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An Economic Examination of Alternative Organic Cropping Systems in New York State

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Abstract: This paper provides an economic analysis that compares the profitability and land management capability of four different organic cropping systems used to produce winter squash (*Cucurbita pepo cv. 'Delicata'*) and cabbage (*Brassica oleracea var. capitata cv.' Farao').* The organic cropping systems are part of a long term experiment designed for vegetable production in the Northeast, and designed to maintain ecological integrity and contribute to environmental stewardship. Our research addresses the causal chain from soil processes to economic outcomes including soil quality, efficiency in cycling of nutrients, off-farm impacts, pressures from weeds, insects and diseases, crop yield and quality, and marketing opportunities. Interactive crop budgets were developed to document both production costs and income streams for each cropping system. Using data from the 2009 trial, a ridge-tillage system that relied on cover crops for nitrogen (System 4) yielded the highest revenues for squash production. The results also indicated that System 1, which relies on compost for nitrogen, occasional cover crops and uses conventional tillage, had the highest revenues for cabbage. Subsequent sensitivity analyses were performed across a range of key parameters, and the results indicated that System 1 and System 4 consistently yielded the highest revenues for cabbage and squash production respectively.

Additional index words: Cropping systems; Economic analysis; Organic production; Sustainable agriculture; Vegetables.

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Introduction

Cabbage and squash are important vegetable crops for New York producers. New York is the 3rd largest producer of fresh and processing cabbage in the United States (USDA-NASS, 2009). In 2007, 460 cwt of cabbage was harvested from 12,600 acres in New York State with a total farm value exceeding $100 million (USDA, 2007). New York is the 5th largest producer of squash in the United States (USDA-NASS, 2007). In New York State, there are approximately 740 farms producing squash on 3900 acres (USDA, 2007); however, more than half of the farms produced less than 1 acre of squash. Overall, small farms (0.1 to 4.9 acres) constituted about 84% of all squash production in New York (USDA, 2007). Data suggest that an increasing share of cabbage and squash that are grown in the United States are produced following USDA organic guidelines (USDA, 2007). The objective of this article is to examine the profitability of producing, or transitioning into, commercial production of organic cabbage and squash in the Northeast. We use data from on-going experimental trials to analyze the economic effects of various organic cropping systems on yield, income, production costs, and revenue of producing cabbage and squash in New York State.

Between 1980 and 2000, organic farming has become one of the fastest growing segments in agriculture in the United States. Much of the increase in sales of organic food has been driven by repeated food safety scares, animal welfare concerns, and broader concerns regarding the impact of industrial agriculture on the environment. In addition, the local and organic food movements are reaching a more mainstream audience and organic consumers are now comprised of a wider range of socioeconomic groups (James, Rickard, and Rossman, 2009). Many organic farmers have identified personal health and environmental concerns as their motivating factors in their decision to farm organically (Mohler and Johnson, 2009). Producers have responded to the boom in consumer demand by increasing the number organic products; Figure 1 shows most retailers, including big box retailers and wholesale clubs are now catering to the growing consumer base by supplying more organic food. Figure 2 shows that retail sales of organic foods have undergone a dramatic rise from $3.6 billion in 1997 to $21.1 billion in 2008. Fresh organic fruit and vegetable retail sales alone have increased fourfold and constitute about 38% of total organic sales (OTA, 2010).

Essentially, organic farming standards involve a commitment to two guiding principles: ecological production and maintaining organic integrity. Ecological production entails using farming techniques and materials that conserve and build soil, minimize pollution, utilize natural pest management, and encourage the development of a diverse agroecosystem. These goals can be achieved with the adoption of organic technology such as diverse crop rotation, cover crops, green manure, and composting, among other management practices. The second requirement revolves around maintaining organic integrity, which consists of actions that prevent the contamination of organic produce with prohibited materials and taking steps that prevent the accidental commingling of organic and conventional products. In order to be in compliance, farmers refrain from using synthetic fertilizers and pesticides and take precautions against pesticide drift from neighboring farms and other sources of contamination. Typically, equipment and storage areas employed in organic fruit and vegetable farming are dedicated solely to organic use. Farmers seeking to transition from conventional farming to organic farming must keep the land free from synthetic fertilizer, pesticides and other prohibited substances for three years prior to the harvest of the first “certified organic” crop (USDA-NOP, 2010).

However, despite the potential economic gains available to producers that transition from conventional farming to organic farming, many challenges and barriers exist for new entrants.

The majority of U.S. farmers that are interested in converting from conventional farming to organic production systems have faced barriers to entry because of the high costs associated with conversion and lack of technical knowledge (Wiswall, 2009). During the required three-year transitional period, farmers incur steep upfront costs, but do not receive the price premium of growing a certified organic crop. Transitioning producers can also experience potential losses due to high production costs, reduced yields and reduced prices for poor quality products. There are also costs of producing cover crops and lost revenue during the transitional period.

Despite the rigorous certification process, producers are turning to certified organic farming systems as a potential way to decrease input costs, lower reliance on nonrenewable resources, capture high-value markets and premium prices, and increase farm income. Figure 3 illustrates the increasing trend of producing certified organic crops over time in the United States; organic farmland has more than doubled in the United States between 1997 and 2005 for many of the crops shown in Figure 3. However, production has not kept pace with consumer demand creating periodic shortages of organic produce (USDA-AMS, 2010).

Although a national standard for organic agriculture was established by the USDA in 1997 and amended by the USDA in 2005 (USDA-NOP, 2010), organic farming systems are extremely heterogeneous compared to conventional farming methods. A variety of strategies that comply with the USDA guidelines of organic production practices can be applied ranging from high input systems to those with greater reliance on internal processes; we examine four such systems that comply with USDA guidelines here. Farmers need to carefully assess the trade-offs between the numerous management options and strategies. Organic production systems have many options concerning land use, cover crops, labor, methods of weed control, and harvest issues. Of these factors, cover crops, fertility inputs, weed management and tillage will be more closely examined here because these variables have important economic implications in vegetable production.

Literature Review

Several articles have been written that examine agronomic and other production issues related to organic agriculture and agricultural systems that use fewer pesticides and chemicals (e.g., Olesen et al. 2002; Schoofs et al. 2005). Much of the economic literature concerning organic agriculture focuses on consumer issues including the impact of labels and the willingness to pay for organic produce relative to conventional food products (e.g., Loureiro, McCluskey, and Mittelhammer, 2001; Giraud, Bond, and Bond, 2005). There has been much less work examining the economics of producing organic crops, and the economics of transitioning into organic production. Most of the economic research in this area has focused on grain crops (e.g., Cavigelli et al. 2009; McBride and Greene 2009) rather than vegetables crops. This article begins to address this imbalance as it specifically examines the costs and benefits of transitioning to organic agriculture across a range of systems in vegetable production. A better understanding of the effect of management practices on income and costs is critical in assisting farmers with making decisions. Here we develop enterprise budgets to calculate income streams, costs, and revenues for two vegetable crops under four alternative cropping systems. Results from our crop budgets highlight break-even prices and quantities and identify profit margins. In addition, our crop budgets allow us to better understand how small changes in price and inputs costs impact farm profitability.

Earlier enterprise budgets for organic cabbage showed net profits of $581.61 per 0.1 acre and calculated a net profit of $86.90 per 0.1 acre for organic squash (Molinar et al., 2005; Wiswall, 2009). Variations in profitability results across different crop budgets can be attributed to labor costs and regional costs of growing these crops. In additional, different estimates for retail and wholesale prices contributed to the variation in net profit. Conner and Rangarajan (2009) studied costs in two different organic farming systems operating under different management systems and their results indicated that costs per acre varied widely due to crop rotation, marketing, and production costs. Similarly, Ogbuchiekwe et al. (2004) found that lettuce and cantaloupe yield and net return were greatly affected by crop management practices. Our enterprise budgets will account for crop rotation schedules and diverse organic management systems, and shed some new light on profitability questions for vegetable producers in the Northeast that are considering a shift towards organic production practices.

In the past, authors have used enterprise budgets to address profitability questions in agriculture, and to track how changes in input usage affect yields and ultimately farm-level revenue. Delate et al. (2008) compared conventional and organic bell pepper growth and yield using strip-tilled or fully incorporated cover crop systems on a research farm. The experiment designed utilized a randomized complete block design with four replications with designed organic and conventional treatments. Another study conducted by Burket et al. (1997) investigated the effect of cover crops and crop rotation on vegetable productivity. This study was also conducted on a research farm and consisted of a randomized split-plot complete block with four replications of winter cover crop treatments. In addition, a study evaluating agroecological and economic effects of different systems on fruit production utilized a similar experimental approach. The experiment was designed as a randomized complete block with four replications of the integrated and organic fruit production (Peck et al., 2010). Building on these past models, we follow a similar methodology, but with the additional goal of analyzing the effect of changes in various inputs on yield and profitability.

A Description of the Cropping Systems

The Organic Cropping Systems (OCS) used in this experiment were developed by scientists and farmers in the Northeast, and represent well-managed organic vegetable systems with user friendly methods for mass replication by commercial organic growers. Organic management systems for vegetables are evaluated with respect to yield, profitability, soil quality, nutrient dynamics, weed populations, disease and insect pressure. In addition, essential ecological processes that are the foundation of successful organic management systems are examined. The OCS for vegetables were designed to emulate real-world producer decisions and practices, and consist of four unique strategies (treatments). The assumptions in the enterprise budget model, outlined in Table 1, place an emphasis on small scale operations which represents the production operations and materials typical of organic farmers in the Western New York region. The experiment uses a randomized block design with four cropping system treatments (System 1, System 2, System 3, and System 4), two entry points into the rotation, and four replications of each. All systems follow a similar basic rotation of cash crops, involving winter squash, cabbage, lettuce and potato.

System 1 is the High Intensity Cropping system. This cropping system simulates farms with limited arable land and focuses on maximizing income via intensive cropping. Six cash crops are grown in a four-year rotation with compost as the primary nutrient source. Moldboard plow, rotovator, harrows, and chisel plow are the used for tillage. Weeds are controlled with approved methods so as to prevent yield loss due to weed competition. System 2 is the Intermediate Intensity Cropping System, and it also simulates a land-limited farm, but obtains most of the nitrogen from legume cover crops. A single cash crop is grown annually. Similar to System 1, weed competition is minimized, but additional preventative weed management measures are also taken. This cropping system is easily adopted, but innovative. System 3 is the Bio-extensive Cropping System, which alternates years in cover crops and fallow. In between growing years, organic material is accumulated while the fallow period reduces the weed seed bank. Nitrogen is primarily derived from cover crops. Shallow plowing and harrowing techniques are utilized to reduce tillage. This system plans to flush out weed seed banks and prevent further weed seed production. It simulates a land-rich farm attempting to reduce labor demands and other input costs by substituting extensive land usage. System 4 is the Ridge-till Cropping System, which uses ridge tilling instead of plowing. Permanent ridges are built with special equipment to control weeds and prepare the soil for planting. The ridge bases are fixed allowing for wheel traffic, and helping to improve soil quality in the row. Nitrogen is provided mostly from cover crops. Weed management and cover crops mimic those in System 2.

The different cropping systems vary tillage methods, cover crops, cropping intensity, applied nutrients, and weed management strategies. Environmental factors such as soil and climate are held constant, as are pest management, crop varieties and irrigation. Pairwise comparisons of System 2 and System 3 will provide insight to the benefits of fallow for weed control and effects on soil quality. Comparing System 1 and System 2 will yield information on the effect of nutrient inputs on various soil parameters and biological populations in the Systems. The comparison between System 2 and System 4 allows for a test of the benefits of reduced tillage on the development of soil quality, and possible reductions in labor and energy usage.

Cropping intensities vary across the four Systems. System 1 has six cash crops in four years, System 2 and System 4 produce one cash crop per year and System 3 will yield two cash crops in four years. The tillage and degree of inversion are highest in System 1 and lowest in System 4. Cover crops that grow well in New York's climate are used in all systems, including legumes, hairy vetch, red clover, field peas, and bell beans; other non-legume cover crops include oats, rye, wheat, and buckwheat. Compost is applied to supplement nitrogen inputs from legume cover crops; however, System 1 receives more compost because legume cover crops are not utilized in this System.

In 2009, cabbage was the main cash crop planted in the first rotation entry point. System 1 yielded 63,476 marketable pounds per acre of cabbage; these plots were bare over winter after the 2008 squash harvest and seeded in early spring with inoculated 'Sugar Sprint' snap peas. However, the stand was poor and the plots were replanted to 'Renegade' spinach. The cabbage crop was transplanted after spinach harvest in early July. System 2 followed a similar regime of transplanting, cultivation, hand hoeing, but was preceded by a cover crop of oats and peas. It yielded less marketable pounds of cabbage per acre than System 1. System 3 deviated from the previous two systems because 2009 was a fallow year and the cabbage cash crop was not grown, therefore the results will not be presented for cabbage production for this system. In the 2009 trial, System 4 (ridge tillage) yielded the lowest marketable pounds per acre of cabbage. Similar to System 3, a spring cover crop of oats and peas were utilized in System 4.

The cash crop for the second rotation entry point in 2009 was winter squash. Plants were transplanted into black plastic in System 1 in early June following a spring cover crop of rye, and harvested in mid-September. System 1 yielded 11,002 marketable pounds per acre of squash. System 2 had a lower yield of squash than System 1, (7909 marketable pounds per acre), following a cover crop of wheat and hairy vetch. System 3 had a higher total marketable yield per acre of 12,156 than System 2, following a cover crop of red clover. System 4, the ridge tillage squash, had the highest total yield of 12,820 marketable pounds per acre following a fall-planted cover crop of hairy vetch and fall oats covering the plots over the winter.

Results

The economic analysis used here develops a framework to outline the financial implications of adopting each of the four organic cropping systems. Our analysis enables a comparison of the effect of different crop management treatments on yield, total income, three cost categories, and net revenue. Total costs are subdivided into mechanical costs, material costs and marketing costs. Total income uses yields in our Systems and prices reported by farm advisors. A key advantage of our model is that it is dynamic and information on costs related to field operations, inputs and crop performance are inter-connected, and are used to calculate farm-level revenues. For example, a lower yield in a vegetable system will result in a lower income, and our model will then recalculate the associated decreases in labor costs for harvest, washing, and packaging. Key parameters that describe the assumptions used in our model are presented in Table 1.

The top portion of Table 2 summarizes the income, costs, and revenues of producing organic cabbage in three different organic cropping Systems. The results are intended to serve as a guide to make production decisions and estimate potential returns across the alternative Systems. Table 2 shows that the marketable yield of cabbage varied greatly among the different management systems, which resulted in net income that ranged from $2,090.01 to $3,034.84 per 0.1 acre given a (retail) cabbage price of $0.75 per lb. Transplant costs were similar across the different systems, while other costs varied significantly. Accordingly, System 1 yielded the highest marketable yield and incurred the highest aggregate production costs. System 2 had the second highest yield and income, while System 4 had the lowest yield and generated the lowest income. The production costs for System 2 and System 4 were comparable, and marketable yield accounted for the major difference between income levels.

The bottom portion of Table 2 focuses on the labor and land management analysis of producing cabbage. Labor in the model is attributed to the farm operator, which emulates realistic small farm operations. This cost is a critical component in the analysis. Under the assumption of 1 unit of labor per season per operator, a farm can manage 1.6 to 2.3 acres of cabbage in 1500 hours in the three systems. The operator would earn $25 to $31.60 per hour with the various systems; System 1 would yield the highest profit with the lowest number of acres to be managed. The next best system would be System 2, and it was comparable in terms of dollars per operator hour to System 1, but would require an additional 0.7 acres in production.

The results in Table 3 show that squash production resulted in lower and more varied net revenue levels than that of cabbage production Systems. System 4 had the highest marketable yield and net operator income, while System 2 had the lowest yield and net operator revenue. Overall, System 3 had the highest aggregate costs and highest costs in the categories of machinery use, materials, costs associated with growing the crop, fuel costs and operator labor. The high costs in System 3 were largely due to the fallow year associated with this cash crop. Despite these high costs, System 3 had the second highest net income per unit of land. Conversely, System 2 had the lowest net income, slightly more than half that of System 3. System 2 was characterized by low costs and low net income which can be attributed to the low yield (approximately 72% of the yield generated by System 1). System 1 had the second highest costs for the majority of the different costs categories, but generated the third highest net income. System 1 also had the second lowest marketable yield. System 4 costs were in the mid-range of all systems; however, System 4 generated the highest marketable yield, (66 pounds more than System 3) and generated approximately $90 additional dollars of income per season. For squash production in our experimental trials, we found that System 4 yielded the best overall economic results.

The bottom portion of Table 3 shows our analysis of labor management across the Systems in squash production, and the results suggest that System 4 provided the highest return to labor across the Systems. An operator could manage the most acres with System 3, but this option would command the lowest wage and profit. System 3 also had the highest labor requirement, which, surprisingly, would lead to the result that is the opposite of its intended objective, namely using additional land to reduce the labor requirement. A farmer would manage fewer acres with System 2, but would generate a marginally higher hourly wage of $13.78. An operator utilizing System 1 would manage the least amount of acres, but would earn the second highest profit and hourly rate. One operator could manage 5.4 acres per season with System 4, but it would generate the highest profit and return per operator hour. The hourly return generated by System 4 is double that of System 2 and System 3. Overall, our analysis of labor management for squash indicates that System 4 would lead to the greatest return to hours spent by the owner-operator of the farm.

Discussion

In these field trials, our results indicate that different organic farm management systems will be best for different crops. System 1 generated the highest yield and net revenue for cabbage, while System 4 was best suited for squash production. Similarly, the analyses of labor management also support System 1 as the most profitable production system for cabbage and System 4 as the most profitable for squash. Additional research is needed to test how the economic results would change over time and under different market conditions. These future results will help organic farmers develop management plans that meet USDA organic certification requirements and generate profits. However, we can begin to explore how sensitive our results are to changes in the key parameters that are expected to change over time using data for the Systems in earlier years of the experiment. Changes in key parameters have the capacity to impact the profitability results across the Systems dramatically; a sensitivity analysis is conducted here to test how sensitive our baseline results in Table2 and Table 3 are to small changes in yield, prices and selected input costs.

Yield is one of the most variable factors in the OCS Experiment, and yields have an important effect on profitability. A 25% decrease in the base marketable yield in cabbage lead to a 27% to 30% decrease in net operator income in System 1 and System 4. System 2 experienced an equal decrease in net operator income. A 10% decrease in yield would reduce net income in System 2 by 7%, while the decrease in System 1 and 2 would lead to a decrease of 10% and 13% respectively. A 10% increase in the marketable yield increased net income by 12% to 16%. Profits in System 2 were the most responsive to changes in yields. A 25% increase in the marketable yield of cabbage led to increases in net income of 28% to 34%. The changes to net income in squash were more significant than those in the cabbage Systems. A decrease in yield of 25% led to a decrease in net operator income of 31% (System 4) to 37% (System2). System 2 experienced the biggest loss. Similarly, a 10% decrease to the base yield of squash resulted in a 12% to 15% decrease across all systems. A 10% and 25% increase in yield mirrored these results in the positive direction. In each squash scenario, System 4 was the least responsive to the changes in yield, while System 2 was the most sensitive to increases and decreases in yield. Percentage change in the net operator income for cabbage and squash were higher than the equivalent change in yield.

Farm prices have been variable over the years in the OCS experiment, and an analysis that uses a range of prices above and below the prices of cabbage and squash in 2009 is conducted in our sensitivity analysis. Results here found that the percentage changes in net operator income for cabbage increased more than the percentage changes in price. A 25% decrease in the base price for cabbage would lower net operator income by 29% to 30% across the three Systems. System 1 was the least sensitive to the change, while System 4 was the most responsive to price changes. Overall, System 1 was the least sensitive to price changes, but would experience the highest gains in net operator income because it began with a higher base. Reducing the squash price by 25% would decrease the net operator income by 32% to 40% across the Systems. This would have the greatest effects in System 1 and System 2; compared to our baseline results, a 25% decrease in price would decrease net income by $245.52 in System 1 and $190.05 in System 2. A 10% increase in price would increase net operator income by 13 to 15%; net incomes would rise to $769.62 and $533.73 for System 1 and System 2. Results from further increases in the baseline price are shown in Table 5, and we find that the net incomes of all systems continue to rise more than the percentage change in price. Across the range of prices used in the sensitivity analysis we find that System 4 maintained the highest operator net income overall because it had a significantly higher base. Both cabbage and squash would benefit from increases in prices; however System 1 for cabbage and System 4 for squash would see the largest gains in net income from an increase in crop prices.

Costs of producing vegetables, notably fuel costs, have changed significantly over the years included in the OCS, and changes in fuel costs affect many of the individual machinery cost items included in our analysis. We find that changes in fuel costs were not proportional to the associated changes in net operator income. All changes considered in the sensitivity analysis for fuel costs led to very small implications for the net income of cabbage. For example, a 25% decrease in fuel costs results in squash income increasing by only 1 to 2%. Overall, fuel prices do not have a significant impact on net profit because many organic farms are small, employ a significant amount of labor, and utilize less machinery (and fuel) than conventional farms.

A decrease in the marketing expenses would lead to relatively small increases in net income. Overall cabbage net income was less sensitive to an increase in marketing costs compared to squash production. A 25% decrease in marketing cabbage costs leads to a 7% increase in net income, while at 10% decrease leads to a 3% increase. Squash net income had similar percentage change in net income in response to changes in marketing costs. Squash net income increased 7% to 9% relative to the baseline results when marketing costs were reduced by 25%. Of course, if additional marketing efforts were used to promote organic cabbage and squash differently, we might find a more responsive effect from changes in marketing expenses.

In addition, an overall sensitivity analysis was conducted to examine the worst and best case scenarios within the framework of the previous tests. In a worst case scenario for cabbage, marketable yield would decrease 25%, the price would drop by 25% (to $0.56 per pound), fuel costs would increase 25% to $3.75 per gallon, while marketing costs would increase to 25%. The net operator income across all systems decreased by 53% to 55% from the baseline results, and System 1 maintained the highest net revenue. The worst case scenario for squash also had a decrease in marketable yield by 25%, a 25% price decrease to $0.94 per pound, an increase in fuel costs by 25% to $3.75 per gallon and an increase in marketing costs of 25%. Similarly, net operator income decreased, but had a wider range of decreases of 61% to 75%. System 4 for squash continued to outperform the other systems despite the decrease. For both crops, losses were driven primarily by changes in marketable yield and price. Conversely, in the best case scenario for cabbage the marketable yield would increase by 25%, price would rise to $0.94 per pound, fuel costs would decrease to $2.25 per gallon and marketing costs would decrease to 15%. Under these conditions, all systems would experience gains in net income of between 75% and 78% of those found in the baseline analysis. System 4 experienced the highest percentage gains, but System 1 continued to have the highest net income. In a best case scenario for squash, the marketable yield would increase by 25%, prices would increase to $1.56 per pound, fuel costs would drop to $2.25, and marketing costs would also decrease to 15%. Squash net operator income also increased significantly, but not as much as cabbage. In this sensitivity analysis the net income would rise by 60% to 70%. Again, System 2 had the highest percentage gains, but System 4 continues to have the highest net income for squash.

Conclusion

USDA regulations concerning organic production practices are now well defined, yet they are quite flexible and allow for a wide range of systems that comply with the policy specifications. This research examines the economic implications of such flexibility, and assesses the profitability of alternative systems. The OCS experiment developed four different cropping systems that comply with USDA organic standards on experimental station fields. Data from the experiment enables us to perform an economic analysis that examines profitability and land management capability across the Systems. We closely examine the economic implications of producing cabbage and squash across the Systems using data from 2009. Our results indicate that revenues range widely across the alternative Systems for each crop, and that different Systems generate the highest revenues for different crops. We find that System 1 generates the highest revenue for cabbage and System 4 generates the highest revenue for squash.

We also performed a detailed sensitivity analysis to examine how small percentage changes in the price and yields of cabbage and squash, fuel costs, and marketing expenses influence net revenue at the farm level. Results from our sensitivity analysis suggest that net income would be more responsive to changes in prices received and yields, and less responsive to changes in input costs. Changes in prices can be achieved through various mechanisms, yet for a niche market such as organic produce, are primarily driven by an increase in demand via new information and promotional efforts that introduce the product to more consumers. Agricultural producers and policy-makers interested in expanding markets and generating revenue for organic produce should look to policies or industry-led initiatives that attempt to increase demand for these products.

In 2005, the USDA updated national standards for organic production and it is believed that this has helped consumers become more aware of organic food products (USDA-NAL, 2010). The Farm Bill in 2008 introduced Title X that provided some assistance to organic producers that were interested in transitioning from conventional agriculture to organic agriculture. It also established funds to be used to support research and development efforts for organic production methods and market opportunities. The Farm Bill that is expected to pass in 2012 provides an opportunity to expand the efforts in Title X with additional emphasis on research and development and other demand enhancement activities for organic vegetables.

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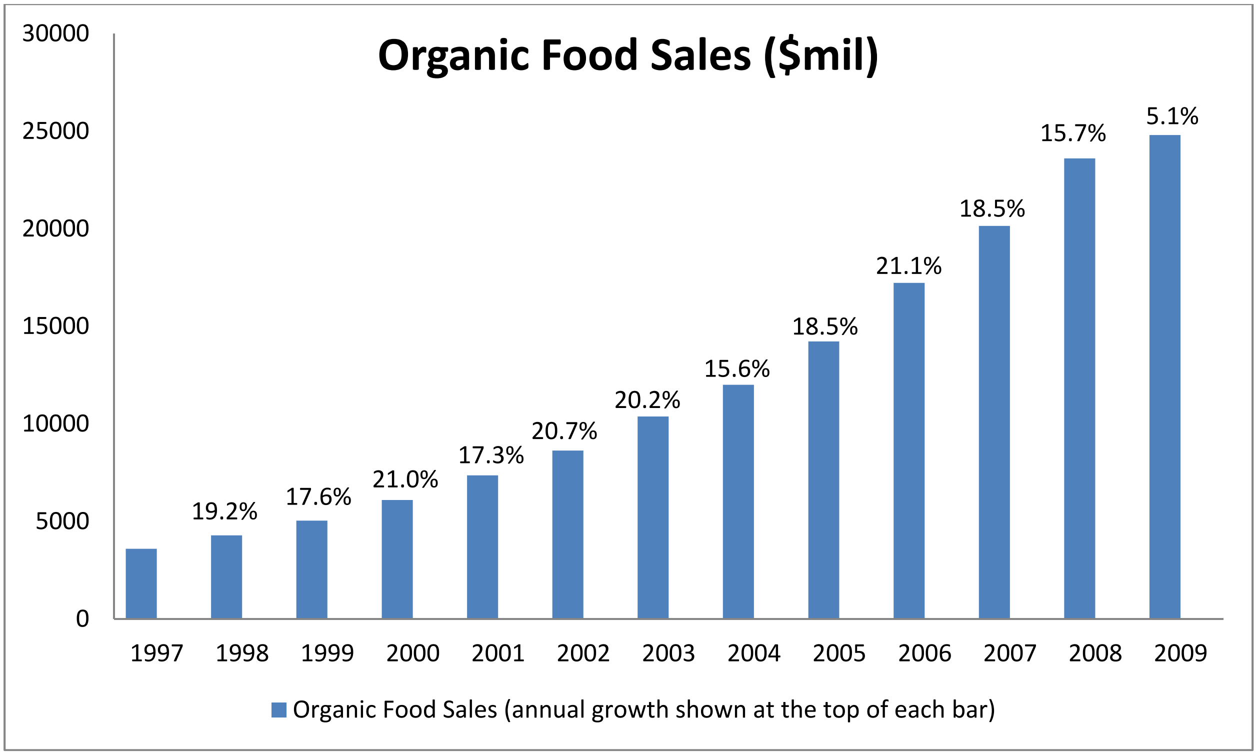

Figure 1. U.S. Organic Food Sales: 1997 to 2009 (in millions of dollars)
Source: OTA (2010).

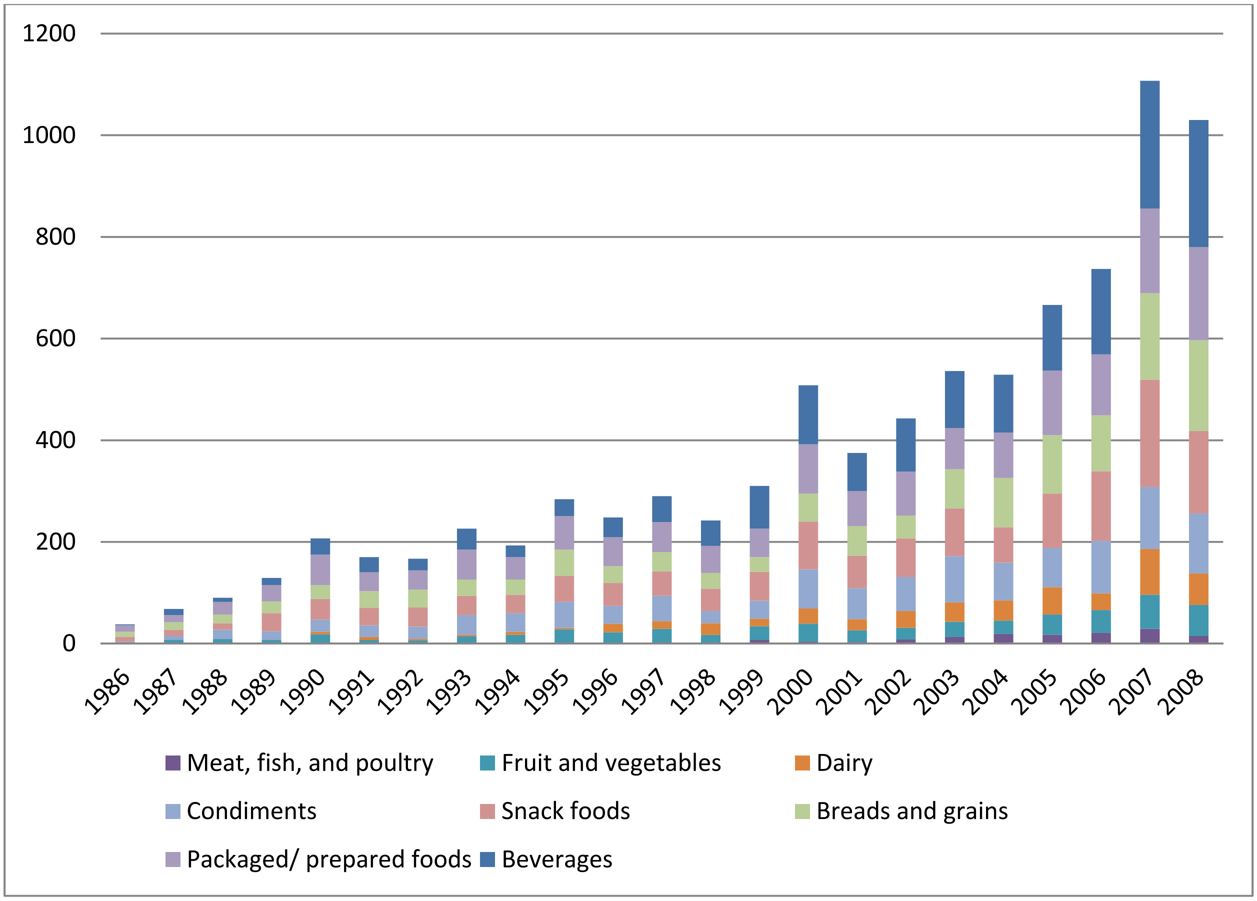

Figure 2. The number of organic product introductions in the U.S. retail markets: 1986 to 2008
Source: USDA-ERS (2008).

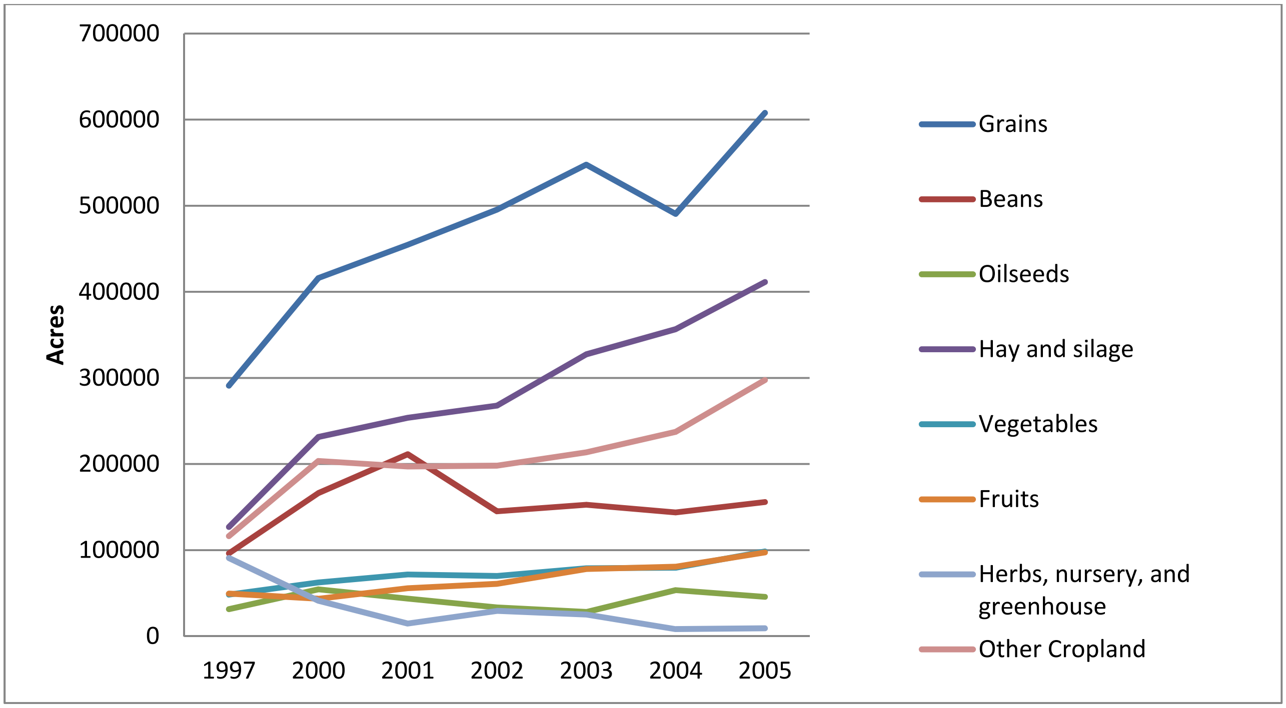

Figure 3. Land used for certified organic crops in the United States: 1997 and 2000 to 2005.

Source: USDA (2007).

Table 1. Parameters used to characterize model assumptions (per 0.1 acre, direct marketed)

	Crop	
Assumptions	Cabbage	Squash
Percent of crop unsold (%)	10	10
Harvest rate (lb/hr)	250	200
Wash and pack cost (lb/hr)	600	600
Machinery cost ($/hr)	21	21
Labor cost ($/hr)[a]	15	15
Compost ($/ton)	60	60
System 1 (plants/acre)	13,835	3,000
System 2 (plants/acre)	14,033	3,000
System 4 (plants/acre)	13,998	3,000
Price ($/lb)	0.75	1.25
Transplant($/flat)	8	8
Fuel ($/gallon)	3	3
Marketing cost (% of gross)	20	20

[a] Here we assume that the owner/operator performs all labor.

Table 2. Economic Analysis of Organic Systems for Cabbage, 2009 (per 0.1 acre)

	System 1	System 2	System 4
Income			
Yield (lb), 90% is Marketable Yield	**6348**	**5468**	**4544**
Price ($/lb)	**$0.75**	**$0.75**	**$0.75**
Total income	**$4,284.90**	**$3,555.90**	**$3,067.20**
Costs			
Machinery Costs	**$179.36**	**$186.85**	**$170.22**
Scrape ridges			$6.20
Moldboard plow		$3.58	
Cultipacker	$2.18	$2.18	
Apply compost	$2.89	$2.89	$2.89
Re-ridge			$3.97
Scrape ridges 2			$6.20
Scrape ridges 3			$6.20
Cultivate cabbage	$5.42	$5.42	$5.42
Cultivate cabbage 2	$5.42	$5.42	$5.42
Cultivate cabbage 3			$5.42
Rotovate	$14.97	$14.97	
Springtooth harrow		$4.37	
Plant oats and peas		$7.32	$7.32
Mow		$8.56	
Misc support time	$52.50	$52.50	$52.50
Harvest machinery time	$95.98	$79.65	$68.71
Material Costs	**$213.72**	**$193.92**	**$193.53**
Apply compost	$60.00	$18.00	$18.00
Transplant cabbage by hand	$153.72	$155.92	$155.53
Plant oats and peas		$20.00	$20.00
Marketing Costs	**$856.98**	**$711.18**	**$613.44**
Total Costs	**$1,250.06**	**$1,091.96**	**$977.19**
Revenue			
Net revenue ($/pound)	**$0.48**	**$0.45**	**$0.46**
Operator net revenue ($/season)	**$3,034.84**	**$2,463.94**	**$2,090.01**
Total Hours	70.88	65.84	66.71
Acres managed (1500 hours/season)	1.62	2.28	2.25
Profit	$ 47,388.49	$ 47,252.92	$ 37,569.71
Labor	$ 1,390.71	$ 987.60	$ 1,000.62
Dollars per operator hour ($/hour)	$ 31.59	$ 31.50	$ 25.05

Table 3. Economic Analysis of Organic Systems for Squash, 2009 (per 0.1 acre)

	System 1	System 2	System 3	System 4
Income				
Yield (lb), 90% is Marketable Yield	**1100**	**791**	**1216**	**1282**
Price ($/lb)	**$1.25**	**$1.25**	**$1.25**	**$1.25**
Total income	**$1,237.50**	**$889.88**	**$1,368.00**	**$1,442.25**
Costs				
Machinery Costs	**$198.44**	**$175.31**	**$249.65**	**$184.32**
Flail mow	$8.56			
Moldboard plow	$3.58	$3.58		
Rotary mow	$8.56	$8.56		
Disc	$3.94	$3.94		
Cultipacker	$2.18	$2.18	$2.18	
Apply compost	$2.89	$2.89	$2.89	$2.89
Cultipacker 2	$2.18	$2.18	$2.18	
Mark rows	$1.00	$1.00	$1.00	$1.00
Transplant by hand				
Cultivate squash	$5.42	$5.42	$5.42	$5.42
Cultivate squash 2	$5.42	$5.42	$5.42	$5.42
Cultivate squash 3			$5.42	$5.42
Irrigate 3x	$63.00	$63.00	$63.00	$63.00
Lay plastic	$4.32			
Rotovate			$14.97	
Springtooth harrow			$4.37	
Springtooth harrow 2			$4.37	
Remove and dispose of plastic	$4.41			
Trap crop charge	$9.69	$9.69	$9.69	$9.69
Misc support time	$52.50	$52.50	$52.50	$52.50
Rotary mow				$8.56
Scrape ridges				$6.20
Harvest machinery time	$20.79	$14.95	$22.98	$24.23
Material Costs	**$124.90**	**$63.40**	**$94.20**	**$63.40**
Apply compost	$60.00	$60.00	$30.00	$12.00
Cultipacker			$33.33	
Transplant by hand	$33.33	$33.33		$33.33
Lay plastic	$13.50	$13.50		
Spray Surround	$1.50	$1.50	$1.50	$1.50
Spray Milstop	$2.80	$2.80	$2.80	$2.80
Spray Milstop 2	$2.80	$2.80	$2.80	$2.80
Remove and dispose of plastic				
Trap crop charge	$10.97	$10.97	$10.97	$10.97
2nd crop charge			$12.80	

Marketing Costs	**$247.50**	**$177.98**	**$273.60**	**$288.45**
Total Costs	**$570.84**	**$416.69**	**$617.45**	**$536.17**
Revenue				
Net revenue ($/pound)	**$0.54**	**$0.53**	**$0.60**	**$0.63**
Operator net revenue ($/season)	**$666.66**	**$473.19**	**$816.62**	**$906.08**
Total Hours	29.38	26.19	41.80	27.67
Acres managed (1500 hours/season)	5.11	5.73	7.18	5.42
Profit	$27,606.62	$20,672.81	$20,499.72	$42,693.42
Labor	$440.67	$392.79	$627.03	$414.99
Dollars per operator hour ($/hour)	$18.40	$13.78	$13.67	$28.46

Table 4. Sensitivity Analysis on Cabbage Net Operator Income (per 0.1 acre) [z]

	(Percent change)	(Level change)	System 1	System 2	System 4
Baseline results[y]			$ 3,034.84	$ 2,463.94	$ 2,090.01
Marketable yield (lb)					
	-25%	n/a	$ 2,210.45	$ 1,845.13	$ 1,464.29
	-10%	n/a	$ 2,717.41	$ 2,281.87	$ 1,826.62
	+10%	n/a	$ 3,393.36	$ 2,864.19	$ 2,309.73
	+25%	n/a	$ 3,900.31	$ 3,300.93	$ 2,672.06
Price ($)					
	-25%	$0.56	$ 2,166.43	$ 1,743.28	$ 1,468.39
	-10%	$0.68	$ 2,714.90	$ 2,198.44	$ 1,860.99
	+10%	$0.83	$ 3,400.49	$ 2,767.38	$ 2,351.74
	+25%	$0.94	$ 3,903.25	$ 3,184.61	$ 2,711.63
Fuel Cost ($ per gallon) [x]					
	-25%	$2.25	$ 3,046.22	$ 2,474.54	$ 2,099.73
	-10%	$2.70	$ 3,039.39	$ 2,468.18	$ 2,093.89
	+10%	$3.30	$ 3,030.29	$ 2,459.71	$ 2,086.12
	+25%	$3.75	$ 3,023.46	$ 2,453.35	$ 2,080.29
Marketing Costs ($)					
	-25%	15%	$ 3,249.09	$ 2,641.74	$ 2,243.37
	-10%	18%	$ 3,120.54	$ 2,535.06	$ 2,151.35
	+10%	22%	$ 2,949.14	$ 2,392.83	$ 2,028.66
	+25%	25%	$ 2,820.60	$ 2,286.15	$ 1,936.65
Overall Total Change[w]					
	-25%	n/a	$ 1,420.91	$ 1,123.45	$ 933.15
	-10%	n/a	$ 2,339.50	$ 1,886.44	$ 1,591.64
	+10%	n/a	$ 3,879.39	$ 3,165.27	$ 2,695.18
	+25%	n/a	$ 5,302.07	$ 4,346.60	$ 3,714.50

[z] System 3 was fallow during this crop rotation.

[y] Baseline results from Table 2.

[x] Fuel is used in to operate many of the pieces of machinery listed in Table 2, and therefore changes in fuel costs influence several cost categories in the analysis.

[w] The overall sensitivity analysis combines increases in yields and prices, and decreases in input costs.

Table 5. Sensitivity Analysis on Squash Net Operator Income (per 0.1 acre)

			System 1	System 2	System 3	System 4
Baseline results[z]			$ 666.66	$ 473.19	$ 816.62	$ 906.08
	(Percent change)	(Level change)				
Marketable yield (lb)						
	-25%	n/a	$ 424.36	$ 298.95	$ 548.76	$ 623.69
	-10%	n/a	$ 569.74	$ 403.49	$ 709.48	$ 793.13
	+10%	n/a	$ 763.58	$ 542.88	$ 923.76	$ 1,019.04
	+25%	n/a	$ 908.96	$ 647.43	$ 1,084.47	$ 1,188.47
Price ($)						
	-25%	$0.94	$ 421.14	$ 283.14	$ 545.21	$ 619.94
	-10%	$1.13	$ 571.62	$ 391.35	$ 711.56	$ 795.32
	+10%	$1.38	$ 769.62	$ 533.73	$ 930.44	$ 1,026.08
	+25%	$1.56	$ 912.18	$ 636.24	$ 1,088.03	$ 1,192.22
Fuel Cost ($ per gallon)[y]						
	-25%	$2.25	$ 677.71	$ 470.13	$ 827.83	$ 917.05
	-10%	$2.70	$ 671.08	$ 463.86	$ 821.11	$ 910.47
	+10%	$3.30	$ 662.24	$ 455.51	$ 812.13	$ 901.70
	+25%	$3.75	$ 655.61	$ 449.25	$ 805.40	$ 895.12
Marketing Costs ($)						
	-25%	15%	$ 728.53	$ 504.18	$ 885.02	$ 978.19
	-10%	18%	$ 691.41	$ 477.49	$ 843.98	$ 934.93
	+10%	22%	$ 641.91	$ 441.89	$ 789.26	$ 877.24
	+25%	25%	$ 604.78	$ 415.19	$ 748.22	$ 833.97
Overall Total Change[w]						
	-25%	n/a	$ 194.64	$ 117.77	$ 295.82	$ 357.88
	-10%	n/a	$ 459.70	$ 309.87	$ 588.24	$ 665.65
	+10%	n/a	$ 911.37	$ 636.66	$ 1,086.74	$ 1,190.52
	+25%	n/a	$ 1,134.47	$ 798.58	$ 1,332.76	$ 1,449.38

[z] Baseline results from Table 3.

[y] Fuel is used in to operate many of the pieces of machinery listed in Table 2, and therefore changes in fuel costs influence several cost categories in the analysis.

[x] The overall sensitivity analysis combines increases in yields and prices, and decreases in input costs.

OTHER A.E.M. EXTENSION BULLETINS

EB No	Title	Fee (if applicable)	Author(s)
2010-13	Organic Agriculture in New York State		Henehan, B. and J. Li
2010-12	2010 Federal Reference Manual for Regional Schools, Income Tax Management and Reporting for Small Businesses and Farms	($25.00)	Bouchard G. and J. Bennett
2010-11	2010 New York State Reference Manual for Regional Schools, Income Tax Management and Reporting for Small Businesses and Farms.	($25.00)	Bennett, J. and K. Bennett
2010-10	Dairy Farm Business Summary, Intensive Grazing Farms, New York, 2009		Conneman, G., Karszes, J., Grace, J., Murray, P., Carlberg, V., Benson, A., Staehr, A., Ames, M., Glazier, N., Anderson, J. and L. Putnam
2010-09	Profiles of Successful Farm Transfers on Long Island		Staehr, A.
2010-08	Dairy Farm Business Summary, New York Small Herd Farms, 80 Cows or Fewer, 2009	($16.00)	Knoblauch, W., Putnam, L., Kiraly, M. and J. Karszes
2010-07	Dairy Farm Business Summary, Hudson and Central New York Region, 2009	($12.00)	Knoblauch, W., Putnam, L., Karszes, J., Buxton, S., Shoen, K., Hadcock, S., Kiraly, M., Hulle, L., Smith, R, Skellie, K., Conneman, G. and R. Overton
2010-06	Dairy Farm Business Summary, Northern NY Region, 2009	($12.00)	Knoblauch, W., Putnam, L., Karszes, J., Murray, P., Vokey, F., Prosper, J., Deming, A., Balbian, D., Buxton, S., Manning, J., Collins, B. and R. Overton
2010-05	Dairy Farm Business Summary, Western NY Region, 2009	($12.00)	Knoblauch, W., Putnam, L., Karszes, J., Hanchar, J., Grace, J., Carlberg, V., Petzen, J., Welch, D., Ames, M., Overton, R. and K. Skellie
2010-04	Dairy Farm Business Summary, New York Large Herd Farms, 300 Cows or Larger, 2009	($16.00)	Karszes, J., Knoblauch, W. and L. Putnam
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