University of Kentucky
College of Agriculture,
Food and Environment
Agricultural Experiment Station

SR-111

Economic Analysis of the University of Kentucky Community Supported Agriculture Organic Vegetable Production System

Tiffany Thompson and Mark Williams, Department of Horticulture; Tim Woods and Carl Dillon, Department of Agricultural Economics; Ric Bessin, Department of Entomology

July 2017

Tiffany Thompson completed this work in fulfillment of a Master's of Science in Integrated Plant and Soil Science. She also worked as the University of Kentucky Community Supported Agriculture (UK-CSA) Manager from January 2012 through January 2016. All data collected for this project was collected first-hand by Ms. Thompson and the UK-CSA staff.

Special thanks to the UK-CSA staff for their data collection and input:
Kristi Durbin
Aaron German
Katie Fiske
Alex Goodman

Contents

Executive Summary 5
Introduction 7
- Community Supported Agriculture 7
- The University of Kentucky CSA Program 7

Organic Vegetable Production System Overview 9
- Crop Production System 9
  - Tractors 9
  - Soil Management 9
  - Plasticulture Production System 10
  - Bareground Production System 10
  - Irrigation 12
  - Pest Management 12
  - Harvest and Post-Harvest Handling 12
  - CSA Delivery 13
- Start-Up Costs 13

Economic Analysis 16
- Organic Crop Enterprise Budgets 16
  - Budget Formation 16
  - CSA Crop Mix 16
  - Budget Results 17
- Whole Farm Analysis for 225 CSA Members 17
  - Crop Production for 225 CSA Members 17
  - Crop Production Labor Costs for 225 CSA Members 18
  - Non-Crop Production Labor Costs for 225 CSA Members 18
  - Labor Overhead Costs for 225 CSA Members 19
- Whole Farm Budget for 225 CSA Members 19

Discussion 21
- Break-Even Analysis 21
- Machinery Cost Analysis 21
- Diverse Market Income 21
- Conclusion 22

Appendix 23
- UK-CSA Crop Budget Workbook 23
- UK-CSA Whole Farm Analysis 23

References 24

Executive Summary

The University of Kentucky Community Supported Agriculture (UK-CSA) program is an integral component of the Sustainable Agriculture (SAG) undergraduate curriculum and links faculty, staff, and students with the UK Organic Farming Unit, located at the UK Horticulture Research Farm. The UK-CSA, which began production in 2007, is used for extension and research in organic vegetable production. It also provides a hands-on learning environment for SAG students to participate and learn from a working farm that strives to balance economic profitability with environmental stewardship and social responsibility. This document presents an economic analysis of the production system used by the UK-CSA program in 2015 to produce 225 CSA shares. Preceding the economic portion is an overview of the production system, providing an appropriate context for how the farm operates. Both of these components offer benchmark comparisons for production standards and farm costs that will be useful for a range of stakeholders.

The production system overview describes in detail how the UK-CSA grows crops on both bareground and plastic mulch, including bed and row spacing, tractors and implements, soil management, irrigation, pest management, harvest and post-harvest handling, and CSA delivery. This description conveys the production standards and procedures that are itemized as input, machinery, labor or overhead costs throughout the economic portion. In addition, the start-up cost is estimated at $326,056, the sum of the purchase price for each piece of machinery, equipment, supplies and infrastructure used by the UK-CSA program in 2015.

The economic analysis consists of thirty organic crop enterprise budgets and a whole farm analysis at a scale of 225 CSA members. All supporting data and calculations used in the analysis are available in the following two Microsoft Excel files:

- **UK-CSA Crop Budget Workbook**
- **UK-CSA Whole Farm Analysis**

These files can be downloaded at http://www.uky.edu/ccd/tools/budgets/UKCSAEconomicAnalysis.

The crop enterprise budgets reveal important differences in costs; the crop production costs per acre range from $6,355 for sweet corn to $23,619 for tomatoes with an average cost of $13,697. Using UK-CSA yield data, a production cost per pound is estimated for each crop to evaluate efficiencies among crops; the average cost is $1.06/lb, ranging from $0.19/lb. to $4.98/lb.

The whole farm budget combines total crop production costs with overhead costs to determine a return to management for a farm selling 225 CSA shares. CSA shares are described in total pounds allotted per member per season with 400 lbs being an approximate average of 2014 and 2015 UK-CSA total pounds received over a 22-week season. Total crop production cost for 225 CSA members is $74,926 and contains all labor costs, variable and fixed machinery costs, and input costs to grow, maintain, and harvest each crop including cover crop management. Crop production labor costs include all hours contributed by staff members, student apprentices, and the farm manager. The overhead costs consist of all potential costs a farmer might encounter at a farm scale of 225 CSA members if using similar production practices as the UK-CSA farm, even if the UK-CSA does not actually pay for those costs. Total overhead costs for non-labor expenditures are estimated at $22,746 and include items such as land rent, utilities, building infrastructure, marketing, software, office supplies, and organic certification. Labor overhead, not including the farm manager's labor hours, totals $29,620 and covers non crop-specific tasks such as washing harvest bins, mowing grass drive-rows or simply moving from one task to another. Labor overhead includes all hours contributed by staff and student apprentices.

The whole farm budget applies a CSA share price of $650/member for a 22-week full-season share of produce. Under this scenario, gross income is estimated at $148,250 or $26,808/acre growing on 5.5 production acres. Total expenses are expected at $118,189 or $21,372/acre and include all costs of production, overhead, and staff salaries but not a return to management. The break-even CSA share price to cover all expenses except a return to management is $516/member. It is assumed that the farm manager is the business owner and would receive the remainder of farm returns, or any income above the break-even share price, as personal income. Return to management when CSA share price is $650/member totals $30,061 or $5,436/acre.

Additional break-even CSA share prices and return to management are estimated at the same 225 CSA member scale for three full-season CSA share sizes, depicted in total pounds distributed per member over 22 weeks (350 lbs, 400 lbs, or 450 lbs), and three CSA share prices, depicted in total cost per member for 22 weeks of produce ($625, $650, and $675). Break-even CSA share prices range from $476/member when providing 350 lbs of produce per member to $557/member when providing 450 lbs of produce per

member, but do not include a return to management. Returns to management range from $15,349/yr. to $44,773/yr. across the different CSA share sizes and prices, illustrating how critical it is to understand costs in order to charge an appropriate CSA share price not only to cover expenses but also to receive a desired return to management.

This economic analysis aims to contribute to the understanding of costs and potential return for mechanized organic vegetable production for a CSA market. Even though all yield and input data were estimated from UK-CSA records, the analysis should not be viewed as costs and returns of a particular season of the UK-CSA program but rather of a mechanized organic vegetable farm selling through a CSA market and operating at a similar scale. The results show that although all expenses, including machinery, can be covered through a 5.5-acre CSA market business, margins may not be big enough to provide financial stability. It is more likely that greater efficiencies and returns could be achieved at larger scales. More research is needed to evaluate how profitability may increase for mechanized organic vegetable farms selling through CSA markets at larger scales. Understanding costs can lead to an appropriate match of scale, CSA share size, CSA share price, and expected return to management. This analysis will help existing farmers evaluate their own enterprises and provide new farmers with benchmarking profitability data.

Introduction

Community Supported Agriculture

Community Supported Agriculture (CSA) has traditionally been defined as a marketing approach in which customers pay an upfront fee in order to receive a mixture of products, usually on a weekly basis, over a defined period of time. Although there are guides that provide a general overall of how traditional CSAs are managed, operated, and marketed (Ehmke, 2013, Woods, 2017), there are few reports that have analyzed the economics of the traditional CSA model. Furthermore, there is even less crop enterprise data for organic CSA growers even though 86.2% of CSA managers report using organic standards even if their operations aren't certified (Woods et al., 2017).

The number of farms operating any type of CSA numbered 12,617 in the 2012 US Census of Agriculture, reflecting a growing consumer interest in purchasing fresh, local, and/or organic food, and developing a stronger sense of community (Polimeni et al., 2006; CIAS, 2001). In the traditional model, CSA is a mutual commitment between a farm and its supporting members. The farm benefits from upfront income and a reliable market for its products. The members receive fresh, affordable local produce and access to other farm amenities sometimes including on-farm events, newsletters and recipes, pick your own crops, and bulk discounts on extra produce. The weekly portion of produce, or share, in a vegetable CSA typically consists of eight to ten seasonal items delivered over a given number of weeks.

Farms marketing through a vegetable CSA are complex businesses facing many operational and economic challenges. To be economically viable, CSA farms must achieve the appropriate match of crops, equipment, and labor with farm size and number of CSA members. A diverse array of vegetable crops are typically grown with unique requirements for crop production, pest management, harvest, and post-harvest handling. An extensive suite of skills, tools, and equipment are required to produce these crops efficiently, and mechanization becomes critical as the number of acres in production increases.

Farms with a large number of CSA customers scale-up by investing in equipment and tools that improve task efficiency and reduce worker fatigue. This level of mechanization resembles how a farm selling produce on the wholesale market may operate. However, mechanized farms selling through a CSA market still receive direct-market prices and therefore typically earn larger gross incomes. In a survey of fresh market vegetable farms ranging from 0.5 to 80 acres in size, Hendrickson (2005) found that although gross income per acre was greater for smaller farms, hourly wage for the farm owner was greater for larger farms; the larger market farms achieved greater income per hour worked due to labor savings through mechanized practices. Mechanized farm operations selling directly to customers through a CSA could earn more per hour than non-mechanized farms selling to the same markets.

The UK-CSA uses a mechanized crop production approach to help demonstrate how reductions in labor costs may contribute to long-term economic success, improved farm worker well-being, and higher return to management. The economic analysis presented here shows the costs and returns to organically produce thirty vegetable crops grown for a 22-week, full-share vegetable CSA program, using the UK-CSA organic vegetable production system. It also presents a whole farm budget at a scale of 225 CSA members. Understanding both enterprise and whole farm costs is critical as CSA businesses continue to utilize even more diverse marketing strategies. This report will help mechanized organic vegetable farms selling through a CSA market better understand costs to set appropriate CSA share prices to cover total farm expenses, including a desired return to management.

The University of Kentucky CSA Program

The University of Kentucky Community Supported Agriculture (UK-CSA) program (http://sustainableag.ca.uky.edu/, http://ukcsa.wordpress.com) was established to provide opportunities for research, extension, and education in sustainable and organic agriculture. The UK-CSA is the site for an on-farm apprenticeship program for students in the Sustainable Agriculture (SAG) undergraduate degree program. Located on the Organic Farming Unit of the UK Horticulture Research Farm in Lexington Kentucky, the UK-CSA is certified for organic production by the Kentucky Department of Agriculture.

The UK-CSA began with 40 members in 2007, growing to 225 in 2015. Shares are restricted to faculty, staff, and students, and are delivered weekly for 22 weeks from May to October. A share consists primarily of vegetables, with some field-grown fruits, herbs, and you-pick cut flowers. Members also receive a weekly electronic newsletter and participate in on-farm potlucks and community building events. Approximately 44% of UK-CSA memberships are shared between two households. Although this report is only focused on the UK-CSA, the UK Organic Farming Unit also generates income through the sale of vegetables to a wholesale produce distributor and at a weekly farm stand. Proceeds from all three marketing channels support farm operations and educational SAG programs.

The current UK-CSA production system consists of many of the same techniques that were in use in 2007; plasticulture for long-season crops and tractor-mounted seeders and mechanical cultivation for bareground production. However, each year improvements are made to specific areas of the production system according to practices developed on the UK Organic Farming Unit and seen at successful organic farms across the country. Many of these improvements have included additional machinery to increase the quality and ease of production and post-harvest handling, or reduce labor costs. The economic analysis reflects the production system practiced in 2015, one that is the result of an evolution of improvements over 9 years.

This economic analysis highlights the UK-CSA production system operating at the 2015 scale (225 CSA members and 5.5 acres) at a share price of $650/member, and an average of 2014 and 2015 UK-CSA share sizes depicted in total pounds received per member over a 22-week season (400 lbs). The results will help the managers of mechanized farms selling through a CSA market evaluate their costs of production and hopefully help their farm businesses move towards economic sustainability.

Crop Production System

A systems approach is critical to mechanized crop production and the UK-CSA uses standardized bed and row spacing for bareground and plasticulture crop production to allow equipment to be used across multiple crops. The bed and row spacing for thirty crops is shown in Table 1. All bareground direct-seeded and transplanted crops are grown on 52 in. center to center bed spacing with two crop rows spaced 16 in. apart and two sub-surface applied drip irrigation lines per bed (Figure 1-2). Two exceptions are green beans in rows spaced 18 in. apart per bed and potatoes that are grown on 72 in. center to center bed spacing with two crop rows spaced 32 in. apart per bed. All crops grown on plastic mulch are on 84 in. center to center bed spacing and have 1, 2 or 3 rows per bed, with the exception of a single row of tomatoes on 96 in. center to center bed spacing. UK-CSA production fields are typically 50 ft. wide by 300 ft. long with 12 ft. grass drive rows between fields. This field width was chosen to accommodate a 25 ft.-long boom sprayer, able to spray the entire field by driving in the grass drive rows along each side. The grass drive rows also allow for greater harvest efficiency as harvest wagons are never further than 25 ft. away and the harvest conveyor can extend into the middle of each field.

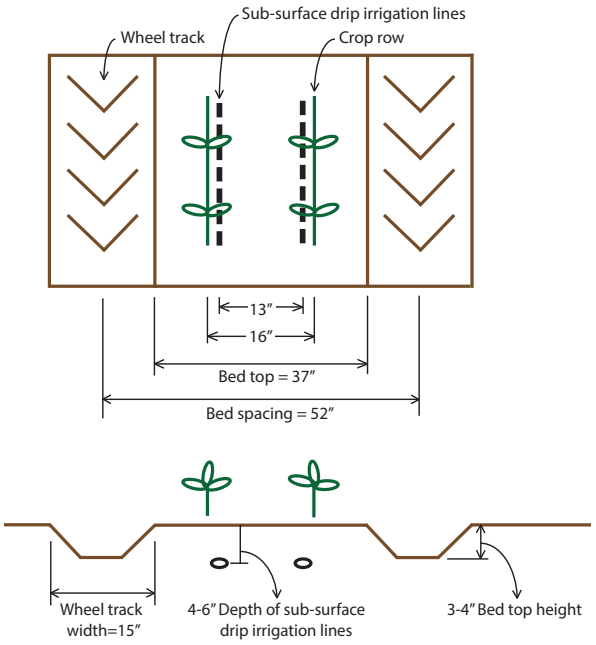

Figure 1. Bareground bed system.

Tractors. Two primary tractors, a 95-HP Kubota M9540 (Figure 3) with cab (Kubota Tractor Corporation, Osaka, Japan) and a 50-HP Kubota L5030 (Figure 4), complete most tasks on the UK-CSA farm with some secondary tasks performed with a 17-HP Kubota B1700 (Figure 5). A zero-turn mower maintains grass drive rows. In addition, two 1960s-era International Harvester (IH) Farmall 140s (Figure 6-7, International Harvester, Warrenville, IL) are used for cultivation.

Soil Management. A mix of cover crops are planted at least once a year on each field with a Tye Pasture Pleaser no-till seed-drill (Tye Agricultural Equipment, Tye, Texas) and terminated by an Edward's 8 ft. flail mower (Edwards Equipment Company, Union Gap, WA). Fields are subsoiled with a Monroe Tufline 2-shank sub-

Table 1. Bed and Row Spacing.

Crop	Plasticulture	Bare-ground	Direct Seed (DS)/ Transplant (T)	Bed Spacing (inches)	Rows per Bed	Between-Row Spacing (inches)	In-row Plant Spacing (inches)	Row Feet/Acre	Plants/Acre
Beans, Green		x	DS	52	2	16	2	20,105	120,628
Beets		x	DS	52	2	16	1.5	20,105	160,837
Broccoli		x	T	52	2	16	14	20,105	17,233
Brussels Sprouts		x	T	52	2	16	24	20,105	10,052
Cabbage		x	T	52	2	16	16	20,105	15,078
Carrots		x	DS	52	2	16	0.8	20,105	301,569
Cauliflower		x	T	52	2	16	18	20,105	13,403
Chard, Swiss		x	DS	52	2	16	2	20,105	120,628
Corn, Sweet		x	DS	52	2	16	8	20,105	30,157
Cucumbers	x		T	84	2	12	12	12,446	12,446
Eggplant	x		T	84	2	12	18	12,446	8,297
Garlic	x		DS	84	3	6	9	18,669	24,891
Greens, Kale/Collards		x	T	52	2	16	12	20,105	20,105
Greens, Salad		x	DS	52	2	16	0.8	20,105	301,569
Herbs, Summer Annual		x	DS	52	2	16	1	20,105	241,255
Kohlrabi		x	T	52	2	16	9	20,105	26,806
Leeks		x	T	52	2	16	9	20,105	26,806
Lettuce, Head		x	T	52	2	16	12	20,105	20,105
Muskmelon (Cantaloupe)	x		T	84	1		15	6,223	4,978
Onions, Bulb		x	T	52	2	16	9	20,105	26,806
Peppers	x		T	84	2	12	15	12,446	9,957
Potatoes		x	DS	72	2	32	8	14,520	21,780
Potatoes, Sweet	x		T	84	1		12	6,223	6,223
Roots, Radish/Turnip		x	DS	52	2	16	1	20,105	241,255
Scallions		x	T	52	2	16	9	20,105	26,806
Squash, Summer	x		T	84	1		15	6,223	4,978
Squash, Winter	x		T	84	1		15	6,223	4,978
Tomatoes	x		T	96	1		18	5,445	3,630
Watermelon	x		T	84	1		24	6,223	3,111
You-Pick	x		T	84	2	12	12	12,446	12,446

Figure 2. Bareground bed system.

Figure 3. Kubota M9540 and Maschio B-230 rototiller.

soiler (Monroe Tufline, Columbus MS) once every 5 years as needed. If preparing a field for cash crops, compost is applied with an H&S manure spreader model 125 (H&S Manufacturing Company, Inc., Marshfield, WI) and cover crop residue and compost are incorporated into the soil with an Imants 5.9 ft. 27-series spader (Figure 4, Imants BV, Reusel, Netherlands). After spading, bed preparation for cash crops typically begins by either discing with a 12 ft. tandem disc harrow, field cultivating with a custom 8 ft. field cultivator, or shallow rototilling with a Maschio 7.75 ft. model B-230 rototiller with hydraulic rear basket depth control (Figure 3, Maschio Gaspardo North America Inc., DeWitt, IA) to encourage cover crop residue decomposition. Implement choice is dependent on soil conditions and crop needs. Weeds are managed on field ends by laying landscape fabric below irrigation header lines, cultivating with a custom 4 ft. field cultivator (Figure 5), or by planting a living mulch with an Andersons SSD drop spreader (The Andersons, Inc., Fostoria, OH).

Plasticulture Production System. For plasticulture crop production, a Rain-Flo model 2600 plastic mulch layer (Rain-Flo Irrigation, East Earl, PA) distributes one line of drip irrigation line and Nature Safe 10-2-8 fertilizer based on crop needs (Darling International Inc., Irving, TX) under the plastic mulch. Planting occurs using a Rain-Flo model 1600 water wheel transplanter (Rain-Flo Irrigation, East Earl, PA). Soil is managed between beds by cultivating or planting a living mulch. Cultivation is used for shorter-season crops or for stale bedding prior to planting a living mulch. An IH Farmall 140 tractor with a custom power steering system uses belly-mounted straight-tooth cultivators and small hilling discs for plastic bed-shoulder cultivation and rear-mounted Danish S-tines for wheel-track cultivation (Figure 7). Living mulch is used for longer-season, multiple-harvest crops and is seeded using an Andersons SSD drop spreader (The Andersons, Inc., Maumee, OH) and incorporated through shallow cultivation. Living mulch is managed by mowing with a BCS walk-behind tractor (BCS America, Portland, OR) with front-mounted flail mower attachment. At the end of the season, cash crops are flail mowed with an Edwards 8 ft. flail mower and plastic is lifted using a Rain-Flo Challenger model 1800 mulch lifter (Rain-Flo Irrigation, East Earl, PA).

Bareground Production System. For bareground crop production, two drip irrigation lines are buried 13 in. apart below the surface of the soil at 4-6 in. depth using a custom

Figure 4. Kubota L5030 and Imants 27-series spader.

Figure 5. Kubota B1700 and custom 4 ft. field cultivator with a series of Danish S-tines and rolling basket.

Figure 6. IH Farmall 140 with a custom power steering system, belly-mounted Buddingh basket weeders, and rear-mounted spyder and Danish S-tine cultivators.

Figure 7. IH Farmall 140 with a custom power steering system, belly-mounted straight-tooth cultivators and small hilling discs for plastic bed-shoulder cultivation and rear-mounted Danish S-tines for wheel-track cultivation.

Andros Engineering sub-surface drip irrigation layer (Figure 8, Andros Engineering, Paso Robles, CA). A custom 4 ft. stale seedbed cultivator (Figure 9) is used to lightly cultivate the top 1 in. and firm the bed surface, and is used up to 2-3 times before planting to reduce the shallow weed seed bank. Transplanted crops are set using a two-row Mechanical Transplanter model 5000 (Figure 10, Mechanical Transplanter Co. LLC, Holland, MI) with hoppers to distribute Nature Safe 10-2-8 fertilizer based on crop needs and a water tank. Direct-seeded crops are seeded using a two-row MaterMacc VegiMacc vacuum seeder (Figure 11, MaterMacc, Ponte Rosso, Italy) with fertilizer hoppers to distribute Nature Safe 10-2-8 fertilizer based on crop needs. For both transplanted and direct-seeded crops, weeds are managed after planting first by using a belly-mounted Buddingh basket weeder (Figure 6, Buddingh Weeder Co., Dutton, MI) on an IH Farmall 140 with a custom power steering system; rear-mounted spyder cultivators eliminate weeds on bed-shoulders and Danish S-tines cultivate the wheel-tracks. Secondary cultivation is performed using a Kress Argus finger weeder (Figure 12, K.U.L.T. Kress and Co. Umweltschonende Landtechnik, Vaihingen, Germany), which provides in-row cultivation. For some late-season fall crops, red clover is undersown with a Spyker model P20-9010 broadcast spreader (Brinly-Hardy Company, Jeffersonville, IN) before the final finger weeder cultivation to provide a winter legume cover crop. For both plasticulture and bareground crop production approaches, an emphasis on eliminating hand-weeding is paramount. However, some hand-weeding using long-handled specialty hoes is still necessary when weather prevents timely mechanical cultivation.

Production systems for potatoes, green beans and tomatoes differ slightly from those already described. For potatoes, a three-point hitch custom potato toolbar with 2 Willsie furrowers (Willsie Equipment Sales, Inc., Ontario, Canada) are used to mark rows. Seed potatoes and drip irrigation lines are set manually and Lilliston rolling cultivators (Bigham, Lubbock, TX) with a custom fertilizer hopper simultaneously cultivate, side-dress Nature Safe 10-2-8 fertilizer, and hill the potato rows. Potatoes are harvested with 2 Willsie harvest shoes (Willsie Equipment Sales, Inc., Ontario, Canada). Green beans are planted on 18 in. between-row spacing and mechanically harvested using a Pixall BH100

Figure 8. Custom Andros Engineering sub-surface drip irrigation layer.

Figure 9. Custom 4 ft. stale seedbed cultivator.

Figure 10. Mechanical Transplanter model 5000 with fertilizer hopper, water tank, and custom transplant tray holding racks.

Figure 11. MaterMacc VegiMacc vacuum seeder.

bean harvester (Oxbo International Corp., Clear Lake, MI). Tomatoes are planted on plasticulture beds spaced 96 in. center to center allowing for increased air circulation to reduce disease and for easier harvest access.

Irrigation. Drip irrigation is used for all crops. At each field, a 12-psi pressure reducer and ball valve connect a 2 in. layflat irrigation supply line to a 1.5 in. layflat irrigation header line that runs the width of the field. Drip irrigation lines are connected to the header line with a valve connector that allows individual drip lines to be opened or closed. Irrigation water for the UK-CSA is drawn from the municipal water supply. Actual water cost is not integrated in the organic crop enterprise budgets because it is more common for farmers to irrigate from wells, ponds, or streams. Instead, the cost of a 6.5-HP pump, sand filters, suction hose, and pressure regulator typical of a commercial vegetable operation of similar size is included. Some longer-season crops that require supplemental fertilizer are fertigated with liquid fish emulsion, sodium nitrate or potassium sulfate as needed using a custom PTO-powered injection system (Figure 13).

Pest Management. Integrated pest management strategies are used to control pests. A range of cultural practices, including rotating cash crop plant families and planting cover crops are utilized to reduce pest pressure. Organic-approved pesticides are sprayed as needed using a Penn's Creek 25 ft. boom sprayer (Figure 14, Penn's Creek Manufacturing, Winfield, PA).

Harvest and Post-Harvest Handling. Harvest and post-harvest handling activities account for much of the labor on the UK-CSA farm. Most crops are hand-harvested into plastic produce containers using knives or pruners. Bulk harvest crops are stored in 1,300-pound capacity produce bins (MacroPlastics, Shelbyville, KY). A wagon-mounted 28 ft. hydraulic aluminum harvest conveyor (Figure 15, distributed by Martin's Produce Supply, Liberty, KY) is used for cabbage, broccoli, watermelon and winter squash.

An 8 ft. x 16 ft. wagon transports all harvested produce to the packing shed. Leafy greens are washed in a repurposed 300-gallon stainless steel dip tank (Figure 16). Sani-Date 5.0 (Bio Safe Systems, LLC, East Hartford, CT), a wash-water sanitizer, is added to the dip tank. Bunched greens are packed directly into clean bins while loose salad greens are spun-dry in an Electrolux-Dito model 601559-Greens Ma-

Figure 12. Kress Argus finger weeder.

Figure 13. Custom PTO-powered fertigation injection system.

Figure 14. Penn's Creek Manufacturing 25 ft. boom sprayer.

Figure 15. 28 ft. hydraulic aluminum harvest conveyor.

chine Stainless Steel Electric Vegetable Dryer (Electrolux, Stockholm, Sweden) before being individually bagged in unsealed produce bags. Items such as melons, peppers, squash, cucumbers, and eggplant are washed in a brusher washer (Figure 17, AZS Brusher Equipment, Ephrata, PA). Loose root crops such as turnips, radishes, potatoes, carrots and beets are washed in a barrel washer (Figure 18, AZS Brusher Equipment, Ephrata, PA). After the crop has been washed, counted, packed, and weighed, it is typically stored in either a walk-in cooler set at 32°F or a custom-built cooler with a CoolBot (Store it Cold, LLC, New Paltz, NY) window-A/C unit set at 55°F, depending on crop need.

Although only crops grown for the wholesale market on the UK Organic Farming Unit were Good Agricultural Practices (GAP)-certified in 2015, the UK-CSA has adopted many food safety measures to reduce the risk of contamination throughout all harvest and post-harvest handling.

CSA Delivery. Approximately 25% of UK-CSA members choose to pick up their shares at the farm and 75% at a delivery site on campus during a 2-3 hour window each Thursday during the season. UK-CSA members bring their own bag, box or container and are instructed in how many items to choose from a market-style display.

Start-Up Costs

Table 2 lists the total purchase price, $326,056, of all machinery, equipment and supplies in use during the 2015 season. If all new equipment were purchased, the cost would be $465,910. The organic crop enterprise budgets incorporate the owning and operating costs of all items listed.

Useful economic life of field machinery is based off of UK-CSA activity log data and reflects shared use on 10 cultivated acres. Useful life of other supplies and tools is estimated based on the manager's experience. Start-up costs are spread over the lifetime of each item as reflected in annual ownership costs throughout the economic analysis.

Figure 16. Repurposed 300-gallon stainless steel dip tank.

Figure 17. AZS Brusher Washer.

Figure 18. AZS Barrel Washer.

Table 2. Start-Up Costs

FIELD MACHINERY	Purchase Year if Known	Purchase Price	Comparable New List Price	Useful Economic Life (yrs)[1]
Tractors				
95-HP Kubota M9540	2011	$43,707	$55,000	50
50-HP Kubota L5030	2004	$20,850	$26,609	40
17-HP Kubota B1700	1999	$10,992	$9,971	50
Zero-turn mower	2015	$5,000	$8,699	20
Subtotal		*$80,549*	*$100,279*	
Soil Management				
H & S manure spreader model 125	2005	$4,975	$8,699	40
Tye Pasture Pleaser no-till grain drill	2007	$3,000	$8,500	50
Edwards 8' flail mower	2010	$5,000	$10,000	30
12' tandom disc harrow	2000	$1,800	$4,000	50
Maschio 7.75' B-230 rototiller with rear-basket depth control	2013	$9,735	$10,000	30
Imants 5.9' 27-series spader	2008	$19,139	$25,000	30
Monroe Tufline 2-shank subsoiler	2015	$1,915	$1,915	50
Custom 8' field cultivator	2000	$1,000	$1,200	50
Plasticulture Production System				
Rain-Flo model 2600 plastic mulch layer	2008	$6,545	$6,600	50
Rain-Flo model 1600 water wheel transplanter & 9 planter wheels	2005	$3,420	$3,500	50
IH Farmall 140 with straight-tooth cultivators, small hilling discs, and Danish S-tines	1974	$4,500	$4,500	60
Rain-Flo Challenger model 1800 mulch lifter	2005	$1,950	$2,000	50
BCS + flailmower	2011	$6,858	$6,900	20
Bareground Production System				
Custom 4' field cultivator	2009	$800	$1,000	50
Custom 4' stale seedbed cultivator	2013	$3,200	$3,200	50
Custom Andros Engineering drip tape layer: 1 drip head	2013	$5,794	$5,800	50
MaterMacc VegiMacc vacuum seeder: 2 rows	2009	$11,740	$12,000	40
Mechanical Transplanter model 5000: 2 rows	2008	$16,328	$16,400	40
IH Farmall 140 with Buddingh basket weeder	2005	$7,220	$7,300	60
Kress Argus finger weeder	2014	$8,641	$8,700	50
Potato Production System				
Custom potato toolbar using Willsie furrowers and harvest shoes	2014	$1,500	$1,600	50
Lilliston Rolling Cultivators with custom side-dresser	2010	$4,700	$5,500	50
Pest Management and Fertility				
Custom 30-gallon tank with PTO-powered pump and agitator for fertigation	2004	$1,400	$1,500	30
Penn's Creek 25' boom sprayer	2009	$4,680	$5,000	30
Harvest				
Hay wagon	2011	$3,000	$3,100	25
28 ft. hydraulic aluminum harvesting conveyor	2015	$2,350	$2,400	30
Pixall BH100 mechanical bean harvester		$20,000	$40,000	40
Subtotal		*$161,190*	*$206,314*	
Vehicles and Irrigation Pump				
Delivery van		$5,000	$30,000	20
2 farm trucks		$10,000	$60,000	20
Irrigation pump and accessories (Berry Hill Irrigation, Buffalo Junction, VA)				10
6.5-HP high pressure pump with Honda engine		$775	$775	10
1 set Triton fiberglass sand filters: TR40		$999	$999	10
Sand for filters		$78	$78	10
20' of 2" suction hose		$125	$125	10
Pressure regulator		$30	$30	10
Subtotal		*$17,007*	*$92,007*	
TOTAL FIELD MACHINERY		**$258,746**	**$398,600**	

GREENHOUSE	Purchase Price	Quantity	Total Cost	Useful Economic Life (yrs)[1]
Greenhouse frame and installation cost			$4,540	20
Greenhouse furnace, fans and installation			$3,177	20
Greenhouse benches, plumbing and irrigation			$1,300	20
Berry Precision Seeder (Berry Seeder Company, Elizabeth City, NC)	$850	1	$850	30
3 seeding plates (162, 128, 72)	$50	3	$150	30
3 dibbling plates (162, 128, 72)	$50	3	$150	30
One 14 gpm Dosatron (Dosatron International, Inc., Clearwater, FL)	$346	1	$346	15
'Redi-Heat Heavy-Duty Propagation Mat' (Phytotronics, Inc. Earth City, MO)	$225	1	$225	15
750 'Winstrip-brand' seedling trays	$5	750	$3,488	20
TOTAL GREENHOUSE			**$14,225**	

Table 2. Start-Up Costs (continued)

PACKING SHED	Purchase Price	Useful Economic Life (yrs)[1]
Equipment		
Walk-in cooler	$10,000	15
Custom-built cooler with CoolBot (Store it Cold, LLC www.storeitcold.com)	$2,500	15
Ice maker	$2,930	15
Barrel washer + sorting table (AZS Brusher Equipment, Ephrata, PA)	$5,850	20
Electrolux-Dito 601559-Greens Machine Stainless Steel Electric Vegetable Dryer	$2,258	20
2 roller conveyors	$1,200	30
AZS brush washer + sorting table (AZS Brusher Equipment, Ephrata, PA)	$5,687	20
300-gallon stainless steel dip tank	$5,000	20
4 stainless steel tables	$1,200	20
Sink	$1,000	20
Subtotal	*$37,625*	

	Purchase Price	Quantity	Total Cost	Useful Economic Life (yrs)[1]
Supplies and Harvest Tools				
Harvest crates	$15	350	$5,250	20
34-FV Macrobins for bulk harvest (MacroPlastics Inc., Shelbyville, KY)	$142	20	$2,840	20
34-FV Macrobin lids for bulk harvest (MacroPlastics Inc., Shelbyville, KY)	$40	10	$400	15
Plastic pallets	$25	20	$500	20
Large harvest knives	$15	6	$90	15
Small harvest knives	$2	6	$12	15
Pruners	$25	10	$250	15
Scales	$150	4	$600	15
Mop + mop bucket	$50	1	$50	15
Brooms	$30	3	$90	15
Scoop shovel	$56	1	$56	15
Squeegee	$60	2	$120	15
Compost bins	$50	4	$200	15
Aprons	$70	8	$560	15
Rubber hose ($50/each) + hose reels ($150/each)	$200	3	$600	15
Subtotal			*$11,618*	
TOTAL PACKING SHED			**$49,243**	

FIELD HAND TOOLS	Purchase Price	Quantity	Total Cost	Useful Economic Life (yrs)[1]
T-Post driver	$31	3	$93	15
T-Post puller	$90	2	$180	15
Digging forks	$83	4	$332	15
Loppers	$50	2	$100	15
Soil-knives	$22	6	$132	15
Hand-weeders (A.M Leonard Horticultural Tool and Supply Company, Piqua, OH)	$29	6	$174	15
Wheel-hoes	$400	2	$800	15
Scuffle-hoes	$55	10	$550	15
Grub-hoes	$50	2	$100	15
Shovels	$36	6	$216	15
Specialty hoes	$40	4	$160	15
Spyker model P20-9010 broadcast spreader	$219	1	$219	15
Andersons SSD drop-spreader	$250	1	$250	15
TOTAL FIELD HAND TOOLS			**$3,306**	

DELIVERY SUPPLIES	Purchase Price	Quantity	Total Cost	Useful Economic Life (yrs)[1]
2 12' x 12' Swift Instant Shelter Pop-Up EZ-Up Tents	$103	2	$206	3
6 folding tables	$40	6	$240	3
Signs and sign clips	$3	30	$90	3
TOTAL DELIVERY SUPPLIES			**$536**	

TOTAL PURCHASE PRICE	**$326,056**
TOTAL COMPARABLE NEW LIST PRICE	**$465,910**

[1] Useful economic life of field machinery is based off of useful life in machine hours and UK-CSA activity log data of machine use per year when used on 10 cultivated acres and then adjusted to realistic values (See UK-CSA Crop Budget Workbook, Table 2: Variable Machinery Cost Per Hour). Useful life of other supplies and tools is estimated based on the manager's experience. All costs are annualized accordingly and included in either the UK-CSA Crop Budget Workbook or the UK-CSA Whole Farm Analysis files.

Organic Crop Enterprise Budgets

Budget Formation. Organic crop enterprise budgets were created to calculate the production costs for thirty crops on a standard unit area of one third acre for the UK-CSA organic vegetable production system. One third acre is approximately the size of one field on the UK-CSA farm and is roughly the maximum acreage grown of any one particular crop. The organic crop enterprise budgets are linked directly to calculations performed within seven budget worksheets using data collected at the UK-CSA farm over a three year period from 2013-2015. This method of crop budget production is adapted from Richard Wiswall's The Organic Farmer's Business Handbook (2009). Seven budget worksheets, thirty organic crop enterprise budgets, and two summary worksheets are located in the file:

► **UK-CSA Crop Budget Workbook**

CSA Crop Mix. The thirty crops chosen for the budgets (see Table 3) are grown every year for the UK-CSA, including a you-pick group, with less common crops omitted and a few crops grouped together: "salad greens" represent the average of arugula, spinach, lettuce mix, and braising mix, "summer annual herbs" represent the average of cilantro, dill and basil, and the "you-pick" group represents the average of green beans, tomatoes and herbs, which are common you-pick crops for UK-CSA members.

The thirty crops are grown for the UK-CSA because they provide a diversity of items both weekly and seasonally, they perform reasonably well in an organic production system, and they are requested by CSA members. A traditional CSA share should include both weekly diversity by including a mix of root, leaf, and fruit crops as well as seasonal diversity as the season progresses. Although the UK-CSA occasionally grows less common crops to offer greater diversity, these thirty crops consistently perform well and are grown every year. Each season, UK-CSA members respond to a survey that requests feedback on quality and quantity of all crops. UK-CSA staff use these responses to adjust crop choices and planting plans to improve customer satisfaction.

Table 3 shows an adjusted average of UK-CSA share contents for each of 22 weeks based on the 2014 and 2015 UK-CSA seasons. Pounds of product are used to illustrate the approximate distribution of each of the 30 crop items to each share over the length of an "average" season.

Table 3. CSA Crop Mix per Member

	Approximate Delivery Date																						
Crop	**May 28**	**June 4**	**June 11**	**June 18**	**June 25**	**July 2**	**July 9**	**July 16**	**July 23**	**July 30**	**Aug 6**	**Aug 13**	**Aug 20**	**Aug 27**	**Sept 3**	**Sept 10**	**Sept 17**	**Sept 24**	**Oct 1**	**Oct 8**	**Oct 15**	**Oct 22**	**Pounds per Member**
Beans, Green							1.0	1.5			1.3	1.0		1.2	1.0		1.0	1.0					**9**
Beets		2.0	2.0		2.0	1.5											2.0		1.5	1.5		1.5	**14**
Broccoli			1.2	1.0	2.1	2.1												3.5	2.1	2.0		2.0	**16**
Brussels Sprouts																						4.0	**4**
Cabbage					2.0	2.0		2.0	2.0								2.0		2.0			2.0	**14**
Carrots				3.0	2.0		3.0	2.0												2.0	2.0	1.0	**15**
Cauliflower																			2.5		1.5	1.0	**5**
Chard, Swiss			0.8		0.8			0.8										0.8			0.8		**4**
Corn, Sweet									2.0	4.0		4.0	3.0	2.0		2.0	1.0						**18**
Cucumbers				1.0	1.0	2.0	3.0	2.0			1.0	3.0	1.0										**14**
Eggplant						1.5	1.5	1.0	1.0	0.6	0.6	0.6	0.6	0.6									**8**
Garlic	0.2	0.2							0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3			**4**
Greens	1.0	1.0		1.0		1.0	1.0								1.0	1.0		1.0		1.0	1.0		**10**
Greens, Salad	2.7	1.5	1.2		0.6										1.4	1.8	0.6	1.5	0.8	0.7	0.9	0.7	**14**
Herbs, Summer		0.2		0.2	0.5	0.2	0.2			1.0		1.0		0.5		0.4	0.2		0.2	0.2		0.2	**5**
Kohlrabi	1.4		2.0			2.2									2.2			2.2					**10**
Leeks							2.0		1.0														**3**
Lettuce, Head	1.5		1.5	2.0	2.0									1.0	1.0		1.0	1.0			1.0		**12**
Muskmelon									5.0		5.0		6.0										**16**
Onions, Bulb	2.0	2.0								1.5	1.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	**18**
Peppers							0.2	0.3	0.9		1.0	4.3	3.2	1.2	2.7	0.7			2.0	1.5			**18**
Potatoes											3.0	2.5		2.5		2.5		2.5		2.5		2.5	**18**
Potatoes, Sweet																	4.0		4.0		4.0		**12**
Radish/Turnips	0.5	1.0		0.5	1.0			1.0							0.8			1.2	0.3	0.7	1.0	2.0	**10**
Scallions			0.5		0.5		0.5	0.5								0.5	0.5			0.5	0.5		**4**
Squash, Summer				2.0	3.0	3.5	2.0	1.5	2.2	2.6	3.0	3.0	2.2										**25**
Squash, Winter													2.0	3.5	2.0	4.0	4.0	4.0	4.0	3.5	4.0	4.0	**35**
Tomatoes							2.0	3.0	5.0	5.5	5.5	4.0	3.0	3.0	4.0								**35**
Watermelon										5.5		5.5		9.0									**20**
You-Pick	1.3		0.1			0.5	0.5	0.5	0.5	1.0	1.0	1.0	1.0	1.0	1.0		0.2	0.2			0.2		**10**
Pounds per Week	**11**	**8**	**9**	**11**	**18**	**17**	**17**	**16**	**20**	**22**	**23**	**31**	**23**	**27**	**18**	**14**	**18**	**20**	**21**	**17**	**18**	**22**	**400**

Budget Results. Table 4 summarizes the organic crop enterprise budget results, extrapolated to one acre to provide data that is easily comparable to other farms. Crop production costs contain all labor costs, variable and fixed machinery costs, and input costs to grow, maintain, and harvest each crop including cover crop management. The average crop production cost per acre is $13,697 and ranges from a low of $6,355 for sweet corn to a high of $23,619 for tomatoes. Projected yields for a one acre production base are provided for each crop in Table 4 and represent the pounds of produce ready to sell after harvest, washing, sorting and packing have occurred. Crop production costs are divided by the corresponding yield to determine a production cost per pound to compare relative production costs across crops. The average production cost per pound is $1.06, with the lowest cost of $0.19/lb. for watermelon and the highest cost of $4.98/lb. for garlic.

Creating results like these from organic crop enterprise budgets could help farmers lower their production costs per pound. In Table 4, the three most expensive crops for the UK-CSA to produce per pound are garlic, leeks and scallions. Further evaluation of these budgets can help UK-CSA staff decide if production practices, such as improved disease control or improved storage conditions, can help reduce costs or increase yield to lower production cost per pound. The organic crop enterprise budgets are critical components of understanding costs on a highly diverse farm. The budgets also facilitate comparisons between crops and other farms.

Table 4. Organic Crop Enterprise Budget Summary

Crop	Crop Production Costs per Acre	Average Yield per Acre (pounds)	Production Cost per Pound
Beans, Green	$11,095	8,947	$1.24
Beets	$9,384	23,254	$0.40
Broccoli	$9,630	12,063	$0.80
Brussels Sprouts	$13,823	10,052	$1.38
Cabbage	$10,658	30,358	$0.35
Carrots	$11,893	13,068	$0.91
Cauliflower	$10,231	11,393	$0.90
Chard, Swiss	$15,447	22,651	$0.68
Corn, Sweet	$6,355	10,186	$0.62
Cucumbers	$20,035	25,929	$0.77
Eggplant	$19,742	25,133	$0.79
Garlic	$14,414	2,894	$4.98
Greens, Kale/Collards	$18,345	15,212	$1.21
Greens, Salad	$15,453	8,779	$1.76
Herbs, Summer Annual	$9,772	13,922	$0.70
Kohlrabi	$10,582	17,089	$0.62
Leeks	$18,627	6,165	$3.02
Lettuce, Head	$10,728	26,404	$0.41
Muskmelon (Cantaloupe)	$12,823	14,748	$0.87
Onions, Bulb	$14,356	20,105	$0.71
Peppers	$20,589	25,327	$0.81
Potatoes	$16,440	12,100	$1.36
Potatoes, Sweet	$9,843	19,685	$0.50
Roots, Radish/Turnip	$9,601	14,743	$0.65
Scallions	$18,564	7,338	$2.53
Squash, Summer	$18,809	24,736	$0.76
Squash, Winter	$13,273	19,353	$0.69
Tomatoes	$23,619	35,393	$0.67
Watermelon	$7,733	40,200	$0.19
You-Pick	$9,037	17,895	$0.51
AVERAGE	**$13,697**	**17,837**	**$1.06**

Whole Farm Analysis for 225 CSA Members

The purpose of a whole farm analysis is to determine the costs and returns of a farm operating at a particular size. The 2015 UK-CSA farm scale at 225 CSA members is evaluated for this analysis. All calculations associated with the whole farm analysis are located in the file:

► **UK-CSA Whole Farm Analysis**

Crop Production for 225 CSA Members. Table 5 outlines crop production costs to provide each of 225 members with the crop mix described in Table 3. Total farm crop production costs are estimated at $74,926. The number of acres required to grow this produce, based on UK-CSA average yield per row foot, is 5.5 acres.

Crop production costs in Table 5 are only associated with yield that the CSA member actually receives as part of their share. However, it is impossible to expect that all crops will yield as expected each year or that all harvested yield will be perfectly stored, transported, or displayed. It may be more realistic to grow more produce than is needed (e.g. 10-15%) to help buffer production risk, with extra produce sold at a secondary market. For this reason, the number of

Table 5. Crop Production Costs Required for 225 CSA Members

Crop	Pounds per Member	Total Pounds for 225 Members	Average Yield (lbs/row foot)	Acres Grown	Crop Production Costs
Beans, Green	9	2,025	0.4	0.2	$2,511
Beets	14	3,150	1.2	0.1	$1,271
Broccoli	16	3,600	1.9	0.3	$2,874
Brussels Sprouts	4	900	2.6	0.1	$1,238
Cabbage	14	3,150	3.3	0.1	$1,106
Carrots	15	3,375	4.0	0.3	$3,072
Cauliflower	5	1,125	4.7	0.1	$1,010
Chard, Swiss	4	900	5.4	0.0	$614
Corn, Sweet	18	4,050	6.1	0.4	$2,527
Cucumbers	14	3,150	6.9	0.1	$2,434
Eggplant	8	1,800	7.6	0.1	$1,414
Garlic	4	900	8.3	0.3	$4,483
Greens, Kale/Collards	10	2,250	9.0	0.1	$2,713
Greens, Salad	14	3,150	9.7	0.4	$5,545
Herbs, Summer Annual	5	1,125	10.4	0.1	$790
Kohlrabi	10	2,250	11.1	0.1	$1,393
Leeks	3	675	11.8	0.1	$2,039
Lettuce, Head	12	2,700	12.5	0.1	$1,097
Muskmelon (Cantaloupe)	16	3,600	13.3	0.2	$3,130
Onions, Bulb	18	4,050	14.0	0.2	$2,892
Peppers	18	4,050	14.7	0.2	$3,292
Potatoes	18	4,050	15.4	0.3	$5,503
Potatoes, Sweet	12	2,700	16.1	0.1	$1,350
Roots, Radish/Turnip	10	2,250	16.8	0.2	$1,465
Scallions	4	900	17.5	0.1	$2,228
Squash, Summer	25	5,625	18.2	0.2	$4,277
Squash, Winter	35	7,875	18.9	0.4	$5,401
Tomatoes	35	7,875	19.7	0.2	$5,255
Watermelon	20	4,500	20.4	0.1	$866
You-Pick	10	2,250	21.1	0.1	$1,136
TOTAL	**400**	**90,000**		**5.5**	**$74,926**

acres grown, 5.5, is the number of acres required if all crop yields were perfectly average with no leftover first-quality produce. Although CSA customers are willing to assume risk by not being guaranteed a certain share quantity, a CSA farmer would typically grow greater than the amount they expect to deliver to help buffer production risk. Each farmer must choose how much extra production is appropriate for their secondary markets to absorb and how much risk they will share with their CSA members. In 2015, the UK-CSA grew 6.25 acres to support a 225-member CSA, donating extra produce to a local gleaning non-profit organization. The whole farm analysis presented in this document does not include the costs for this extra 10-15% production buffer because this economic analysis is solely based on the CSA market and does not include potential income and expenses associated with secondary markets.

Crop Production Labor Costs for 225 CSA Members. Within the $74,926 from Table 5 required for crop production, labor costs account for $43,125. This figure represents all field work, harvest, and post-harvest handling activities contributed by staff, student apprentices and the farm manager and was derived from the following worksheet:

► **UK-CSA Whole Farm Analysis workbook, Organic Crop Enterprise Budget Summary worksheet**

Wages are set at $11/hr. and assigned to all labor hours, regardless if a staff member or a student apprentice performed the task. In addition, one assistant manager's wages are set at $13/hr. Composite hourly cost for all workers that assumes a 4:1 ratio per hour of staff/students to assistant manager or farm manager and includes worker's compensation and employee taxes is $13.19/hr. These calculations are located in the following worksheet:

► **UK-CSA Crop Budget Workbook, Budget Worksheet 2: Field Activity Labor and Machinery Costs per Third Acre worksheet, Table 1: Labor Costs per Hour**

An estimation of monthly time spent by the farm manager and all staff/students on crop production versus overhead tasks was assumed based upon the manager's experience. A table showing farm manager and staff/student labor hours by month are located on the following worksheet:

► **UK-CSA Whole Farm Analysis, Overhead Costs worksheet, Table 8: Farm Manager and Staff Labor Hours**

The farm manager's yearly crop production hours total 690, or 30% of their total labor, and are accounted at the same $13.19/hr. rate, since any staff/student could replace the farm manager for those tasks. Therefore, $9,103 (690 hrs at $13.19/hr.) of the $43,125 in crop production labor is attributed to the farm manager and the remaining $34,023 is attributed to staff/student labor. Return to management, as shown in Table 7, includes $9,103 for completing crop production activities as well as a return to the farm manager for implementing administrative and management duties.

Table 6. Overhead Costs for 225 CSA Members

Non-Labor Overhead		
Land rent		$1,500
Electricity		$3,621
Insurance		$1,700
Infrastructure and other equipment costs		$6,938
Field hand-tools and packing shed supplies		$416
CSA delivery costs		$308
Web hosting fee		$540
CSA member management software fee		$3,000
Credit card processing fee		$3,000
Organic certification		$150
Marketing and office supplies		$573
Other supplies		$1,000
	Subtotal	*$22,746*
Labor Overhead		
Staff: CSA delivery		$4,226
Staff: other		$25,395
Farm manager: administrative and management		$20,958
	Subtotal	*$50,579*
TOTAL OVERHEAD COSTS		**$73,324**

Non-Crop Production Labor Costs for 225 CSA Members. All overhead cost calculations are located in the following worksheet:

► **UK-CSA Whole Farm Analysis, Overhead Costs worksheet**

Non-labor overhead costs in Table 6 include all farm operating expenses such as land rent, utilities, building infrastructure, marketing, software, and organic certification that are not directly associated with crop production. Even though the UK-CSA does not pay for overhead costs such as land rent or electricity, all potential overhead costs are included to provide a more realistic understanding of typical overhead costs on a commercial farm.

Land rent covers 10 acres of rented land at a cost of $150/acre to cover both cultivated acres and land for greenhouses and infrastructure. Insurance costs consist of a general farm liability policy as well as insurance on vehicles. The infrastructure and other equipment costs totaling $6,938 are annualized costs of building maintenance, post-harvest handling equipment, harvest bins, vehicles, irrigation pump, etc. based on expected years of use on each item. The field hand-tools and packing shed supplies category is a sum of small tools, harvest knives, scales, etc. annualized over 15 years for a total of $416/yr. Delivery material costs, $308, include the tables, tents, and signs annualized over three years. A web hosting fee is set at $45/month. CSA member management software and credit card processing fees are set at ~2% of gross sales each based on UK-CSA expense records. Organic certification in Kentucky in 2015 costs $150/yr. Marketing and office supplies include advertisements, the cost to print fliers, and paper, pens, printer-ink, etc. and were estimated at $573/yr. Any small hand-tool replacements or additional supplies is covered in the final non-labor overhead cost line item of $1,000. Non-labor overhead costs total $22,746.

Labor Overhead Costs for 225 CSA Members. Labor overhead shown in Table 6 includes CSA delivery and overhead hours of staff/students workers and all administrative and management tasks performed by the farm manager. CSA delivery labor costs are calculated separately and total $4,226 for the year. The total number of hours worked by four staff/students and one assistant manager during an entire year is 4,824, a majority of those hours logged during the months of May-October. A table showing these hours by month can be viewed on the following worksheet:

► **UK-CSA Whole Farm Analysis, Overhead Costs worksheet, Table 8: Farm Manager and Staff Labor Hours**

These hours represent a split of 53% crop production (2,579 hrs.), 40% overhead (1,925 hrs.), and 7% CSA Delivery (320 hrs.) for a total staff/student overhead and CSA delivery labor cost of $29,620. This cost is associated with CSA delivery, mowing grass roadways, washing harvest bins, chores, twice daily crew meetings, and transitional hours moving from one task to another. Return to management for administrative and management activities is estimated from Table 7, and totals $20,958 when crop production costs of the farm manager ($9,103) are subtracted from a total return to management ($30,061).

The return to management of $30,061/yr is under the assumption of 400 lbs received per CSA member over the 22 week season at a price of $650/member. If the farm manager's crop production hours are valued at $13.19/hr. for a total of $9,103, all other administrative and management hours would be valued at $14.07/hr. to total $20,958. This represents the return to administrative and management tasks associated with crop planning, budgeting and book-keeping, ordering supplies, marketing, managing CSA member communication and payments, writing a newsletter, monitoring and responding to emails, payroll, scouting for pests, developing task lists for field workers, maintaining equipment, and managing staff needs.

Table 7. Whole Farm Budget for 225 CSA Members

Cultivated Acres	5.5	
CSA Shares Sold	225	
REVENUE		
CSA Income @ $650/Share	$146,250	
80 25-lb tomato boxes sold at $25/box as a CSA add-on	$2,000	
Total Revenue	**$148,250**	
Total Revenue/Acre	*$26,808*	
EXPENSES	**Total Cost**	**% of Total**
Wages for 5 Staff/Students (4824 hrs. @ $13.19/hr.)		
Crop production	$34,023	28.8%
Labor Overhead (CSA delivery and other non-crop tasks)	$29,620	25.1%
Subtotal	*$63,643*	*53.9%*
Crop Production and Harvest/Packing Inputs		
Vegetable seed	$4,385	3.7%
Transplant production costs	$2,183	1.8%
Compost	$1,935	1.6%
Fertilizer	$2,965	2.5%
Plastic mulch	$492	0.4%
Drip tape	$1,460	1.2%
Cover crop seed	$994	0.8%
Pesticides/Fungicides	$1,222	1.0%
Irrigation supplies	$543	0.5%
Other crop management inputs	$2,236	1.9%
Harvest & Post-Harvest Supplies	$1,267	0.4%
Subtotal	*$19,683*	*16.7%*
Machinery		
Variable	$4,131	3.5%
Fixed (assumes shared ownership costs on 10 cultivated acres)	$7,987	6.8%
Subtotal	*$12,117*	*10.3%*
Non-Labor Overhead (land rent, utilities, building infrastructure, marketing, software, and organic certification)	$22,746	19.1%
Total Expenses	**$118,189**	**100.0%**
Total Expenses/Acre	*$21,372*	
RETURN TO MANAGEMENT		
Return To Management	**$30,061**	
Return to Management/Acre	$5,436	

Whole Farm Budget for 225 CSA Members

Table 7 depicts a whole farm budget with revenue, expenses, and return to management expected for a traditional 22-week full-share CSA market at a scale of 225 CSA members. Revenue reflects a CSA share price of $650/member plus $2,000 earned from selling extra bulk tomato boxes to shareholders for a total revenue of $148,250 or $26,808/acre. The crop production costs from Table 5, assuming a CSA share size of 400 pounds, were combined with overhead costs from Table 6, assuming 5.5 acres in

Table 8. Return to Management at 225 CSA Members

CSA Share Size Per Year	Acres In Production	Break-Even CSA Share Price Per Member[1]	CSA Share Price Charged and Return To Management		
			$625/ member	$650/ member	$675/ member
350 lbs	4.8	$476	$33,523/yr.	$39,148/yr.	$44,773/yr.
400 lbs	5.5	$516	$24,436/yr.	$30,061/yr.	$35,686/yr.
450 lbs	6.2	$557	$15,349/yr.	$20,974/yr.	$26,599/yr.

[1] Break-even CSA share price per member will cover all crop production costs and overhead costs but not a return to management.

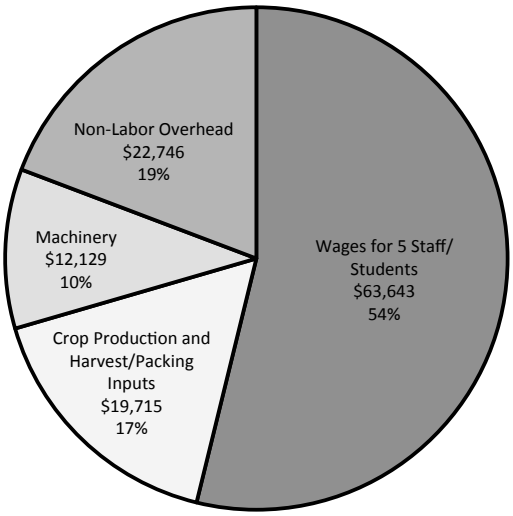

Figure 19. Expense categories for 225 CSA members.

production, to approximate total expenses of $118,189 or $21,372/acre. Return to management is $30,061 or $5,436/acre.

Figure 19 depicts the expense categories from Table 7. This graphic clearly shows that staff/student labor at $63,643 is the biggest expense at 54%. Non-labor overhead costs are $22,746 or 19% of total expenses. Crop production and harvest/packing input costs are $19,683 and account for 17% of expenses, and machinery costs are $12,117 and account for 10% of expenses.

The whole farm budget for 225 CSA members provides some important economic benchmarking numbers for mechanized organic vegetable farms selling through a CSA market at a similar scale of approximately 5.5 acres:

- A gross income of $26,808/acre is possible from a CSA market channel when charging $650/CSA member.
- On 5.5 production acres when giving out 400 lbs per member, total expenses are $21,372/acre and return to management is $5,436/acre.

In this analysis, the farm manager receives the return after all wages for staff/students, crop production and harvest/packing inputs, machinery, and non-labor overhead are covered. Table 8 shows different scenarios of how CSA share size and CSA share price charged affect break-even CSA share price per member and return to management at 225 CSA members.

Break-even CSA share price per member reflects the minimum share price required to cover all expenses but does not include a return to management. For each CSA share size, the greater CSA share price charged will result in a larger return to management. Similarly, for each CSA share price charged, the return to management decreases with increasing CSA share size.

Discussion

Break-Even Analysis

The whole farm budget of 225 CSA members shows that the UK-CSA organic vegetable production system is capable of covering all costs on 5.5 acres when giving out 400 lbs of produce per member and charging a CSA share price of at least $516/member with no return to management. A CSA share price of $650/member ensures a return to management of $30,061/yr. or $5,436/acre. Return to management would change under different CSA share sizes and prices. If both the CSA share size changed to 450 lbs/yr. and the CSA share price changed to $625/member, return to management would be $15,349/yr.; if the CSA share size changed to 350 lbs/yr. and the CSA share price changed to $675/member, return to management would be $44,773 (Table 8).

The ability to use the data in a whole farm analysis to plan CSA share price is extremely useful to ensure farm profitability. Crop production costs when coupled with an understanding of total overhead costs and average yield per row foot provide the tools to understand how CSA member number, CSA share size and price affect farm returns. Bruch and Ernst (2010) call this technique of CSA share pricing 'Cost-Plus Pricing' and also suggest that farms selling through CSA markets consider 'Competition Pricing' (what are other comparable farms charging?) and 'Customer-Based Pricing' (what are customers willing to spend?).

The analysis of a 5.5 acre farm with a farm manager receiving $30,061/yr. in returns from a CSA market with nothing left to invest into the farm business is not a very desirable reality. It is more likely that a farm business with a similar machinery mix would be scaled-up to spread equipment costs across more production acres, sell through multiple market channels, provide a greater return for the farm manager and accrue greater total farm returns to invest in farm business improvements.

Machinery Cost Analysis

One of the main hypotheses of the authors before completing this analysis was that the machinery used by the UK-CSA would be prohibitively expensive to own at 5.5 production acres. It was therefore assumed that all field machinery ownership (fixed) costs would be shared across 10 production acres. Under this assumption, Table 7 shows that income from a CSA on 5.5 acres covers $7,987 of field machinery ownership costs and also $4,131 in variable machinery operating costs, a combined 10% of total CSA expenses. Alternatively, if all field machinery ownership costs were covered under the CSA market on 5.5 acres and not shared across 10 production acres, total field machinery ownership costs would be $14,521 resulting in total farm expenses of $124,422, a higher break-even share price of $544, and a lower return to management of $23,828/yr. or $4,309/acre. Therefore, even though start-up machinery costs of $326,056 (Table 2) seem prohibitive, this analysis concludes that a mechanized organic vegetable farm selling through a CSA market could afford to own and operate the set of machinery and tools listed in Table 2 when purchase costs and depreciation are spread over the lifetime of each piece of equipment, whether or not fixed machinery costs were shared across 10 production acres or only 5.5 production acres. This claim does not take into account many variables that make investing $326,056 into equipment to manage 5.5 acres of production a suboptimal scenario. Some of those variables include capital buying power, interest rates, credit worthiness, customer willingness to spend $650/share, and farmer ability to earn as little as $30,061/yr. from CSA market returns.

Again, it is critical to note that the UK-CSA has built its production system with equipment that demonstrates efficiencies on farm scales beyond 5.5 acres. Particular machinery costs per hour would decrease with increasing farm size as the cost to own the machine would be spread over more hours of use and provide more opportunities for income. A farm business that was as mechanized as the UK-CSA might find the amount of machinery ownership at 5.5 acres difficult to justify at such tight margins and it would be recommended to operate at a larger scale. For this reason, the organic crop enterprise budgets and the whole farm analysis spread the ownership costs of all machinery over 10 production acres while analyzing the returns for a single market channel on a little over half of this acreage.

Diverse Market Income

If a farm did operate on 10 acres in production, with 5.5 dedicated to CSA production, secondary markets might include farmer's markets, direct-to-restaurant, wholesale, or extended season sales. In 2015, the UK-CSA grew 6.25 acres for 225 CSA members, with any extra produce from high yielding crops donated to a local non-profit gleaning organization or sold through a farm stand; in addition, 2 acres of produce were sold wholesale through a local distributor for use in UK dining halls. Any additional income from secondary markets would recover costs for growing a 10-15% production buffer for the CSA market and could potentially boost total farm returns and farm manager income.

Conclusion

The economic analysis of the UK-CSA organic vegetable production system demonstrates that a mechanized organic vegetable farm marketing through a CSA may be a profitable business model for produce farmers. The results provide economic benchmarking data for similar mechanized farms; a gross income of $26,808/acre is expected from a CSA market when charging $650/member. Expenses are estimated at $21,372/acre when the CSA share size is 400 lbs/member. Return to management can be approximated at $5,436/acre.

The organic crop enterprise budgets set benchmark crop production costs for thirty crops commonly grown on the UK-CSA farm; the average cost of production for all thirty crops is $13,697/acre. In addition, by comparing production cost per pound of harvested crop yield across all crops, attention can be directed toward reducing production costs or increasing yield for the most costly to produce crops. Other mechanized organic vegetable farms selling through CSA markets can view these budgets to compare their production system costs to the UK-CSA system. Understanding costs of production for each unique farming system assists in setting appropriate CSA share sizes and prices.

The whole farm analysis combines the crop production costs and overhead costs for a scale of 225 CSA members. The results confirm that a mechanized organic vegetable farm selling through a CSA market and operating with similar equipment to the UK-CSA could cover all costs at approximately 5.5 acres and 225 members if charging a break-even CSA share price of at least $516/member and sharing ownership costs of equipment across 10 production acres. When charging $650/member, the farm manager could earn $30,061/yr. in returns from the CSA market.

The results from this economic analysis will help existing farmers evaluate their own farm costs, leading to a more complete understanding of scale, size, price, and economic sustainability.

Further research is needed to make this information more relevant, useful, and detailed for other farmers. Using labor data from skilled workers instead of a mix of staff and unskilled student laborers would provide more accurate labor data. In addition, although crop production labor hour data was highly detailed and comprehensive, overhead hours were assumed loosely based on the manager's expertise and could be improved. The CSA share prices that each farmer is able to charge are highly dependent on perceived market value by the CSA member, a factor not discussed in this report. Any farm operating a 225 member CSA will most likely have secondary markets, and a whole farm analysis that includes these production costs and potential income would provide a more complete picture of total farm expenses and returns. Finally, a whole farm planning model could be developed to estimate the maximum net return possible when operating within various constraints of the UK-CSA organic vegetable production system, including yield, equipment, labor, weather and crop mix; this model would contribute to the understanding of matching appropriate scale with equipment, labor, and CSA share size and price for a maximum total farm return potential.

Appendix

UK-CSA Crop Budget Workbook

http://www.uky.edu/ccd/sites/www.uky.edu.ccd/files/UK-CSA%20Crop%20Budget%20Workbook.xlsx

A Microsoft Excel file in which the crop budgets were formed through data and calculations within seven budget worksheets. Seven budget worksheets, thirty organic crop enterprise budgets, and two summary worksheets are included in this document. The summary worksheets allow for total and detailed crop production costs comparisons across all thirty crops.

UK-CSA Whole Farm Analysis

http://www.uky.edu/ccd/sites/www.uky.edu.ccd/files/UK-CSA%20Whole%20Farm%20Analysis%20.xlsx

A Microsoft Excel file in which UK-CSA production costs are analyzed at a scale of 225 CSA members. Included are eight worksheets that calculate and explain how crop production and overhead costs are applied to a 225 CSA member market.

References

Bruch, Megan, Matthew Ernst. 2010. A Farmer's Guide to Marketing through Community Supported Agriculture (CSAs). University of Tennessee Extension. https://extension.tennessee.edu/publications/Documents/PB1797.pdf

Center for Integrated Agriculture Systems (CIAS). 2001. CSA: more for your money than fresh vegetables. College of Agricultural and Life Sciences: University of Wisconsin, Madison, WI. Research Brief #52. http://www.cias.wisc.edu/csa-more-for-your-money-than-fresh-vegetables/

Ehmke, Cole (Editor). 2013. Rural Guide to Community Supported Agriculture. The University of Wyoming Extension, Department of Agricultural and Applied Economics, College of Agriculture and Natural Resources. http://wyomingextension.org/agpubs/pubs/B1251.pdf

Hendrickson, John. 2005. Grower to Grower: Creating a livelihood on a fresh market vegetable farm. Center for Integrated Agricultural Systems (CIAS), College of Agricultural and Life Sciences: University of Wisconsin, Madison, WI. http://www.cias.wisc.edu/wp-content/uploads/2008/07/grwr2grwr.pdf

Polimeni, John M., Raluca Iorgulescu Polimeni, Richard L. Shirey, Christina L. Trees, W. Scott Trees. 2006. "The Demand for Community Supported Agriculture." Journal of Business & Economics Research 4(2): 49-60.

USDA. 2014. 2012 Census of Agriculture, Selected Practices, Table 43. https://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_US_State_Level/st99_2_043_043.pdf

Wiswall, Richard. 2009. The Organic Farmer's Business Handbook. Chelsea Green Publishing, White Rive Junction, Vermont.

Woods, Tim, Matthew Ernst, Debra Tropp. 2017. Community Supported Agriculture: New Models for Changing Markets. U.S. Department of Agriculture, Agricultural Marketing Service.

University of Kentucky
College of Agriculture, Food and Environment

Issued 7-2017