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Summary

This case study reviews the economic, social, and environmental benefits associated with organic agriculture in the U.S. These benefits include measurable impacts and unmeasurable impacts that affect both agricultural and consumer systems in fundamental ways. Both are discussed in this study.

Measurable impacts are quantified in two ways – by comparing characteristics of organic and conventional farmers and by comparing indicators of benefits in counties with organic farms and counties without. Statistical differences in counties with and without organic farms are strong evidence that organic farms need not be numerous to generate benefits. There were 1,208 counties containing 4,868 organic farms in the U.S. in 1997, the last year for which location data are available.

Findings of measurable impacts include:

- Organic farmers are more likely to be female, hold a college degree, and be full-time farmers. The average organic farmer is 7 years younger than the average U.S. farmer.
- Retail price premiums for organic foods average 10% to 30% higher than conventional. Farm price premiums are 70% to 250% more than what conventional farmers receive.
- Counties with organic farms have stronger farm economies and contribute more to local economies through total sales, net revenue, farm value, taxes paid, payroll, and purchases of fertilizer, seed, and repair and maintenance services.
- Counties with organic farms have more committed farmers and give more support to rural development with higher percentages of resident full-time farmers, greater direct to consumer sales, more workers hired, and higher worker pay.
- Counties with organic farms provide more bird and wildlife habitat and have lower insecticide and nematicide use.
- Watersheds with organic farms and have reduced agricultural impact and lower runoff risk from nitrogen and sediment.

Findings of unmeasurable impacts include:

- Organic farming under current standards avoids social and economic costs such as pesticide poisonings and costs of testing for genetically engineered foods.
- The market in organic foods is more efficient than for conventional foods, because prices reflect more of the cost of producing socially desirable outputs, such as clean water, as a byproduct of food production activities. This reduces the need for government intervention through taxes or subsidies to obtain these benefits.

- Innovation and openness to new ideas are necessary for growth in knowledge-based organic systems, and result in rapid development and dissemination of information on nonchemical production methods that benefit all farmers.

Overall, the findings of this study are surprising in the strength of support for the hypothesis that organic farming produces more benefits than conventional farming. Nearly every indicator tested across the range of economic, social, and environmental benefits favors organic systems. Even though organic farmers are not a large percentage of the total number of U.S. farmers, their influence is felt through their innovation of management techniques and leadership in meeting the organic standards.

I. Introduction

The domestic organic foods market is conservatively estimated at $9.35 billion.[1] The National Organic Program (NOP) specifying requirements for organic agriculture were finalized in February 2001, and became fully implemented in October 2002. The process of unifying the patchwork of U.S. standards into a national rule began more than 10 years ago, and has influenced market development since then. Firms that produce raw or manufactured agricultural commodities in accordance with the NOP for "100% organic" or "organic" and whose operations are certified compliant by a US Department of Agriculture (USDA)-accredited certifying organization are entitled to use USDA organic labels on their products. Certified products may be sold through organic marketing channels throughout the U.S. and may be exported and sold as organic in countries where the USDA labels are legally recognized as equivalent to their domestic standards.

Prior to promulgation of the NOP, a patchwork of state, private not-for-profit, and private for-profit organizations offered certification according to differing standards, with differing degrees of credibility. The USDA labels under the NOP assure those in the marketing chain, including consumers, that certified production systems comply with a standardized set of rules. Reducing this variability makes product flow less costly because organic claims do not have to be independently and repeatedly verified at each point in the marketing chain. Standardized rules allow consumers to form consistent expectations of the benefits resulting from organic purchases because all certifiers insure that the same rules are followed across the country. Greater certainty about expected benefits of organic foods encourages consumers to pay the price premiums that internalize these benefits.

Consumers believe that organic foods are safer, healthier, and better for the environment, that they are superior in quality and nutrition, and that they are safer for farmers to produce.[2, 3, 4] Research on claims of superior quality, nutritional value, and safety is inconclusive.[5, 6] One review found that for a typical adult, daily intake of vitamin C, iron, magnesium, and phosphorus would be higher if only organic vegetables were consumed.[7] Organic superiority in some macro and micronutrients, firmness, and taste have been noted in tomatoes[8] and apples[9] in the U.S. Farmers cite both personal and business reasons for organic farming, including belief that organic is better for the land, concern over environmental and health impacts of conventional farming, enjoyment of solving the challenges of organic systems in innovative ways, and ability to make positive net returns on small scale, intensively managed farms.[10, 11, 12, 13] Most of the farm level benefits usually cited – improved soil quality, greater diversity of soil organisms, insects, wildlife, and plants, greater net return and reduced income risk, better drought resistance, higher cumulative energy efficiency, and safer on-farm environment - are outcomes of the methods required for organic farming.[9, 14, 15, 16, 17, 18] Beyond the farm, benefits claimed from organic farming include enhanced biodiversity and habitat, cleaner groundwater and surface water, and reduced greenhouse gas emissions.[14, 19]

Avoided costs are one measure of benefits associated with organic farming. As one example, the EPA estimates that there are 10,000 to 20,000 cases of acute pesticide poisonings nationwide among agricultural workers, due mostly to insecticides.[20] Chronic and delayed onset illnesses, such as cancer, are also associated with pesticide exposure, but national and state reporting systems do not monitor these effects.[21] Substitution of organic methods would drastically reduce or eliminate this risk and the associated economic impact of lost workdays. As another example, the cost of testing for genetically engineered (GE) food crops to protect the integrity of non-GE crops is not incurred with an organic system, because GE seed and stock are not permitted.

Unfortunately, most studies of organic benefits in the U.S. have been localized in nature. To generalize research results to the entire country, indirect statistical measures must be used. The statistical method used here is a comparison of relevant economic, social, and environmental characteristics of counties (sub-state governmental units) or watersheds with and without organic farms. Combined with literature documenting linkages between organic farming and benefits, this indirect approach establishes that the presence of organic farms indicates, if not results in, numerous benefits. The results suggest that even a single organic farm in a county or watershed can produce positive spillover effects by leading through example and encouraging change in conventional farming practices.

II. Organic Market Demand And Supply

This section reviews demand and supply conditions in the organic market and describes important characteristics of consumers and farmers.

A. Demand

One benefit of organic agriculture is to broaden choices for consumers, offering them a true alternative to food produced with synthetic chemicals, genetically-engineered (GE) plants and animals, sewage sludge, and irradiation, among other conventional practices. This benefit may be valued as willingness to pay to either avoid buying such food unwittingly, by requiring that it be labeled, or to actively seek an alternative guaranteed not to use such practices, by buying organic foods. While studies of negative attribute labeling are hypothetical, one may actually observe organic price premiums over nonorganic products in the market place, and so are more reliable for analytical purposes.

Retail price premiums for organic foods average 10% to 30% over conventional foods, but may range widely.[22] U.S. price premiums are lower than in many countries, because a higher percentage of sales is through mainstream supermarkets.[22] In 2000, conventional supermarkets sold 49% of all organic products, with natural products retailers accounting for 48%.[23] Relative availability, product placement, branding, and resistance to premiums affect the range of premiums. As an example, in observations at 75 conventional supermarkets and natural products stores in Atlanta, Georgia in 1999, average premiums were 32% for coffee, 24% for rice cakes, 20% for spaghetti sauce, 17% for milk, 5% for baby food, and -0.5% for breakfast cereal.[24]

Occasional buyers, estimated at 50% of U.S. households, purchase organic foods once a month or less frequently.[3, 4] Regular buyers who purchase organic foods at least once a week comprise 9% to 19% of all households, depending on product category.[4] Occasional buyers are more likely to use price premiums as a deciding factor in purchase. Regular buyers tend to be less price-sensitive, more knowledgeable about organic production practices, and more focused on perceived benefits in making purchase decision. Converting occasional consumers to regular buyers should be as much of a priority for the organic industry as attracting new customers who have never tried organics.

Recruitment of regular buyers from the occasional buyer category is expected to be easier with the implementation of the NOP. Uniformity of organic standards and labeling will reduce consumer confusion and enable generic advertising of organic foods that should benefit sales across all categories. A simulation of U.S. market behavior showed that as buyer costs of identifying and locating organic foods decline, both organic consumers and producers and conventional consumers are made better off, with reduced market prices and increased organic quantities sold.[25]

B. Supply

The supply side is difficult to assess because organic yields are not known, although acreage data have been collected by the USDA.[26] These data indicate that total certified acreage grew 151% between 1992 and 2001, from 935,450 acres to 2,344,272 acres. Direct marketing to consumers and retailers are more frequently used by organic producers than by conventional producers.[23] The allocation of acreage among marketing channels in 1997 was 13.2% direct to consumers, 6.7% direct to retail, and 80.1% to wholesale outlets.[27] Of the direct to consumer options, on-farm sales (8.3% of organic acreage), farmer markets (2.3%), and subscription farming (0.9%) all require face-to-face interactions. This structural characteristic generates important benefits from organic agriculture – locally organized food systems that reduce energy use and costs for storage, handling, and transportation, improve farmer-consumer relations, build political capital to protect local growers, provide consumers with fresher foods, maintain agricultural green space, and educate consumers about food production.

Price premiums at the farm level change with local and national availability and with crop-specific demand. Since premiums are measured with respect to conventional prices, the calculation also depends on those prices. Grain and oilseeds in North Dakota had price premiums ranging from 71% for oats to 175% for soybeans in 2000.[28] For 16 commodities, North Carolina horticultural farmers received average organic premiums of 186% (fob sales to wholesalers) and 251% (fob sales to retailers) above prices for conventional produce in 1998.[29] The farmgate premiums are substantially higher than retail differentials in part because organic farmers keep more of the value of the organic crop, particularly when using direct marketing strategies.

This means that organic farmers are internalizing more of the value of producing socially desirable outputs from their production practices, such as cleaner water. That is, farmers are paid higher prices to use methods that generate these benefits even if the methods are more difficult to use or cost more to implement. This makes the market work more efficiently because prices for food and other agricultural outputs more accurately reflect the true costs of producing them. Instead of the government having to subsidize or tax farmers to encourage production that yields better social, economic, and environmental conditions, the market signals farmers through higher prices that such systems should be adopted. Although some researchers have suggested that farm price premiums are necessary to make organic farming competitive with conventional agriculture, yield or cost parity, or other off-setting advantages such as reduction in yield variability, would have the same effect on competitiveness.[23] As long as the market price reflects the true cost of organic farming, this benefit accrues regardless of whether the organic price is higher, equal to, or even lower than the conventional price.

Organic farmers differ from conventional farmers in several characteristics. **Figure 1** shows the characteristics of organic farmers and all U.S. farmers along five dimensions – average age, sex, education, farm management structure, and intensity of farming activity.[30] All attributes are measured as the percentage of farmers with the characteristic, except average age, which is measured in years. **Figure 1** shows that organic agriculture dominates conventional in four of the five dimensions. Organic farmers are 21% female, (compared with only 9% of all farmers), 62% full-time farmers (vs. 39% of all farmers), 56% college-educated (vs. 19% of all farmers), and on average 47.5 years old (vs. 54.6 years for all farmers). Proportionally more conventional farmers operate sole proprietorships (90% vs. 72% of organic farmers). These dimensions are indicators of rural development and farmer recruitment, suggesting that organic agriculture is more likely to positively affect rural society than will conventional agriculture.

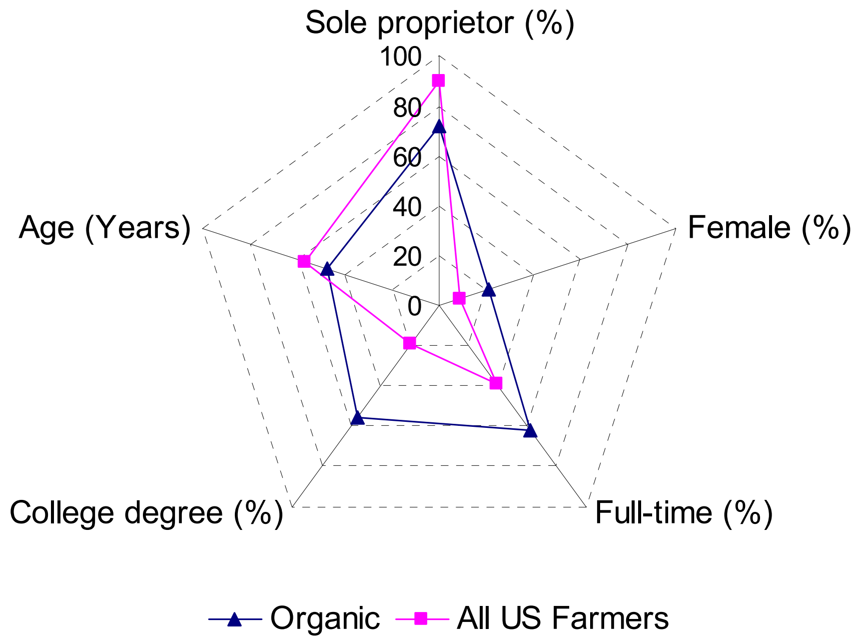

Figure 1. Characteristics of Organic and All U.S. Farmers

Innovation and openness to new ideas are behavioral attributes unique to organic farmers that result in rapid development and transmittal of information on new nonchemical methods. Among organic farmers, 87% have conducted their own on-farm experiments.[31] The primary sources of information about organic production practices are other farmers, periodicals and books, and conferences and seminars, which are conducive to sharing such informal research results.[27] In essence, organic farmers are generating information as a public good, which benefits organic and conventional farmers equally.

III. Analytical Results on Benefits

This section describes the data and statistical method used to test selected indicators of economic, social, and environmental benefits of organic agriculture, and presents results of this analysis.

A. Method of Analysis

Statistical comparison of organic farms with conventional farms would ideally be conducted at the farm level, with observations on each individual operation. In the absence of such data sets, county level data, the next highest geographic level of analysis, were used. Data on the number of organic farmers per county were collected for 1997 from the Organic Farming Research Foundation and from certifiers throughout the U.S.[32] Only one major certifier, accounting for about 200 farmers, and two smaller certifiers with fewer than 20 farmers each, refused to participate in the data collection, so the sample is nearly the entire population of organic farmers.

Table 1 shows the distribution of organic farms in 1997.[32] The number of farms is greater than the number of counties, because some counties support more than one enterprise. Four frequency classes were constructed to allow for this variation. About one third of organic farms are present in counties with four or fewer organic farms. Another third are found in counties with between five and 12 farms. Thus, nearly 70% of organic farms in the U.S. are in relatively sparse distribution within counties.

Table 1. Distribution of Organic Counties and Farms by Frequency Class, 1997

Farms per County	Units	Counties	Farms
1-4	Number	905	1,665
	% All	74.9%	34.2%
5-12	Number	233	1,714
	% All	19.3%	35.2%
13-29	Number	60	1,049
	% All	5.0%	21.5%
30-64	Number	10	440
	% All	0.8%	9.0%
All	Number	1,208	4,868

Using the unique county identifiers, called FIPS codes, all counties in the U.S. were classified as either "with" or "without" at least one organic farm. With 3,078 FIPS codes accounted for, 39.2% of counties in the U.S. had at least one organic farm at the time of the analysis. The weighted average number of organic farms in these 1,208 counties was 3.3.

The distribution of farms across the United States in 1997 is shown on the map in Appendix A. The greatest concentrations of organic farms are in the West (California, Oregon, and Washington), the Northeast (Maine, Vermont, New Hampshire, New York, Massachusetts, and Pennsylvania), and the populous counties of the North Central region (Michigan, Minnesota, Wisconsin). The South region has the sparsest distribution of organic farms, with concentrations around major population centers and few farms elsewhere.

The means of selected indicators from the U.S. Agricultural Census were calculated for counties with and without organic farms.[33] The indicators are described in sections IIIB, IIIC, and IIID. The number of observations used to construct the means varied because not all counties contained data on the variables of interest. The counties were compared using a t-test for equality of the means. If the means were statistically different, then either the organic or conventional system was declared "preferred."

A similar process was conducted to evaluate watershed indicators, described in Section IIID. FIPS for the counties with and without organic farms were matched to watershed identifiers known as HUCS. Since it is common for several counties to overlap a watershed, yet not be contained within it, the condition was set that all counties making up the watershed had to have at least one organic farm in order to be considered "with organic farms." Means for watershed with and without organic farms were constructed from U.S. Environmental Protection Agency data on watershed indicators.[34]

Although this method makes use of the best available data, aggregation to two groups - counties with and without organic farms – may obscure some differences between organic and nonorganic farms. Across counties, the percentage of organic farms as the share of all farms in a county ranges from 0.04% to 43.7%. The intensity of adoption, measured by this percentage, should have effects on the level of benefits obtained – more organic farms should mean greater benefits. This effect is captured implicitly, but not explicitly, with the method used. With aggregation across the entire U.S., differences by growing conditions, crops grown, and other region or area specific characteristics are unlikely to be revealed.

There are advantages to aggregation. First, the method is consistent with the theory that organic farmers influence other farmers' behavior and county economies by their presence and contributions to the management information set within the county. Even a single organic farmer can stimulate change by requests to county extension agents, applications for government programs, participation in field demonstrations, and other activities that raise the awareness of both farmers and information providers. This assumes that one organic farmer can be as influential as several. Second, this approach prevents the results from being skewed by states having many counties with large numbers of organic farmers, such as California and Washington. For example, confounding factors such as stricter pesticide laws in California do not influence the findings of benefits because California is not disproportionately represented in the sample, as it would be if the aggregation unit was the number of organic farmers.

The method used relies on correlations to document organic farm influence. Causality is not established, as it might be with regression analysis, so it cannot be definitively stated that the presence of organic farms is the cause of the benefits indicated. There may be other commonalities in counties with organic farms that account for observed differences, perhaps proximity to cities or types of crops grown. Observing statistically significant results across multiple indicators would strongly suggest that the presence of organic farmers, rather than other factors, accounts for the differences. Even if sufficient data were available to conduct a regression analysis, the number of organic farmers in most counties is so small relative to the total number of farmers that it is unlikely to show any statistically significant relationship between benefits and intensity of organic adoption. Aggregation to counties allows statistical tests for the influence of organic farms, even if the relationship cannot be precisely quantified.

B. Economic Benefits

Table 2 shows the economic indicators compared for counties with and without organic farms. Best performance is assessed for the system with the higher mean if the indicator has a (+), and the lower mean preferred if the indicator has a (-). If the category heading has one of these signs, all indicators in the category should be higher or lower to be best, with exceptions marked. If the difference of the means is not statistically significant, then neither system exhibits the best performance. As stated in section IIIA, this test is not a definitive indicator of the superiority of organic or conventional systems; rather, it indicates that counties with organic farms perform statistically differently than counties without.

The first set of indicators is related to farm economy. Nearly all recent research documents equal or superior profitability for organic farms.[23] Counties with organic farms have both higher total farm sales and higher expenses, although the average gross return is $12,621 higher while the average farm expenses are $8,610 higher. These values differ with prices of outputs and inputs as well as their mix, and are subject to change as farmers adopt new practices, varieties, or crops. The net return to agricultural sales, calculated separately from gross returns and farm expenses, averages $3,587 per farm higher for organic farms. The per farm market value of land and buildings is an important measure of financial stability for farmers, since the value of the farm represents both collateral for loans and retirement capital. Counties with organic farms have $36,510 more market value in land and buildings.

The local economy is also affected by farming activities. In many states, property taxes pay for public schools, hospitals, and other infrastructure. The average farm in a county with organic farmers pays $10,521 more than in counties without. This can translate to significant benefits to nonfarmers in counties where there are numerous farmers. Adding payroll to the local economy is important not only for the multiplier effect in the retail and service sectors, but because it provides another avenue for farmer recruitment if young people are hired and trained in farming. About 30% of organic farmers hire full-time year round employees, mostly one or two workers.[27] About 20% hire full-time, seasonal workers or part-time year round workers, again mostly one or two workers. Nearly 50% hire part-time, seasonal workers, averaging 9 workers per farm. Among all U.S. farmers, 11% hire only full-time workers (at least 150 days per year), 29% hire only part-time workers (less than 150 days per year), and 60% hire both full-time and part-time workers.[33] The average hired worker payroll in counties with organic farmers was $7,460 more than for counties without.

Table 2. Economic Indicators Tested for Counties With and Without Organic Farms

				Best Performance[a]		
Indicator	Units	Mean With Organic	Mean Without Organic	With Organic	Neither[b]	With Conventional
Farm Economy (+)						
Total farm sales	dollars per farm	111,696	99,075	X		
Total farm expenses **(-)**	dollars per farm	85,358	76,748			X
Net return to agricultural sales	dollars per farm	25,813	22,226	X		
Market value of land and buildings	dollars per farm valued	511,250	474,740	X		
Local Economy (+)						
Property taxes paid	dollars per farm paying	95,000	84,479	X		
Hired worker payroll	dollars per farm hiring	24,145	16,685	X		
Fertilizer purchased	dollars per farm buying	8,681	7,770	X		
Agricultural chemicals purchased	dollars per farm buying	7,306	7,340		X	
Livestock and poultry purchased	dollars per farm buying	38,232	40,733		X	
Commercially mixed feed purchased	dollars per farm buying	26,763	36,201			X
Seed, bulbs, and trees purchased	dollars per farm buying	6,976	5,215	X		
Custom work, machinery rented	dollars per farm renting	5,110	4,758		X	
Repair and maintenance purchased	dollars per farm buying	6,268	5,365	X		

[a] A plus (+) indicates a higher mean is best and a minus (-) indicates a lower mean is best. Unless an indicator is otherwise marked, the sign for the category heading is the same for all indicators.
[b] Neither system is best if a t-test of equality of the means for with and without is not statistically significant at α=0.05.

Concern has been raised that community-based agribusinesses (input sellers and service providers) could be economically damaged by organic agriculture through reduced purchases of seeds, pesticides, fertilizers, and custom services.[35] Organic farmers tend to be more self-sufficient than conventional producers, with as many as 31% of growers raising their own seed, 47% their own livestock feed, and 74% their own transplants.[27] At the same time, locally purchased inputs include cover crop seed (56% buy the input locally), livestock feed (44%), mineral soil amendments (46%), biological/blended fertilizers (37%), and specialized equipment (32%). The comparison of spending on purchased inputs shows that counties with organic farmers average $911 per farm more in fertilizer sales, $1,761 more in seed sales, and $903 more in repair and maintenance services purchased. Counties with conventional farms bought $ 9,438 per farm more in commercially mixed feeds. There was no significant difference in purchases of agricultural chemicals, livestock and poultry, and custom work. Organic farms are at least as beneficial to the local agribusiness economy as conventional farms in all but one input category.

Not evident in these figures is the difference in the mix of inputs used by organic farmers compared with conventional farmers. As indicated, sales of fertilizers to organic farmers would include mineral and biological amendments approved by the NOP, many of which are offered through conventional farm supply stores. As defined by the USDA, the agricultural chemicals category covers all insecticides, fungicides, herbicides, and other pesticides, including application costs. This would include sales of the nonsynthetic plant protectants used by organic farmers, such as *Bacillus thuringiensis* (used regularly by 39% of organic farmers), insecticidal soaps (29%), botanical pesticides (23%), dormant sprays and oils (21%), pheromones (13%), and viral pathogens (2%). These inputs are typically much more expensive than conventional fertilizers and chemicals, so even a small quantity sold could generate higher sales values. These attributes of nonsynthetic inputs may account for the lack of a statistical difference in agricultural chemical sales and the higher value of fertilizer sales for counties with organic farmers. Agribusinesses need not handle large volumes of conventional fertilizers and chemicals in order to make the same return on sales of NOP-approved inputs.

C. Social Benefits

Table 3 shows the social indicators compared for counties with and without organic farms. The first category is farm ownership. Concern over the industrialization of agriculture has led to scrutiny of farm transition among families. The mean percentage of farms in both counties with and counties without organic farmers is overwhelmingly sole proprietorship, but the 1% higher share in counties without is statistically significant. Family held corporations make up a much smaller percentage of farms, with a statistically higher share in counties with organic farms. Among the other types of ownership arrangements (partnerships, nonfamily corporations, cooperatives, estate and trust farms, institutional farms) that accounted for the remainder, there were no statistical differences across counties with and without organic farms. Counties with organic farmers have 0.4% more female farmers, which translates to greater gender equity in the farming sector. There was no statistical difference in percentage of farmers renting some or all of their land for agricultural operations.

Table 3. Social Indicators Tested for Counties With and Without Organic Farms

				Best Performance[a]		
Indicator	Units	Mean With Organic	Mean Without Organic	With Organic	Neither[b]	With Conventional
Farm Ownership (+)						
Sole proprietorship	percent of all farms	84.2	85.2			X
Family held corporation	percent of all farms	5.2	4.4	X		
Female farmer	percent of all farms	9.3	8.9	X		
Renting some or all land **(-)**	percent of all farms	41.5	48.1		X	
Operator Characteristics (+)						
Operator lives on farm	percent of all farms	72.1	68.0	X		
Farming principal occupation	percent of all farms	53.4	48.7	X		
Full-time farming	percent of all farms	65.4	62.7	X		
Years operating present farm	average years	20.5	20.1	X		
Rural Development (+)						
Direct to consumer sales	dollars per farm	5,247	3,489	X		
Worker pay	dollars per worker	4,122	3,675	X		
Workers hired	workers per farm	5.1	4.0	X		
Farms with net losses **(-)**	percent of all farms	47.8	50.2	X		

[a] A plus (+) indicates a higher mean is best and a minus (-) indicates a lower mean is best. Unless an indicator is otherwise marked, the sign for the category heading is the same for all indicators.
[b] Neither system is best if a t-test of equality of the means for with and without is not statistically significant at α=0.05.

Attributes of organic farmers were described in Section IIB. Counties with organic farmers exhibit statistically higher percentages of farms where the operator lives on farm (+4.1%), farming is the principal occupation of the operator (+4.7%), and the operator is a full-time farmer (+2.7%). Experience operating the present farm is also greater by nearly 5 months on average for counties with organic farmers. These factors contribute to a desirable rural sociology by stabilizing the agricultural sector and maintaining a local network among which to trade information and social favors.

Direct to consumer sales are an important means of linking farmers and consumers, as discussed in Section IIB. Farmers in counties with organic farms obtain nearly 50% more revenue ($1,758) from direct sales for human consumption than do counties without. Farm workers need to earn a living wage in order to contribute to the rural economy and maintain a reasonable standard of living. More workers are hired per farm in counties with organic farmers (5.1 compared with 4.0 in counties without) and pay per worker is higher ($4,122 compared with $3,675). Social stability is easier to maintain if farmers are not going out of business. Among organic farmers, 7% reported no income or a loss in 1997.[27] A lower percentage of farms report net losses in counties with organic farmers.

D. Environmental Benefits

Table 4 shows the environmental indicators compared for counties with and without organic farms. Most studies count diversity and dispersion of crop-damaging species and beneficial species to measure ecological benefits of organic farming. Organic systems have been shown to promote earthworm and above ground arthropod development, enhance conditions for beneficial soil biota, and offer a reduced risk environment for pollinators.[9, 36, 37, 38] Bird activity, including nesting, is higher in organic than in conventional fields, due to the larger numbers of food insects and plants.[39] Most studies agree that reduced soil disturbance, more soil organic matter, and reduced chemical applications are the bases for these improvements. Increased tillage can reduce the gains from these practices by altering the insect habitat and disturbing bird nests. Land under the U.S. Conservation Reserve Program (CRP) is particularly beneficial for waterfowl nesting as long as it is not hayed.[40]

Table 4. Environmental Indicators Tested for Counties or Watersheds With and Without Organic Farms

				Best Performance[a]		
Indicator	Units	Mean With Organic	Mean Without Organic	With Organic	Neither[b]	With Conventional
Bird and Wildlife Habitat (+)						
Idle or in permanent cover crops	acres of cropland	14,476	9,790	X		
Idle, cover cropped, or woodland	acres of farmland	27,487	24,019	X		
Land under CRP/WRP	acres	13,297	9,230	X		
Chemical Use (-)						
Fertilizer use	acres per farm using	204.94	200.70		X	
Insecticide use	acres per farm using	153.67	183.15	X		
Herbicide use	acres per farm using	240.09	240.27		X	
Nematicide use	acres per farm using	20.22	37.48	X		
Runoff Risk (-)						
Agricultural impact index[c]	weighted index	0.85	1.03	X		
Nitrogen runoff index[c]	weighted index	0.79	1.03	X		
Pesticide runoff index[c]	weighted index	0.94	1.01		X	
Sediment runoff index[c]	weighted index	0.86	1.02	X		

[a] A plus (+) indicates a higher mean is best and a minus (-) indicates a lower mean is best. Unless an indicator is otherwise marked, the sign for the category heading is the same for all indicators.
[b] Neither system is best if a t-test of equality of the means for with and without is not statistically significant at α=0.05.
[c] Tested for watersheds with and without organic farms. Index values are 0, 1, 2 for low, medium, and high risk.

Agricultural habitat for birds and wildlife was defined in several ways for this study. Cropland that is idle or in permanent cover crops is important specifically for soil biota and insects that aid organic farming. The larger category of idled or covered cropland plus woodland that is not pastured attracts a broader species mix than open cropland alone, particularly predator species.[41] Farmers who enroll land in the CRP or the Wetlands Reserve Program (WRP) receive government payments, and may not alter the land management practices until the end of the contract. The total acreage in the county was used as the unit of measure because contiguity of habitat is crucial.[41] Total acres are more likely to capture this feature than per farm acreage. The counties with organic farmers have statistically more acres of land in all three categories than do counties without.

Since effects of chemicals cannot be limited to the farm, the extent of use across the county is captured by measuring acres on which chemicals are used. There is no statistical difference between counties with organic farmers and those without in terms of per farm fertilizer and herbicide use. As explained in section IIIB, one reason for this result could be that organic farmers do use fertilizers, but in the form of nonsynthetic biological and mineral derived nutrient sources. With relatively few alternative weed control methods that do not rely on more time consuming mechanical or cultural practices, there might be little difference in use between conventional farmers in counties with and without organic farms. The presence of organic farms in this case would not influence conventional farmers to reduce herbicide use. Insecticide use was less by nearly 30 acres (-16%), and nematicide use by 17 acres (-46%) on farms in counties with organic farmers. Thus, assuming the toxicity of the weed control alternatives used is not higher than for chemicals used in counties without, a better habitat for above and below ground arthropods and soil biota is created in counties with organic farms.

The runoff risk category is a watershed level analysis, as explained in Section IIIA. The index of agricultural runoff impact is a composite of a nitrogen runoff index, a pesticide runoff index, and a sediment runoff (erosion) index. The sub-indexes are rated 0, 1, or 2 for low, medium, and high risk of runoff. The ratings were determined by the risk quartile each watershed was in after EPA analysis. The counties with organic farms are at statistically lower risk ranks for overall agricultural runoff impact, nitrogen runoff impact, and sediment runoff impact. Given the higher acreages in idled cropland and permanent cover, and enrolled in the CRP/WRP, there is less risk of erosion due to lower soil disturbance so less sediment impact. The lower nitrogen runoff impact is consistent with fertilizer use data when the method of application and types of fertilizer are considered. Legumes, green manures, animal manures, kelp, blood meal, and other natural fertilizers release nitrogen more slowly than do synthetic chemicals. Some natural fertilizers increase soil organic matter as they decompose, further improving nutrient retention. Since the NOP regulations emphasize soil management, attention to nutrient balance may be greater on organic farms. As a result, even if areas of application are larger, there is a lower likelihood of nitrogen runoff.

The pesticide runoff risk was not statistically different between counties with and without organic farms. There may be statistical and practical reasons for this result that suggest caution. The pesticide impact index values were missing for more than 500 of 2,108 watersheds, compared with only 1 missing for the nitrogen index and 5 for the sediment index. The missing observations could be ones necessary to establish a statistical difference in mean values of the index. Practically, the pesticide risk result may be due primarily to herbicide use. Herbicides account for 69% of all U.S. acreage on which herbicides, insecticides, nematicides, and disease-controlling chemicals are used.[33] Since there is no statistical difference between counties with and without organic farms in terms of herbicide use, it is reasonable that the pesticide runoff index would also exhibit no difference.

IV. Concluding Remarks

This case study documents the benefits associated with organic farming in the United States. Many of the benefits are due to the structure of the organic sector and the market behavior, neither of which could function efficiently without the National Organic Program. Even though organic farmers are not a significant percentage of the total number of U.S. farmers, their influence is felt through their innovation of management techniques and leadership in operating their farms in accordance with the NOP. The influence is shown through the statistically significant differences between counties with and without organic farmers for numerous indicators of economic, social, and environmental benefits associated with organic farming. The organic sector is pulling mainstream agriculture closer to sustainability through its progress in finding solutions to production and marketing problems that confront all farmers.

These results are from 1997, the last year for which data were available from the U.S. Agricultural Census and the Organic Farming Research Foundation's survey series. The organic sector continues to expand. In 2001, there were 6,949 certified organic farms accounting for 2.3 million acres of cropland, pasture, and rangeland.[42] Two significant events in 2002 are expected to further stimulate this expansion and make data analysis of the type used in this case study more accurate. The full implementation of the NOP will create a common definition of certified organic farmer, and will generate publicly available data on the location of every certified farm in the U.S. Eventually, county comparisons may be made within states, within production regions, and even within counties. The federal Farm Bill authorized cost sharing for organic certification and established the Conservation Security Program, an agri-environmental subsidy program that will provide an income safety net for participating organic farmers. There is little doubt that as the sector expands, the economic, social, and environmental benefits associated with organic farming will multiply accordingly.

V. Notes and References

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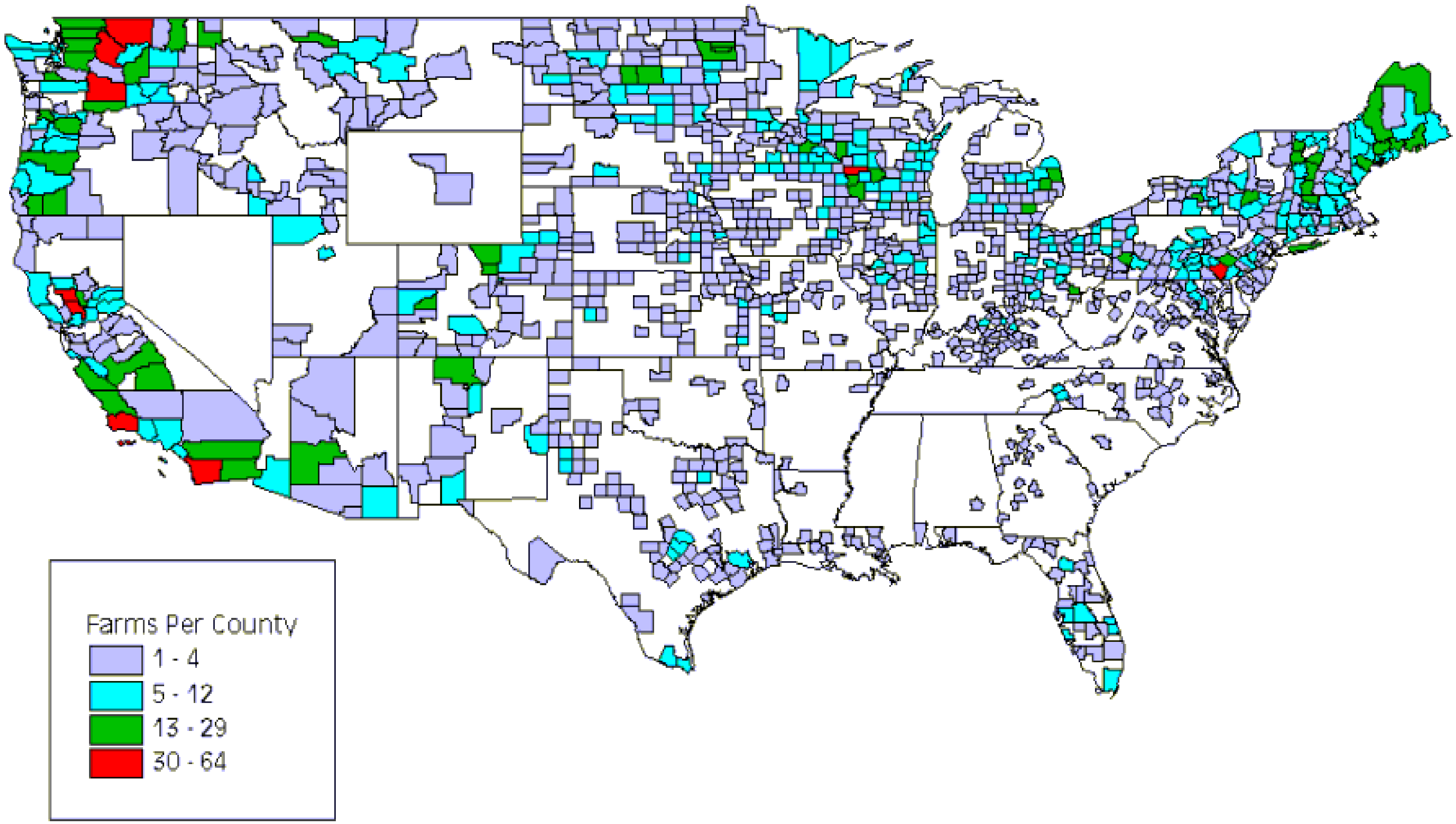

Appendix A. Frequency Distribution of U.S. Organic Farms, 1997

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