support and research, to subsidizing the conversion of conventional farmers to organic production.

Potter (1998) and Lampkin and Padel (1994) have observed that agricultural income support policies in European countries have moved away from price supports for particular commodities, to policies that support the concept of rural areas as producers of environmental services as well as agricultural products. Organic farming is seen as a critical part of this approach. The advantage of organic farming over many other approaches is that buyers of agricultural products support the protection of the rural environment, which relieves pressure on public coffers and taxpayers for financing remedial measures. In 1987, Denmark introduced financial support policies for organic farming, including information and marketing support and financial assistance, during the conversion from conventional to organic farming. This policy led to a tremendous increase

in the size of the organic sector (Lampkin and Padel, 1994; Michelsen, 1996). Other countries soon followed Denmark's lead; they include Sweden (which, through taxes and other charges on fertilizers and pesticides, funds research into reducing and eliminating chemicals in agricultural production), Germany (Nieberg and Pals, 1995), Norway, Finland, Austria, and Switzerland. These efforts have increased the organic farming sector substantially since their inception (Lampkin and Padel, 1994; Lohr and Salomonsson, 1998).

The United States, too, has provided support for organic agriculture. On the state level, for instance, a number of programs have appeared. A prime example is Iowa, which, as mentioned previously, supports organic farming through EQIP, a program that provides targeted financial incentives to farmers. EQIP is administered by the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture (USDA) and is designed to promote the adoption of particular conservation management practices. EQIP is a cost-share program through which states design the list of conservation management practices. If EQIP funding can be increased, and if environmental, consumer, and sustainable agriculture groups can persuade state legislatures to designate certified organic production as a conservation practice, then EQIP could play an important role in increasing the acreage under organic management. Iowa also imposes fees and taxes on pesticides and synthetic fertilizers, and funds activities (such as the operations of the Leopold Center for Sustainable Agriculture at Iowa State University) to reduce the use of hazardous agricultural chemicals. Other states, such as California, have also taken the latter approach.

On the national level, the USDA's Agricultural Research Service has established organic trials at its Beltsville, Maryland, site. In addition, the USDA has for more than ten years funded research through its Sustainable Agriculture Research and Education (SARE) Program, which often provides useful information to current and potential organic farmers. Another federally funded program, Appropriate Technology Transfer for Rural Areas (ATTRA), provides information on resource-conserving agricultural practices, including information relevant for organic farming.

A number of land-grant universities have pushed forward in this arena as well. They have developed research efforts to test alternatives to chemically intensive agriculture, engaged sustainable farming groups, and designed undergraduate and graduate curricula in sustainable agriculture (Francis et al., 1995).

What Else Is Needed?

By themselves, current U.S. efforts to promote organic farming as an environmentally and financially preferable option are not enough. Perhaps the most pressing need is for more research. Mark Lipson (1997)

of the Organic Farming Research Foundation authored a ground-breaking report, *Searching for the "O-Word."* In it he details the results of a search through the USDA's Current Research Information System (CRIS) database to identify projects relevant to organic farming. Thirty-four projects were identified as "strong organic," and their funding totaled only \$1.5 million or about one-tenth of one percent of total public agricultural research spending. Lipson offered several recommendations to the USDA, which essentially encouraged the agency to publicly embrace organic agriculture as a needed and helpful vehicle for achieving production, economic, and environmental goals.

If organic agriculture becomes more widely accepted by traditional research institutions, then the trajectory of current research efforts might change. Lampkin and Padel (1994) have argued that research on organic farming should move away from conventional-organic comparisons, to research solely within the organic framework. Although studies that compare conventional and organic cropping systems will prove useful for the foreseeable future, Lampkin and Padel have provided an important insight. That is, the size of the organic industry, the stability and growth of consumer interest in organic products, and the legitimization of organic agriculture as an environmental protection tool underscore the need to establish purely organic cropping system trials. These trials could compare several organic rotations within a number of ecosystem areas to determine which are the most productive and profitable.¹⁰ In establishing these trials, special attention should be paid to the rotations of currently operating organic farms. Case studies of organic farms (Cavigelli and Kois, 1988; Chan-Muehlbauer et al., 1994) show that in practice, organic farmers may use longer and more diverse rotations than those currently used in experimental trials. For this reason, organic farmers should be part of the research teams developing cropping systems trials (Posner et al., 1995). In this vein, OFRF (1999) found that the top production research needs identified by organic field crop farmers are, in order of importance, weed management, crop rotations for fertility and pest management, the relationship between fertility management and crop health, pest and disease resistance, the relationship between organic growing practices and nutritional value of the product, and cover cropping and green manures.

Conversion planning should receive a great deal of attention from both funding and intellectual capital perspectives. Even in the absence of conversion subsidies or cost-sharing payments, information and expertise on developing conversion plans is critical for farmers who are considering making the transition to organic farming (Lampkin and Padel, 1994; Lohr and Salomonsson, 1998; see also National Commission on Small Farms, 1998). Universities may wish to develop courses on conversion planning and train students and extension workers in this area.

¹⁰Delate et al. (1998) report that Iowa State University's recently initiated cropping system trials compare a conventional corn-soybean system with three organic systems (corn-soybean-oats, corn-soybean-oats-alfalfa, and soybean-rye).

Turning from production to marketing, much work on the marketing aspects of organic agriculture is needed. Specifically, state departments of agriculture, as well as other interested parties that view organic agriculture as a potentially fruitful area for rural development and environmental management, might invest resources developing price reporting services and other marketing information useful to organic farmers. The U.S. Department of Agriculture should participate as well, by serving as the national clearinghouse for organic market data (Richman, 1999). In addition, extension services could assist organic farmers in developing or locating market outlets or developing individual or cooperative marketing strategies. OFRF (1999) found that organic farmers who identified market-related issues as important tended to want information on consumer demand and education, alternative marketing systems, farm processing, and value-added markets.

Given the large current and projected demand for organic products, relatively minor adjustments in agricultural policy could result in significant shifts in acreage under organic production. The literature reviewed for this report indicates that such a shift could have substantial benefits not only for farm-level workers, but for the continued well-being of our natural world as well.

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