TRENDS AND ECONOMICS OF WASHINGTON STATE ORGANIC VEGETABLE PRODUCTION

Trends in Washington Organic Crop Production Series

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TRENDS AND ECONOMICS OF WASHINGTON STATE ORGANIC VEGETABLE PRODUCTION

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Abstract

Washington State is a leading producer of organic vegetables in the U.S. -- specifically for sweet corn, green peas, snap beans, potatoes, onions, and carrots. In this publication, prospective and current growers will find recent data on acreage, production, and value to help them assess entry into, or expansion of, organic vegetable production for these types of vegetables.

Trends and Economics of Washington State Organic Vegetable Production

Summary

Washington State is a leading producer of organic vegetables in the United States, and recent data on acreage, production, and value are presented to help growers and other industry personnel in their business decisions. Washington WSDA-certified organic producers reported a gross farmgate value for organic vegetables of $43.2 million for the 2012 sales year, compared to $34.3 million for 2009. Vegetables accounted for 15% to 20% of total organic crop value, not including livestock or poultry products. From 2009 to 2013, organic vegetable acreage ranged from about 12,000 to 16,326 acres, compared to a peak of 20,000 acres in 2007. Six crops accounted for more than 80% of the organic vegetable acreage and 60% of the value, including sweet corn, green peas, snap beans, potatoes, onions, and carrots. Eighty percent of the organic vegetable acreage is located in the irrigated agricultural regions east of the Cascade Range, primarily in the Columbia Basin. Average organic vegetable yields tended to be less than USDA-National Agricultural Statistics Service (NASS) average yields, while organic prices were typically higher than NASS reported prices. Maximum yields indicated that yield potentials are similar to conventional for all six crops. Nationally, Washington organic sweet corn and green beans ranked first in acreage, production, and value in 2011 and green peas ranked first for acreage (NASS 2012).

Introduction

Organic production is an important component of the Washington State vegetable industry; Washington leads in national organic sweet corn, green pea, and snap bean production (NASS 2012). Organic food sales, including vegetables, continue to increase and create opportunities for producers. The Organic Trade Association's 2014 Industry Survey (OTA 2014) reported a 15% annual growth in U.S. retail sales of organic produce during 2013, with fruits and vegetables representing 36% of all organic food sales. As retail sales continue to experience strong growth, supply of organic products remains tight.

This website summarizes recent **acreage**, **production,** and **value** and provides a baseline analysis of organic **yield, price,** and **gross revenue per acre** for the top six organic vegetables in Washington State. The publication is part of a series on select Washington organic specialty crops and is intended to assist industry supply forecasts, support producer decisions regarding entry into, or expansion of organic production, and help manage financial risk, especially important for crops where Washington production represents a significant portion of the national organic supply. Price and yield data are limited and difficult to find. The information provided in this study represents a significant addition to what is currently available publicly.

The six crops are presented together to make for a more convenient and useful presentation of data.

Specific information about acreage, trends, total crop value, and the like, can be found in the **Production and Sales Trends** section. See the **Profitability and Risk** section for a detailed analysis on profits and the risks involved.

Methods and Data Description

Data were provided by the Washington State Department of Agriculture (WSDA) Organic Food Program which includes approximately 95% of National Organic Program (NOP)-certified Washington producers. Four years (2009 to 2012) of acreage, production, and gross crop sales (farmgate, not including value added) were compiled and compared to similar USDA-National Agricultural Statistics Service (NASS) data for all farms. Additional acreage data were provided by other certifiers such as Oregon Tilth Certified Organic (OTCO). In some cases, data have been segregated by geography in the state, with "west" meaning west of the Cascade Range and "east" meaning east of the mountains.

All reported production was converted to weight, using industry standards found in the USDA Fruit and Vegetable Market News Users Guide (USDA-AMS 2012). To protect producer confidentiality, all observations were anonymous and values were reported only where a minimum of three producer observations were provided, and where no one producer accounted for 60% or more of total value annually. More detailed definitions and explanation of data calculations can be found online at: http://csanr.wsu.edu/data-and-calculations.

Production and Sales Trends

Vegetable production is an important component of Washington State's organic industry. Organic vegetable producers are located across the state and have highly diverse operations, typically producing multiple types of vegetables. A typical rotation on an irrigated Columbia Basin farm could include green peas, sweet corn, potatoes, field corn, onions, vegetable seed or grains, and alfalfa. Organic production occurs on both small and large farms. Small scale vegetable producers grow primarily for fresh market. Larger scale producers may grow for both processing and fresh market. Large operations with organic production often have parallel conventional production.

The fraction of Washington organic acres devoted to vegetables has ranged from 25% (2005 to 2007) to 13% in 2010. In 2013, vegetable acreage comprised 20% of the certified organic acres, compared to tree fruit (22%), and forage (34%). Washington organic vegetable acreage experienced strong growth from 2005 to 2007; acreage increased 82%, to more than 20,000 acres. Producers adjusted acreage downward from 2008 to 2010, followed by a steady increase in plantings to 16,326 acres in 2013. Six crops, including sweet corn, green peas, snap beans, potatoes, onions, and carrots, accounted for 85% of all Washington organic vegetable acreage. Sweet corn and peas were the most widely planted organic vegetables (60% of the organic vegetable acreage), but accounted for less than 30% of the average value (Figure 1, Table 1).

Vegetables earned 15% to 20% of Washington's total organic gross farmgate value for crops (not including livestock/poultry products or value-added products) reported by WSDA-certified producers from 2009 to 2012. Vegetables ranked second after tree fruit, which had 60% of the state's total organic crop value.

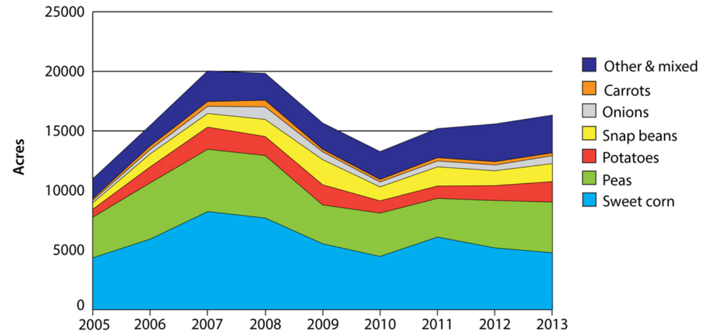

Figure 1. Washington State certified organic vegetable acreage, 2005-2013.

Producers reported an average yearly gross farmgate value for organic vegetables of $37 million for the 2009 to 2012 period (Table 1). Annual sales ranged from $34.3 million for 2009 compared to $43.2 million for the 2012 sales year.

The organic sector remains a relatively small portion of the Washington vegetable industry, with an estimated 5% of all Washington vegetable acreage, value, and production. Organic snap beans accounted for 23% of all snap bean acres in the state, while green peas had the highest average organic share of sales value (14%) and quantity of production (8%). Organic potatoes had just 1% of total Washington potato acreage, value, and production.

WSDA certified 300 unique Washington producers with organic acreage segregated as "vegetables" during the 2009 to 2012 period; about 35% of all certified producers in any given year grew vegetables. The annual number of WSDA-certified vegetable producers during this period ranged from 203 to 226 (Table 2). The annual producer number varied as growers entered or exited organic vegetable production, or made adjustments in crop rotation, or crop choice. Other NOP-certifiers reported a few additional Washington organic vegetable producers.

Table 1. Top six Washington organic vegetable crops: acreage, farmgate value, and organic share (4-year average, 2009-2012).

	4-Year Average (2009-2012)							
	Organic acres	% of organic veg acres	Sales year value ($mill)[a]	% of organic veg. sales	Value[b]	Organic share of state crop (%)		
Vegetables	14,636	100%	36.97	100	Rank	Acreage	Value	Production
Sweet Corn	5,315	36.3%	6.41	17.3	5	6	4	4
Peas, Green	3,527	24.1%	3.55	9.6	11	10	14	8
Beans, Snap	1,531	10.5%	(d)	(d)	16	23	—	—
Potato	1,257	8.6%	4.86	13.1	7	1	1	1
Onion	510	3.5%	3.87	10.5	10	2	3	2
Carrot	246	1.7%	1.82	4.9	17	9	—	6
Top 6	12,386	84.6%	22.56	61.0	—	—	—	—

[a]Based on WSDA-certified Washington producers; [b]Value relative to all Washington organic crops; excludes organic carrot seed production (1-150 ac/yr).

Based on producer data, 56% of the organic vegetable producers were located west of the Cascade Range; however 80% of the acres were in the irrigated region east of the Cascades, primarily in the Columbia Basin. Organic vegetable acreage ranged from less than 0.01 acre to more than 2,000 acres per producer. In 2012, 60% of organic vegetable producers had 5 or fewer vegetable acres, with a similar number of these producers located on the west and east sides of the state. Another 24% of producers had 5 to 50 vegetable acres, with two-thirds of those growers located in the west. Just 10% of organic vegetable producers had more than 100 acres of vegetables; 70% of these were located in the Columbia Basin (Figure 2). The 4-year (2009 to 2012) producer average for organic vegetable acreage was 69 acres, statewide. As expected, producers on the east side had a higher average of 129 acres, compared to 21 acres on the west side. Interestingly, the statewide median organic vegetable acreage was 3.5 acres (i.e. half of all Washington organic producers had more than 3.5 acres, and half had less than 3.5 acres) and was similar for both regions (Table 2).

Producer characteristics varied by geography and crop among the top six organic vegetables. The average and median acreages for the top six organic vegetables were larger for east side production regions in all cases (Table 2).

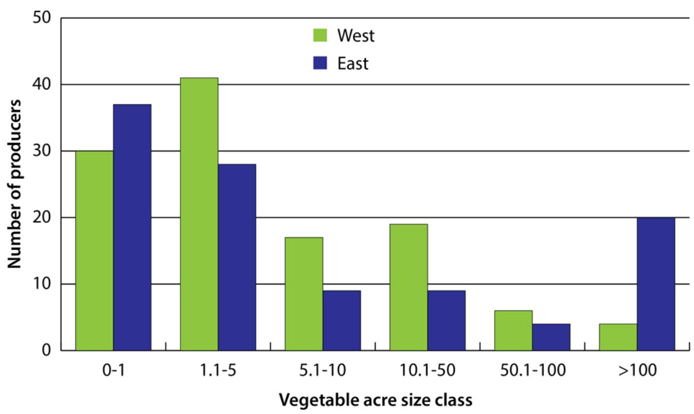

Figure 2. Washington State organic vegetable acres per farm, 2012.

The number of producers varied for different crops. For example, WSDA reported organic acreage for 24 different carrot growers from 2009 to 2012, compared to 66 potato producers, statewide. The annual number of producers reporting carrot acreage ranged from 10 to 15, while 13 to 18 producers reported sales and/or production data. The difference in the annual number of producers reporting acreage versus sales or production occurred because a portion of growers with certified organic vegetable acreage did not report annual sales or production data segregated by crop. Also, a few producers with acreage certified as "mixed vegetable" or "mixed horticulture" reported sales or production information segregated by crop (i.e. a producer with acreage certified as "mixed vegetable" reported sales individually for carrot, potato, and peas).

Details on individual crops are presented below, with additional data in Appendix 3.

Sweet Corn

Washington State leads the nation in sweet corn production, with the greatest amount used for processing (frozen), and less than 15% for fresh market. Washington ranked first in U.S. organic sweet corn acreage, production, and value in 2011 (NASS 2012). Acreage, production, and value for all sweet corn and organic sweet corn are presented in Table 3. NASS values include both conventional and organic; these categories are not segregated in the NASS data (NASS 2013b; 2013c).

The number of growers listing annual sweet corn sales and/or production data ranged from 19 to 28 (Table 2). Additional producers likely reported small areas of organic sweet corn as "mixed vegetables." In 2009, 39 producers had organic sweet corn acreage, compared to 26 producers in 2012. There were 28 producers with organic sweet corn in 2009 that did not show sweet corn acreage in 2012; 14 producers with acreage in 2012 did not have certified sweet corn acreage in 2009.

Table 2. Number of Washington organic vegetable producers and average and median producer acreage, 2009-2012.

	No. of producers			4-year average and median producer acreage (2009-2012)					
				State (ac)		East (ac)		West (ac)	
	Total No.	Annual range	Sales/ yield data range	Avg.	Median	Avg.	Median	Avg.	Median
All Vegetables[a]	300	203-226	163-179	69	3.5	129	3.1	21.3	3.8
Sweet Corn	60	19-28	17-26	182	12	269	125	8	1.9
Peas, Green	37	15-20	17-20	202	65	300	135	0.6	0.3
Beans, Snap	28	12-15	10-18	113	2	147	86	97	0.5
Potato	66	30-35	24-31	40	2	50	50	12	1.0
Onion	33	14-20	14-18	31	1.5	50	24	0.7	1.5
Carrot	24	10-15	13-18	22	4	50	50	5	0.5

[a]In addition to the six vegetables listed here, the "All Vegetables" category from WSDA includes growers with other individual vegetables, as well as farms with acreage listed as "mixed vegetables."

Table 3. Washington sweet corn acreage, production and value, 2009-2012.

	Organic[a]				NASS-WA[b] (Processed + Fresh)			
Aggregate Total	2009	2010	2011	2012	2009	2010	2011	2012
WA Acres[c]	5,528	4,462	6,091	5,178	93,200	79,100	84,300	97,000
Reported Acres[d]	3,790	4,273	5,638	5,325	—	—	—	—
Production (ton)	39,644	32,423	43,145	36,194	955,110	777,780	877,200	944,230
Crop Yr Value ($mill)[e]	5.95	5.24	8.77	>5.06	173.45	146.65	163.68	155.26
Sales Yr Value ($mill)	5.70	5.43	7.42	7.09	—	—	—	—

[a]Organic includes fresh and processed; [b]NASS values are for both conventional and organic Washington sweet corn; [c]includes acreage from WSDA site acreage data and acreage from any additional certifiers (Kirby and Granatstein 2014); [d]includes acreage compiled from WSDA-certified producer organic income and production data; [e]"Crop year" value represents sales from a crop harvested in a specific year that may be sold over multiple years; "sales year" value is the total sales of a crop in a specific calendar year, regardless of the year of harvest; value of the 2012 crop year incomplete due to sales being made and reported over multiple years.

Washington organic sweet corn acreage is concentrated in Grant and Franklin counties; 70% of the producers and 98% of the acres, production, and value were located in the Columbia Basin from 2009 to 2012. Sweet corn producer acreage ranged from less than 1 acre to more than 1,000 acres. An estimated 55% of the producers had 10 or fewer acres of organic sweet corn; a similar number of these producers were located in the eastern and western regions of the state (data not shown). Over 90% of the 29 farms with 10 or more acres of organic sweet corn were located in the Columbia Basin, where the 4-year average acreage was 269 acres (median of 125 acres). West side producers typically had smaller acreages with a 4-year average of 8 acres and a median of 1.9 acres (Table 2).

Average yield, price, and gross revenue per acre were calculated for organic sweet corn from WSDA grower data and compared to NASS values for all Washington sweet corn from 2009 to 2012 (yield) and from 2009 to 2011 (price and gross revenue). Table 4a shows the organic market average yield (MAY), market average price (MAP), and gross revenue per acre (MAR) compared to Washington NASS (2013b; 2013c) values for all sweet corn. The organic data are a composite of fresh and processed values. Table 4b shows the organic grower average values for yield (GAY), grower average price (GAP), and gross revenue per acre (GAR), along with some basic statistics. The differences between market average and grower average are discussed in the Data and Calculations web page.

Washington sweet corn yields vary widely by type of sweet corn, variety, and planting date. Typical conventional sweet corn yields in the Columbia Basin range from 7.5 ton/ac for fresh corn to 10.75 ton/ac for processing corn. Organic market average yields (MAY) for pooled fresh and processed sweet corn were below NASS yield values, except in 2009. Organic MAY ranged from 10% above to 20% lower than NASS values.

There is also a large price differential between sweet corn sold fresh and that sold to a processor. During 2009 to 2012, Washington NASS fresh sweet corn prices ranged from $660 to $776 per ton versus $80 to $113 per ton for processor prices (Table 4a).

Organic market average prices (MAP) ranged from $117 to $201 per ton, indicating that, similar to conventional corn, most of the organic corn is grown for processing. Organic market average gross revenues (MAR) were similar for organic compared to NASS revenue for processed corn; higher prices received for organic apparently offset reduced yields. Processing prices in general can be lower than fresh market due to contract clauses where some processors pay for certain production expenses (e.g., seed, pesticides, and/or harvest and hauling); this can vary by processor.

The unweighted organic grower average yield (GAY), price (GAP) and gross revenue (GAR) values help to estimate what an "average" grower might expect. Organic GAY values (5.1 tons/ac over four years) were well below MAY and NASS values, which averaged 8.4 and 10.2 tons/ac, respectively, and indicated that a significant number of smaller producers had lower yields than the larger producers. Only 30% of the organic GAY observations were at, or exceeded 7.5 ton/ac; an estimated 20% of organic producers achieved that level. However, GAYs observed in the 9 to 10 ton/ac range indicated that organic yield potential, assuming a high level of management, can be comparable to NASS average yields. Just 6% of producers reported yields in this range. Sweet corn yields vary with use, with fresh yields lower than processing, and also with variety.

Organic GAP and GAR values were well above market prices for processing sweet corn. Part of this may be explained by producers receiving higher prices for fresh corn, as well as direct marketing. However, it is the cost of organic production, in addition to price and yield, which determines potential profitability of growing organic sweet corn. A recent Willamette Valley, Oregon enterprise budget calculated a break-even price for organic processing sweet corn at $131 per ton, assuming a 7 ton/ac yield (Julian et al. 2008a). Using prices indexed to 2011, an assumed 20% higher production cost for organic corn in the Columbia Basin, and the higher organic MAY of 8.4 ton/ac, an estimated breakeven price would be $148/ton (Appendix 2).

Table 4a. Washington sweet corn **market average** yield, price and gross revenue per acre, 2009-2012.

Market Average (MA)	Organic[a]				NASS-WA[b] Processed				NASS-WA[b] Fresh			
	2009	2010	2011	2012	2009	2010	2011	2012	2009	2010	2011	2012
Yield (ton/ac)	11.5	7.6	7.7	6.8	10.4	10.0	10.75	10.0	9.4	9.0	8.25	7.75
Price ($/ton)	117	161	203	—	109	80	109	113	750	776	820	660
Revenue ($/ac)	1,333	1,222	1,555	—	1,131	798	1,172	1,133	7,050	6,984	6,765	5,115

[a]Organic includes both fresh and processed; [b]NASS values are for all Washington sweet corn (conventional and organic).

Table 4b. Washington organic sweet corn **grower average** yield, price and gross revenue per acre, 2009-2012.

Grower Average (GA)	Organic[a]				Organic 3–4 YR			
	2009	2010	2011	2012	Mean	Median	S.D[b]	n[c]
Yield (ton/ac)	4.51	5.44	5.57	4.89	5.1	5.36	2.73	61
Price ($/ton)	418	371	554	—	456	207	457.7	50
Revenue ($/ac)	2,191	1,326	1,520	—	1,756	1,342	1,496	51

[a]Organic includes sweet corn for both fresh and processed markets; [b]S.D. = standard deviation; [c]n=number of observations.

Green Peas

Washington State ranked first in production of green peas in the United States for processing, while production of peas for the fresh market was minor (NASS 2013b; 2013c). Washington also led the nation in organic pea acreage, production, and value in 2011 (NASS 2012). Peas are often double-cropped with sweet corn and the majority of the production is located in the Columbia Basin. Acreage, production, and value for all green peas and organic green peas are presented in Table 5.

The annual number of growers listing green pea sales and/or production data ranged from 17 to 20 (Table 2). Ten producers reported acreage in at least three of the four years.

Similar to sweet corn, Washington organic pea acreage ranged from less than 1 acre per grower to more than 1,000 acres. During this period, 57% of the organic producers and 99% of the acres, production, and value were located in the Columbia Basin, concentrated in Grant and Benton counties. Organic pea acreage per farm was much larger in the Columbia Basin, than the west side (Table 2). Peas had the highest average and median acreages (per producer) of the organic vegetables studied.

Organic pea MAY values were an estimated 25% lower than NASS values over the four years, but included peas for both fresh and process markets. Washington fresh pea data are not available from NASS. GAY values were higher than MAY, reflecting some high yields reported by smaller scale, intensive growers (likely with multiple harvests, versus a single harvest for processor peas), but still averaged 19% below NASS (2013b; 2013c) values (Table 6a, 6b).

Possible reasons for the reduced yields include poor stands due to seedling diseases (lack of effective seed treatments) and severe weed competition. However, similar to sweet corn, producer data validated that it is possible for Washington growers to achieve organic pea yields comparable to conventional yields. An estimated 32% of the GAY observations were at, or above 5,800 lb/ac, the average NASS yield for 2009 to 2012.

During the same period, organic MAPs for pooled fresh and processed peas ranged from $0.20 to $0.25 per pound, nearly double NASS processing pea prices. As a result, organic MARs also exceeded NASS revenue values in all years, with higher prices offsetting yield reductions. Organic pea GAP values, ranging from $1.15 to $1.61, were substantially higher than both MAP and NASS averages, again indicating that a number of smaller growers received higher “value-added” type prices, likely for fresh and/or direct markets, in addition to premiums for organic.

WSDA data backed up this assumption with 57% of observations averaging $0.35/lb, most likely a processing price, while the remaining observations averaged just under $3/lb. Organic processing pea values were estimated as follows: 4,820 lb/ac (GAY), $0.24/lb (GAP), and $1,118/ac (GAR).

No organic enterprise budget was available for green peas. With an estimated 2011 production cost of $925/ac (indexed from Hinman et al. 2002), and conventional yield of 6,500 lb/ac, the breakeven price was $0.14/lb. Using indexed costs to 2011, an increased production cost for organic of 10%, and a lower yield of 5,000 lb/ac, breakeven price would be $0.20/lb (Appendix 2).

Table 5. Washington green pea acreage, production and value, 2009-2012.

Aggregate Total	Organic[a]				NASS-WA Processing[b]			
	2009	2010	2011	2012	2009	2010	2011	2012
WA Acres[c]	3,256	3,636	3,241	3,975	40,200	33,800	27,900	40,900
Reported Acres[d]	3,467	3,274	3,171	4,534	—	—	—	—
Production (lb x1000)	12,361	15,947	15,134	19,306	200,200	179,820	191,400	256,080
Crop Yr Value ($mill)	3.01	3.17	3.78	4.25	26.53	19.06	24.12	35.25

[a]Organic values include fresh and processed; [b]NASS values include all Washington peas for processing (conventional and organic); [c]includes acreage from WSDA site acreage data and acreage from any additional certifiers (Kirby and Granatstein 2014); [d]acreage compiled from WSDA-certified producer organic income and production data.

Table 6a. Washington green pea **market average** yield, price and gross revenue per acre, 2009-2012.

Market Average (MA)	Organic[a]				NASS-WA[b] Processing			
	2009	2010	2011	2012	2009	2010	2011	2012
Yield (lb/ac)	4,250	4,866	4,773	4,258	4,980	5,320	6,860	6,260
Price ($/lb)	0.22	0.20	0.25	0.22	0.13	0.11	0.13	0.14
Revenue ($/ac)	901	962	1,193	939	660	564	864	862

[a]Organic values include fresh and processed; [b]NASS values include all Washington peas for processing (conventional and organic).

Table 6b. Washington organic green pea **grower average** yield, price and gross revenue per acre, 2009-2012.

Grower Average (GA)	Organic[a]				Organic 4-Year			
	2009	2010	2011	2012	Mean	Median	S.D.[b]	n[c]
Yield (lb/ac)	3,854	4,286	5,107	4,730	4,524	4,596	2,343	51
Price ($/lb)	1.15	1.15	1.59	1.61	1.38	0.28	1.66	60
Revenue ($/ac)	3,660	2,946	4,572	5,583	4,190	1,997	7,069	52

[a]Organic values include both fresh and processed; [b]S.D. = standard deviation; [c]n=number of observations.

Snap Beans

The 2012 Census of Agriculture shows a 13% reduction in snap bean acreage in the United States from 2002 to 2012. In contrast, Washington snap bean acreage more than tripled during the same time period, from 1,613 acres to 5,297 harvested acres (about 2% of U.S. total). Over 70% of Washington snap bean acres are planted for the processing market (NASS 2014). NASS has not published annual Washington data for snap beans since 1989.

Washington organic production is a significant component of the state's snap bean industry and of the national organic snap bean sector. An estimated 23% of Washington snap bean acres are under organic management. Washington ranked first in U.S. organic acreage, production, and value (NASS 2010, 2012). Acreage and value peaked in 2009 (Table 7), while peak production occurred in 2011.

Twenty-eight unique Washington State organic producers reported acreage as snap bean (both WSDA and OTCO) over the 2009 to 2012 period (Table 2), with the number of growers listing sales and/or production data ranging from 10 to 18 annually.

Organic snap bean acreage is concentrated in Whatcom, Pierce, Benton, and Grant counties. In contrast to the other vegetables in this study, 61% of snap bean producers and 60% of snap bean acreage, production, and value were located on the west side of the state. It is difficult to characterize "typical" organic snap bean producers, particularly in the Columbia Basin, where 45% of the producers listed snap beans in only one of four years, and annual producer acreage was highly variable. Statewide, just seven producers listed snap beans in at least three of the four years. Half the producers had less than 1 acre in production, on average over the four years. Fewer than 10 growers dominated production during this period; eight producers had an average of 100 acres or more in the years they planted, and were located in both western Washington and the Columbia Basin. Similar to the other vegetables, the average and median acreages were still larger on the east side of the state (Table 2); 85% of the plantings of less than 1 acre were on the west side.

Washington organic snap bean MAY values were similar to NASS conventional yields in Washington reported for 1986 to 1989 (8,800 lb/ac), but 25% to 50% less than current NASS (2013b) yield values for Oregon (processing) and California (fresh) beans during this period (Table 8a).

Table 7. Washington snap bean acreage, production and value, 2009-2012.

Aggregate Total	Organic[a]				Ag Census[b]		
	2009	2010	2011	2012	2002	2007	2012
WA Acres[c]	2,107	1,169	1,602	1,247	1,613	3,346	5,297
Reported Acres[d]	1,486	(d)[e]	1,703	(d)	—	—	—
Production (lb)	13,130,263	(d)	13,855,140	(d)	—	—	—
Crop Yr Value ($mill)	3.04	(d)	2.67	(d)	—	—	—

[a]Organic values include both fresh and processed; [b]Ag Census values include all Washington snap bean (conventional and organic); [c]includes acreage from WSDA site acreage data and acreage from any additional certifiers (Kirby and Granatstein 2014); [d]acreage compiled from WSDA-certified producer organic income and production data; [e](d) data not disclosed to protect confidentiality.

Table 8a. Snap bean **market average** yield, price and gross revenue per acre, 2009-2012.

Market Average (MA)	Organic-WA[a]				NASS-OR[b] Processing				NASS-CA[b] Fresh
	2009	2010	2011	2012	2009	2010	2011	2012	2009-2012
Yield (lb/ac)	8,907	6,460	8,136	6,481	11,884	12,899	13,300	13,620	10,500-11,000
Price ($/lb)	0.23	0.20	0.19	0.24	0.11	0.09	0.11	0.11	0.65-0.67
Revenue ($/ac)	2,046	1,296	1,568	1,565	1,283	1,203	1,457	1,517	6,835-7,359

[a]Organic values include both fresh and processing; [b]NASS values not available for Washington.

Table 8b. Washington organic snap bean **grower average** yield, price and gross revenue per acre, 2009-2012.

Grower Average (GA)	Organic[a]				Organic 4-Year			
	2009	2010	2011	2012	Mean	Median	S.D.[b]	n[c]
Yield (lb/ac)	6,351	3,440	7,791	7,708	6,449	6,222	4,468	34
Price ($/lb)	1.08	1.13	1.75	2.04	1.58	1.49	1.15	47
Revenue ($/ac)	4,146	2,746	8,899	11,683	6,986	4,141	7,748	35

[a]Organic values include both fresh and processed; [b]S.D. = standard deviation; [c]n=number of observations.

It is not known what proportion of Washington organic snap beans go to processing or the fresh market. However, MAPs ranging from $0.19 to $0.24 indicate that a high percentage goes to processing. Organic MARs were similar to NASS values for Oregon processed beans but below California fresh beans.

Organic GAYs were also less than NASS values (Table 8b), but 25% of producers had organic yields in excess of 10,000 lb/ac in one or more crop years (data not shown). GAP and GAR values were high relative to market averages. This suggests that some growers are receiving very high prices for their produce, probably through fresh market direct sales; 25% of the growers received an average price at, or exceeding $2.00/lb, over the 4-year period.

A comparison of organic and conventional snap bean production for processing in the Willamette Valley, Oregon (Julian et al. 2008b; 2010b) found organic to have 31% lower cost of production, but 51% lower yield (6,000 lb/ac), resulting in a $211/ac loss with an assumed price of $0.15/lb. For Washington, using costs indexed to 2011, assuming organic costs the same as conventional, and organic MAY of 7,500 lb/ac, a breakeven price would be $0.15/lb (Appendix 2). A fresh market budget is not available, but the higher prices for this product would support higher production costs.

Potatoes

Potatoes are the leading vegetable crop in the United States and the fourth most important crop worldwide. Washington State produces about one-fifth of the U.S. total fall potatoes. Russets are the most widely planted variety, with over 85% of the total state acreage; 75% of Washington potato acres are planted for the processing market. Washington organic potatoes ranked fourth in U.S. organic potato acreage and third in production and value (NASS 2012; USDA-ERS 2013). Acreage, production, and value for all potatoes (NASS, 2013a) and organic potatoes are reported in Table 9.

WSDA reported acreage segregated as certified organic potatoes for 66 unique Washington producers from 2009 to 2012 (Table 2). The annual number of producers ranged from 30 to 35; 17 producers had acreage in at least three of the four years. Washington organic potato acreage is concentrated in Grant, Benton, Adams, and Franklin counties. Over the 4-year period, 42% of the producers and 83% of the state organic potato acreage were located in the Columbia Basin. The number of acres of organic potato plantings per farm was less than those for peas and sweet corn; ranging from less than 1 acre to more than 250 acres.

While 32% of potato producers had less than 1 acre, 23% of producers had an average of more than 50 acres of organic potatoes. East side producers tended to have larger areas of potatoes (Table 2). Half of the 36 organic potato producers in western Washington had 1 acre or less, while seven west side producers had plantings of 10 or more acres in one or more of the four years, including four producers with 40 acres or more (data not shown).

Organic MAY values were 30% to 35% lower than NASS values, averaging just over 400 cwt/ac (Table 10a). However, data also showed the potential for growers to achieve organic potato yields similar to conventional yields. Six producers had yields greater than 600 cwt/ac (data not shown).

While organic growers received MAPs 40% higher than NASS prices, revenue values were very similar; higher MAPs did not compensate for revenue lost to lower yields in all years. With estimated higher production costs (Appendix 2), many growers will need to boost yields and receive price premiums to reliably achieve profitability. Using 2010 costs for conventional Russet Burbank production (Taylor 2010), assuming a 550 cwt/ac yield, a breakeven cost was $8.02/cwt; assuming a 30% higher production cost for organic with the same yield, a breakeven cost would be $10.43/cwt.

GAYs were lower than both MAY and NASS yields. Larger east side potato growers achieved GAYs that were twice that of growers on the west side of the state. GAPs were six to eight times higher than MAPs, leading to GARs substantially higher than both MAR and NASS returns. The organic potato yield values are not easily interpreted. Some fraction of apparent lower yield is likely explained by a proportion of organic acreages being planted to lower yielding specialty varieties for the fresh market, as compared to NASS values which are dominated by Russet production. For example, Miller et al. (2008) characterized Western Washington yield of organic red, yellow and fingerling type potatoes at 200 to 320 cwt/acre. In contrast, Columbia Basin organic Russet yields were 600 to 640 cwt/ac for processing, and 440 cwt/ac for fresh market. Lower GAY values (less than 300 cwt/ac) coupled with very high GAPs (Table 10b) support this explanation.

These averages indicate that some growers are selling organic specialty potatoes into the fresh market (often direct sales) for prices much higher than those received by organic Russet potatoes, generating higher gross revenues per acre than Russet potatoes, despite lower yields.

Table 9. Washington potato acreage, production and value, 2009-2012.

Aggregate Total	Organic[a]				NASS-WA[b] All			
	2009	2010	2011	2012	2009	2010	2011	2012
WA Acres[c]	1,701	1,032	1,046	1,255	145,000	135,000	160,000	165,000
Reported Acres[d]	1,374	874	927	1,272	—	—	—	—
Production (1000 cwt)	480.9	372.1	367.2	472.7	87,230	88,440	97,600	95,940
Crop Yr Value ($mill)	4.67	4.61	3.94	>5.18[e]	645.50	654.46	777.36	700.36
Sales Yr Value ($mill)	5.25	3.91	3.45	6.67	—	—	—	—

[a]Organic values include all types of potatoes and seed potato; [b]NASS values include all Washington potatoes (conventional and organic); [c]includes acreage from WSDA site acreage data and acreage from any additional certifiers (Kirby and Granatstein 2014); [d]acreage compiled from WSDA-certified producer organic income and production data; [e]value for the 2012 crop year incomplete.

Table 10a. Washington potato **market average** yield, price and gross revenue per acre, 2009-2012.

Market Average (MA)	Organic[a]				NASS-WA[b] All			
	2009	2010	2011	2012	2009	2010	2011	2012
Yield (cwt/ac)	414	416	424	409	610	660	615	585
Price ($/cwt)	9.31	12.52	9.77	12.22	7.40	7.40	7.90	7.30
Revenue ($/ac)	3,476	4,963	4,122	5,292	4,452	4,848	4,859	4,245

[a]Organic values include all types of potatoes; [b]NASS values are for all Washington fall season potatoes (conventional and organic).

Table 10b. Washington organic potato **grower average** yield, price and gross revenue per acre, 2009-2012.

Grower Average (GA)	Organic[a]				Organic 4-Year			
	2009	2010	2011	2012	Mean	Median	S.D.[b]	n[c]
Yield (cwt/ac)	211	269	240	260	243.7	193	205	77
Price ($/cwt)	83.83	68.29	79.74	77.03	77.19	60	75.3	85
Revenue ($/ac)	6,426	6,416	8,417	8,135	7,396	5,260	7,424	77

[a]Organic values include all types of potatoes; [b]S.D. = standard deviation; [c]n=number of observations.

Onions

Onions are the second highest value vegetable crop in the nation, and Washington State ranks first in the nation for production and value of summer storage onions. Storage onions are the most widely planted type, with 90% of the total state acreage. Washington organic onions ranked second in U.S. organic onion acreage, production, and value (NASS 2012). Acreage, production, and value for all onions (NASS 2013b; 2013c) and for organic onions are presented in Table 11. Onion producers face several production challenges—from weed competition and increasing pest pressure, to relatively higher production costs and storage losses and quantity of foreign imports. Potential marketing niche opportunities exist for U.S. onion producers, including regional or varietal branding, and "sustainable production" branding, including organic. However, disease and weed control are major challenges to organic production in Washington State.

WSDA reported acreage segregated as certified organic onions for 33 unique Washington producers from 2009 to 2012 (Table 2). Over the 4-year period, 50% of Washington organic onion producers were located in the Columbia Basin region, along with 99% of the reported onion acreage, production, and value. Organic onion acreage is concentrated in Adams, Franklin, and Grant counties. Seven producers accounted for 90% of the reported acreage and production. Grower onion acreage ranged from less than 1 acre to more than 180 acres. Thirty percent of producers showed organic onion acreage in at least three years during 2009 to 2012; a handful of these producers accounted for the majority of the state's acreage and production. Grower acreages were larger in the Columbia Basin (Table 2). Just four west side producers had onion acreage of 1 to 2 acres; the others had plantings of less than 1 acre in any year (data not shown). Larger growers typically use high density/multi-row bed systems with intensive thermal and mechanical weed control versus small growers with low density, widely-spaced single or double rows, with greater reliance on hand weeding.

Organic onion MAY values were similar to Washington NASS (2013b; 2013c) storage onion yield values (Table 12a), and exceeded the NASS value in 2010, with 36.5 ton/ac. The similar values indicated that most of the organic onion production was the storage type, typical for Washington production, and that organic production does not necessarily translate to a reduction in yield when compared to conventional production.

Table 11. Washington onion acreage, production and value, 2009-2012.

Aggregate Total	Organic[a]				NASS-WA[b], Storage + Non-storage			
	2009	2010	2011	2012	2009	2010	2011	2012
WA Acres[c]	653	408	637	480	21,000	24,000	22,200	26,600
Reported Acres[d]	623	438	623	451	—	—	—	—
Production (ton)	14,246	15,973	19,762	12,384	598,500	704,000	688,500	741,600
Crop Yr Value ($mill)	5.04	4.27	4.12	>2.06[e]	103.97	168.81	121.68	184.09
Sales Yr Value ($mill)	3.38	3.69	3.55	4.87	—	—	—	—

[a]Organic values include both storage and non-storage; [b]NASS values include Washington conventional and organic onions); [c]includes acreage from WSDA site acreage data and acreage from any additional certifiers (Kirby and Granatstein 2014); [d]acreage compiled from WSDA-certified producer organic income and production data; [e]value for the 2012 crop year incomplete.

Table 12a. Washington onion **market average** yield, price and gross revenue per acre, 2009-2012.

Market Average (MA)	Organic[a]				NASS-WA[b]							
					Storage				Non-Storage			
	2009	2010	2011	2012	2009	2010	2011	2012	2009	2010	2011	2012
Yield (ton/ac)	28.8	36.5	31.7	27.5	31.5	30.5	32.5	29.5	18.75	16.5	17.5	18.5
Price ($/ton)	320	267	208	266	328	224	178	234	590	1,002	456	636
Revenue ($/ac)	8,093	9,751	6,607	6,402	9,395	6,170	5,207	6,282	11,063	16,533	7,982	11,766

[a]Organic values include both storage and non-storage; [b]NASS values include all Washington onions (conventional and organic).

Table 12b. Washington organic onion **grower average** yield, price and gross revenue per acre, 2009-2012.

Grower Average (GA)	Organic[a]				Organic 3–4 YR			
	2009	2010	2011	2012	Mean	Median	S.D.[b]	n[c]
Yield (ton/ac)	14.8	18.9	15.2	18.5	16.7	11.2	14.8	47
Price ($/ton)	1,769	1,436	1,512	—	1,557	764	1,512	43
Revenue ($/ac)	6,202	9,314	8,453	—	8,105	6,598	6,800	39

[a]Organic values include both storage and non-storage; [b]S.D. = standard deviation; [c]n=number of observations.

However, GAY values were 40% to 50% less than NASS values, illustrating the wide variability in yields achieved among individual producers (Table 12b). The 4-year average GAY for all producers was 16.7 ton/ac. In contrast, GAY for large-scale producers with the majority of the acreage and production was 31 ton/ac; a number of these producers achieved 40 ton/ac in one or more crop years (data not shown).

Organic onion MAP and MAR values for the 2010 to 2012 organic crops exceeded NASS storage onion averages by around 15%, and represented the bulk of the production. Organic GAP was six times higher than MAP, showing the opportunity for producers to receive prices much higher than the market price. Average 4-year GAR of $8,105/ac was more similar to organic MAR and NASS revenue, indicating that the higher prices were received for a relatively small proportion of the production tons; higher prices did not translate to higher GAR.

No organic enterprise budget was available for Washington onions. With an estimated 2011 production cost of $4,547/ac for conventional onions (indexed from Hinman and Pelter 2004), and a conventional yield of 35 ton/ac, an estimated breakeven price would be $130/ton.

Assuming organic onions to entail 20% greater costs, and produce yields of 31.5 ton/ac (Appendix 2), an estimated breakeven price would be $173/ton, less than the organic MAPs reported in Table 12a, which averaged $265/ton.

Carrots

Washington ranked as the number two carrot producer in 2012 (30% of national production), with an estimated 70% of carrot acreage for processing (Table 13) (NASS 2013b; 2013c). Washington organic carrot acreage, production, and value ranked second nationally, behind California (NASS 2012; USDA-ERS 2013). The organic share of carrot acreage statewide has grown from just 2% in 1998 (Sorenson 2000) to an estimated 9% in 2012. Because price varies greatly for processed versus fresh carrots, it is not possible to estimate a reliable organic share of dollar value for carrots without knowing the fractions of fresh or processed carrots sold as organic.

Organic carrot acreage is concentrated in Grant, Benton, and Klickitat counties. WSDA reported acreage segregated as organic carrot for 24 unique Washington producers from 2009 to 2012 (Table 2). More than half of the 24 producers reported less than 1 acre of carrots in their planting years; 20% had between 1 and 10 acres and 25% had 11 or more acres.

Table 13. Washington carrot acreage, production and value, 2009-2012.

	Organic[a]				NASS-WA[b], Processing			
Aggregate Total	2009	2010	2011	2012	2009	2010	2011	2012
WA Acres[c]	217	215	273	280	3,800	3,600	3,400	3,100
Reported Acres[d]	193	212	260	301	—	—	—	—
Production (ton)	4,304	6,398	7,776	8,210	117,800	111,600	120,700	98,580
Crop Yr Value ($mill)	1.56	1.61	1.90	2.22	10.01	9.15	10.38	7.97

[a]Organic values include both fresh and processing; [b]NASS values include all Washington carrots for processing (conventional and organic); [c]includes acreage from WSDA site acreage data and acreage from any additional certifiers (Kirby and Granatstein 2014); [d]acreage compiled from WSDA-certified producer organic income and production data.

Table 14a. Washington carrot **market average** yield, price and gross revenue per acre, 2009-2012.

	Organic[a]				NASS-WA[b], Processing			
Market Average (MA)	2009	2010	2011	2012	2009	2010	2011	2012
Yield (ton/ac)	36.7	28.9	29.0	29.3	32.0	31.0	35.5	31.8
Price ($/ton)	265	252	245	241	85.00	82.00	86.00	80.90
GRA ($/ac)	6,210	5,407	5,670	7,314	2,635	2,542	3,053	2,573

[a]Organic values include both fresh and processing carrots; [b]NASS values include Washington carrots for processing (conventional and organic).

Table 14b. Washington organic carrot **grower average** yield, price and gross revenue per acre, 2009-2012.

	Organic[a]				Organic 4 Year			
Grower Average (GA)	2009	2010	2011	2012	Mean	Median	S.D.[b]	n[c]
Yield (ton/ac)	19.63	15.95	16.04	19.6	17.6	11.3	14.6	35
Price ($/ton)	2,088	1,771	2,398	1,898	2,026	1,743	1,632	46
Revenue ($/ac)	15,572	9,739	13,775	17,999	14,415	8,895	13,989	38

[a]Organic values include both fresh and processing carrots; [b]S.D. = standard deviation; [c]n=number of observations.

Less than half of the producers showed carrot acreage in 2 or more years during 2009 to 2012. The majority of the farms with less than 1 acre were located on the west side of the state, while most producers with 50 or more acre plantings were on the east side. The majority (86%) of the state's carrot acreage is located east of the Cascades, but consists of only 40% of the producers statewide. This geographic difference was validated by the 4-year average and median carrot acreage values (Table 2). East side producers had larger acreages and higher yields than west side producers. However, west side producers received higher average prices.

Washington NASS (2013b; 2013c) storage carrot yield values ranged from 31 to 35 ton/ac during the 2009 to 2012 period (Table 14a). Organic MAY values were within 10% of NASS values, except in 2011 when MAY was around 18% less than NASS yield, indicating that the bulk of Washington organic production goes to processing, and that organic production methods can yield close to conventional. Thirty percent of producers achieved organic yields between 18 to 40 ton/ac, typical for Washington conventional yields for fresh and processing carrots. MAP and MAR values were 2 to 3 times higher than NASS values, making organic carrots a seemingly attractive crop to grow, depending on the cost of organic production. Prices for fresh carrots are much higher than for processed carrots. The Agricultural Marketing Resource Center (USDA-AgMRC 2013) reported fresh market prices of $524/ton for fresh, compared to $103/ton, for processing, in 2012. Grower average values (Table 14b) show the effect that smaller growers with lower yields, and/or receiving high prices such as for fresh market, have on the industry. GAYs were 50% to 60% of NASS yields, while extremely high GAPs offset the yield differences and resulted in a very large potential GAR ranging between $9,739 to $18,000/ac.

No organic enterprise budget was available for Washington carrots. With an estimated 2011 production cost of $3,805/ac for conventional dicer carrots (indexed from Hinman et al. 2000), and a conventional yield (cleaned) of 40 ton/ac, an estimated breakeven price would be $95/ton. However, this appears high compared to NASS prices in Table 14a, suggesting that the indexed cost is overestimated. Assuming organic carrots entail 20% greater costs, and organic MAY (assumed cleaned) of 31.0 ton/ac (Appendix 2), an estimated breakeven price would be $147/ton, less than the organic MAPs reported in Table 14a. Conventional fresh market carrot yields were assumed to be 29 tons/ac and had 12% greater production costs than processer carrots (Hinman et al. 2000).

Profitability and Risk

In this section we turn our focus from gross revenue to profit and risk. It goes without saying that profitability is a key goal for any business because it is necessary for its survival. However, there is typically a tradeoff between risk and return. Some growers are willing to have greater variability in their profits over time if it means they get a higher profit on average. Other growers are more averse to risk and would rather lower their average level of profit if it means profits are less variable. In this section we discuss (1) how to combine the data on price and yield discussed in this report with information on costs to move from gross to net revenues, or profits, and (2) analyze variability in prices and yields to consider risk.

Costs of Production for Projecting Profitability

This report does not provide a detailed analysis of profitability across organic vegetables because cost data were not included in the available records. There are few published cost of production budgets on organic vegetable crops. Costs tend to be less variable and uncertain than revenue, so growers who have estimates of their current costs under conventional management and how they might change with organic management can use their own information instead.

In order to help readers evaluate the crops discussed, information from other budgets is presented in Appendices 1 and 2. These include budgets for conventional sweet corn, green peas, potatoes, onions, and carrots in the Columbia Basin, and budgets for both conventional and organic sweet corn and snap beans in the Willamette Valley of western Oregon. Other sources include budgets from other states (organic and conventional), other technical documents (e.g., Pest Management Strategic Plan for Organic Potatoes in the Western U.S.), and conversations with growers and agricultural professionals familiar with organic vegetable production. Cost of production values from older budgets were adjusted to 2011 using the indexing of costs from NASS (undated) for *Items Used for Production, Interest, Taxes & Wage Rates (PITW).*

Two consistent areas of increased cost emerged for organic production – weed control and crop nutrition. For poorly competitive crops, such as onions and carrots, the absence of viable herbicide options for organic growers necessitates a number of preventive strategies, along with increased use of mechanical, thermal, and cultural controls, and hand weeding that can cost $1,000 per acre or more. Even WSU budgets for conventional carrot and onion (with herbicides) call for hand weeding of $700/ac and $200/ac, respectively. Each additional cultivation for weed control costs $25/acre or more, with three to five more required for organic production. Growers can choose from a range of nutrient sources, with manures generally least expensive in terms of product cost, but with added cost for hauling and spreading, and the potential to introduce weed seeds, which can add to weed control costs.

Well-heated compost destroys many, but not all weed seeds, and may be slower to release nutrients. It can be applied within the 90 to 120 day pre-harvest interval required by the National Organic Standards, whereas raw manure cannot. Feather meal is a common high-nitrogen source used (12% N), but can cost over $6 per pound of N, compared to $1.50 to $2.00 per pound N in compost and manure. Fish meal and kelp may be used as foliar sprays or applied through irrigation systems. Manufactured organic fertilizers are increasingly available and offer more predictable nutrient release, exemption from the pre-harvest interval, absence of weed seeds or pathogens, and suitability in existing fertilizer spreading equipment, but the price per pound of nutrient is often higher than from composts or manures. Cover crops, especially legumes, are sometimes used prior to the vegetable crop to fix nitrogen and recycle other soil nutrients. Growers may be spending up to $1,000 or more per acre on their nutrient program for heavy feeding crops such as potatoes and corn.

Cost differences for insect pest and disease management differ by crop, and no reliable information was available for estimating differences. In some cases, organic growers can avoid problems through their choice of crop rotation and other cultural practices, and thus spend less on pesticides than conventional growers. However, they also have fewer tools to prevent economic crop loss.

As shown in Appendix 1, production cost estimates vary considerably, due to different crop end uses, different budget assumptions and/or methods, and regional differences in yield levels, crop protection needs, and contractual arrangements. Direct comparisons between other states and Washington may not always be appropriate. While organic production appears slightly less costly than conventional in the Oregon sweet corn and snap bean budgets, yields are substantially lower, and growers may be altering their crop rotations in ways that have a negative economic impact not reflected in the individual crop budget. Growers using more intensive management to achieve yields similar to conventional will likely incur substantially higher costs. Many of the published budgets are set up to allow growers to enter their own costs when known, and utilize the assumed cost when not. Given that organic production often involves changes to the entire system, cost categories may need to be added that are not considered for conventional production. Small, diversified growers may be able to farm with minimal levels of external inputs, and thus costs on a per acre basis could be lower than the conventional budgets. Inclusion of additional labor costs for such farms would be necessary. If readers are able to define an estimated yield and cost of production, they can use the breakeven tables in Appendix 2 to evaluate what prices are needed to be profitable and compare these to the historical data presented in this report.

Variability in Yield, Price, and Gross Revenue Per Acre

Understanding the tradeoff between profits and risk is a critical part of almost every farm, conventional or organic. Again, without cost information it is not possible to provide a direct comparison of risk versus return for organic vegetables in this report. However, understanding variability can provide a starting point for current and prospective organic vegetable growers. Yield and price, and therefore gross revenue per acre, vary over time, and across growers for a number of reasons. Market conditions change due to changes in supply and demand. Growers receive different prices, even at the same point in time, due to differences in their product quality, skill in negotiating contracts, or ability to navigate the direct sales market, for example. It is beyond the scope of this report and the available data to further analyze the causes of variability across growers and over time.

Histograms (bar charts) are used here to depict variability in a graphical manner and to show how observations are distributed between the highest and lowest observed values. Compared to other measures of variability, like standard deviation and variance, histograms are useful because they do not require any previous background in statistics, and are fairly easy to interpret. The width of each bar on a histogram (on the horizontal or x-axis) defines the range of values that are counted in that bar. The vertical axis (y-axis) reports the percent of all observations that are within the range of values for a given bar. The sum of the y-axis value for all the bars on a graph equals 100. As an example, consider the histograms for yield shown in Figure 3. Looking at sweet corn, the first bar covers the range from 0 to 2 tons/acre. The height of the bar shows that 16% of all observations for sweet corn yield were within this range. The bars are all the same width, so the second bar covers 2 to 4 tons/acre and has about 20% of the observations. The highest bar is in the 6 to 8 tons/acre range with 25% of all observations.

The height of the bars can be added together to better understand average yield. Starting from the left most bar, the height of each bar can be added together to calculate how many observations were below a certain value. For example, by adding together the height of the first two bars for sweet corn, one finds that 36% of all yield observations were below 4 tons/acre. If a grower estimates that their break-even yield is 4 tons/acre, then this provides a rough estimate of how likely they are to achieve a yield below this critical threshold, recognizing that these values were observed in the recent past and the future may be different.

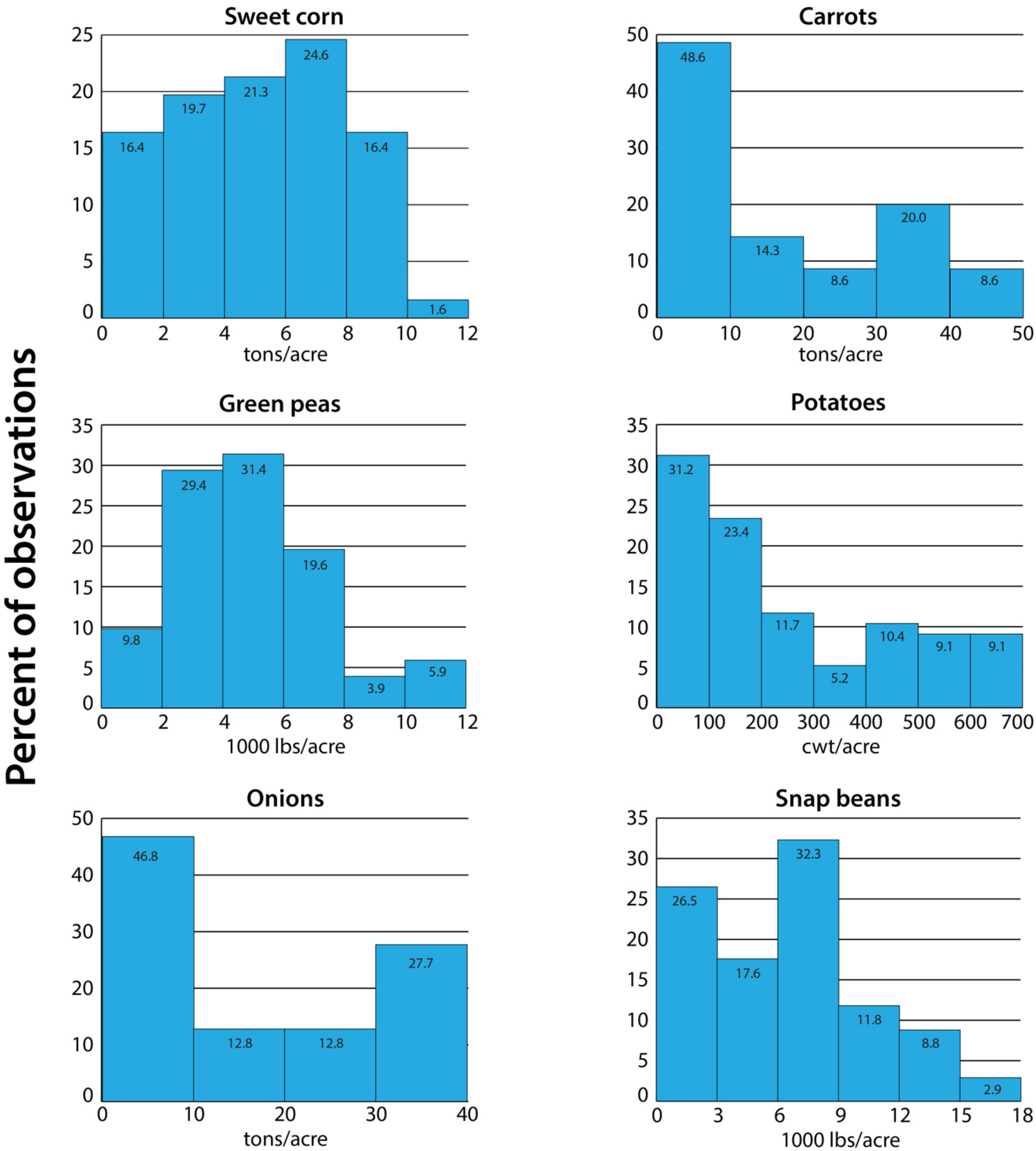

Figure 3. Frequency of observed organic vegetable yields across all growers and years.

The histograms can be used to compare variability among crops. The distribution of sweet corn and green pea yields are more similar to each other than to the other crops, because they have a higher concentration of observations towards the middle of the observed range, rather than at the highest or lowest values. This means that observed yields are fairly evenly spread above and below the average yield reported earlier.

In contrast, carrots, potatoes, and onions have the most observations in the lowest range. This means that most yield observations for these crops are below the reported average. Snap bean is in between the others in that it has its highest bar in the middle of the range, but also has a large number of observations in the lowest range. The take-home message is that it appears far more likely to achieve yields similar to the average for sweet corn and green peas.

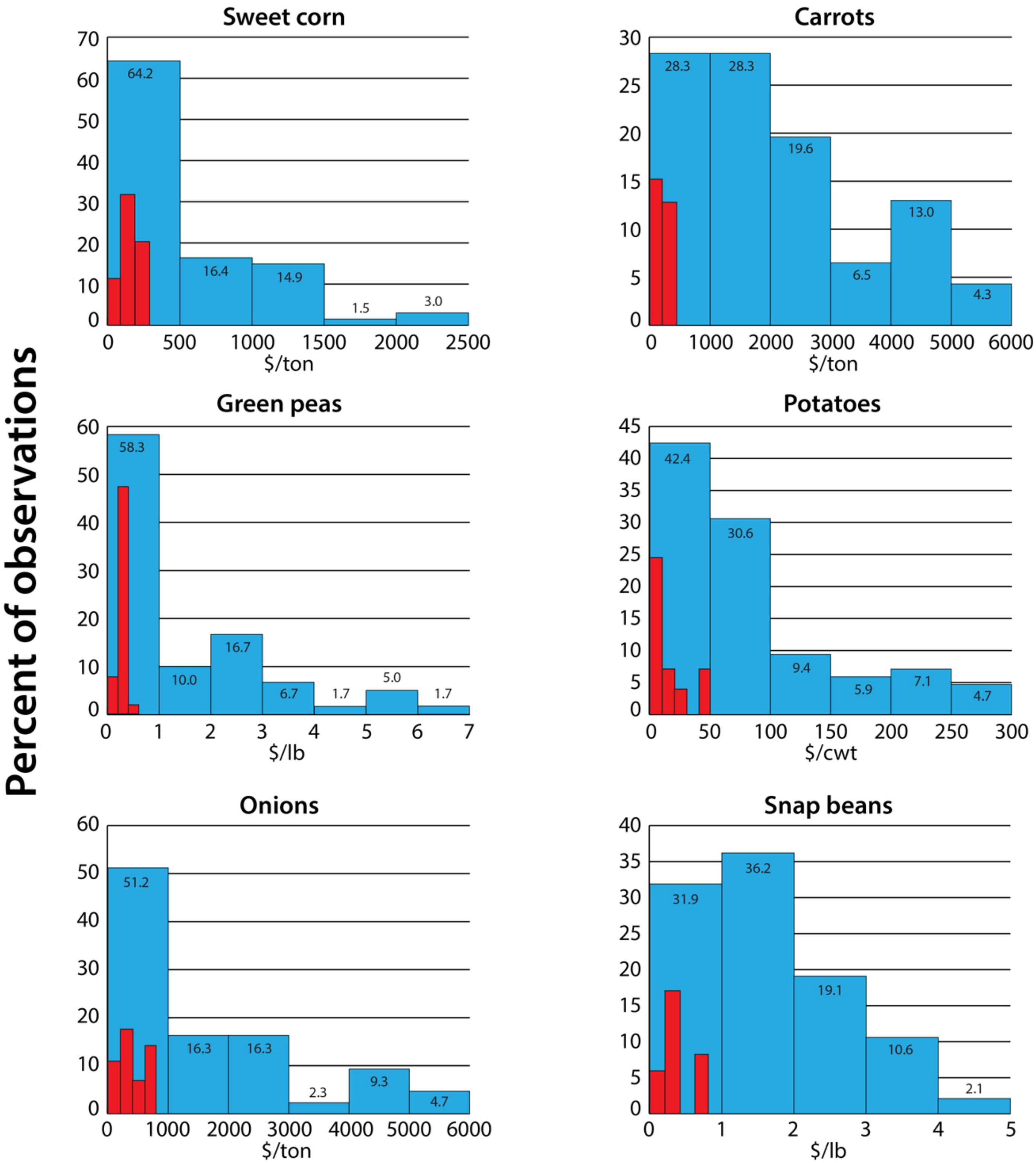

Figure 4. Frequency of observed organic vegetable prices across all growers and years. ***NOTE: Red bars break down the first blue bar into five smaller intervals due to the large number of observations at the low end. Intervals for each red bar by crop are as follows: sweet corn, $100; green peas and snap beans, $0.20; onions and carrots, $200; potatoes, $10.***

Potential growers of the other crops may want to be more conservative in their yield expectations given that 30% to 50% of observations, depending on the crop, are in the lowest range. While there are many reasons why yields vary across growers and over time, we examined two factors that might affect yield: scale of production and growing region.

Growing conditions are very different east of the Cascade Range compared to west of the mountains. Prospective growers might want to know whether yields are correlated with how many acres of the crop are grown on the farm. Regression analysis was used to test whether yields tended to be higher or lower depending on region and scale.

Results showed no clear trend across all crops, although some similarities were found. Potatoes, sweet corn, and onion all showed a positive correlation between yield and scale, which means that larger growers had higher yields. For these crops, once scale was accounted for, yields for growers east of the Cascades were not significantly different from yields west of the Cascades. There is more evidence that region does matter for carrots, green peas, and snap beans. For each of these, yields were lower for growers west of the Cascades, after accounting for scale.

Green peas were unique in that scale was negatively related to yield, which means that smaller growers tended to achieve higher yields. While not possible to confirm, this could be due to differences in management, such as multiple harvests of indeterminate varieties, more intensive weed control, or production of unshelled peas (e.g., sugar snap peas).

The histograms for price are shown in Figure 4. An additional set of bars, colored in red, are included for price that were not included for yield to provide a breakdown of the left-most bar that covers the lowest range. This additional set of bars was included for two reasons.

First, a high percentage of observations are contained within the lowest range for five of the six crops. Over half of all price values for sweet corn, green peas, and onions are in the left-most bar. Second, based on the available cost of production information discussed earlier in this section the break-even price is likely to fall within the first bar. Therefore, it helps to more accurately estimate the proportion of observations below a break-even value in this low range with the red bars. Adding up the height of each of the red bars equals the height of the first blue bar. There are five red bars for each crop, although some have a height of zero. Therefore, the range that each covers is one-fifth of the width of the blue bar. For sweet corn this means that the first red bar covers the range from $0 to $100/ton, containing 11% of the observations.

While it may seem odd that so many price observations are in the lowest range, this may be explained by the difference between selling into direct and/or fresh markets versus wholesale and/or processing markets. Price premiums received for organic produce can help offset potential decreased yields. While premiums for organic compared to conventional occur in both wholesale and direct sale markets, average direct sale prices tend to be higher than wholesale. Washington vegetable producers reported 16.5% of their organic farmgate value from direct market sales averaged over the 2009 to 2012 period; 70% of sales were reported as wholesale. The remaining 14% of sales were not specified as either direct or wholesale. Direct sales included sales to end consumers (e.g. farm stand, farmers markets) and also to retail establishments (e.g. restaurants, schools, grocers).

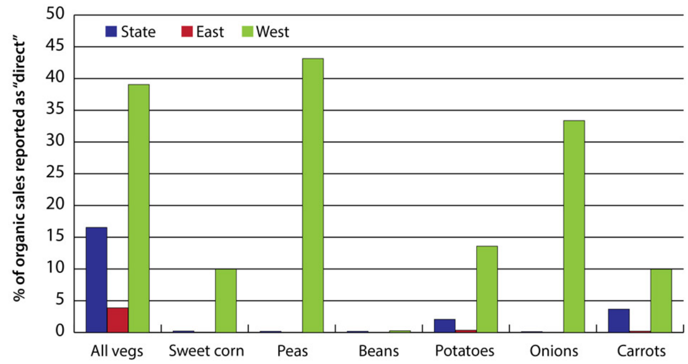

Figure 5. Percent of Washington vegetable producer organic farmgate sales reported as direct, 4-year average (2009-2012).

Location and crop type both affected the proportion of direct sales. Producers on the west side reported 39% of their organic sales as direct, compared to 4% reported by east side producers (Figure 5). Producers reported 16.5% of all organic vegetable sales as direct (statewide); direct sales fractions ranged from 0.13% for onion to 3.7% for carrot.

Histograms for gross revenue per acre are shown in Figure 6. In general, they have a greater resemblance to the price histograms than the yield histograms. This suggests that most of the growers are below the grower average gross revenue per acre reported earlier in this report. Another way to think about this, is that a small number of growers achieve high values for gross revenue per acre. The left-most bar is the lowest for sweet corn which still has 35% of all observations. Green pea is the highest with 80% of observations in the left-most bar.

Conclusions

Organic vegetable production in Washington State generated over $43 million in farmgate sales in 2012. Six crops dominated in terms of acres and economic value, and were largely grown on Columbia Basin irrigated farms.

The bulk of this production was sold into wholesale markets compared to the larger share of direct market sales in western Washington, which tended to bring higher prices. Market average yields were typically below NASS-reported yields for the state, but higher than grower average yields, suggesting that larger growers often achieved higher yields than smaller growers, which regression analysis verified. There were yield observations at or exceeding the 4-year NASS averages for 2009 to 2012 for each of the crops, including up to 15% to 30% of organic green pea, carrot, and onion yield observations, indicating that organic systems can yield as well as conventional under certain circumstances.

Lower average yields were normally accompanied by prices higher than NASS-reported prices. Smaller growers with lower yields often reported the highest prices, probably due to their direct markets.

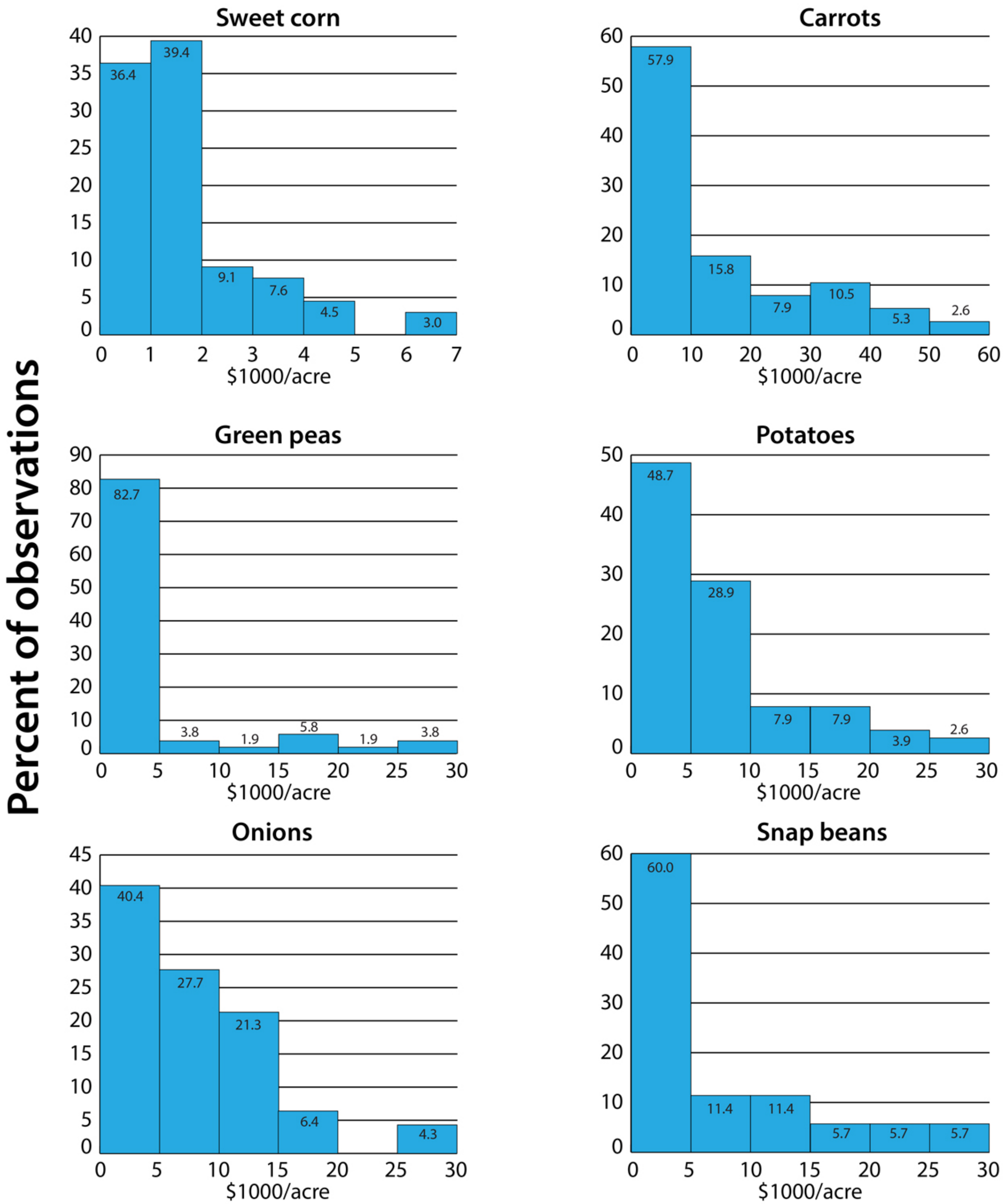

Figure 6. Frequency of observed organic vegetable gross revenue per acre across all growers and years.

Gross revenue per acre was often higher for grower average (more representative of smaller growers) than market average, and almost always exceeded the NASS value. For example, the NASS gross revenue for processing carrots ranged from $2,500 to $3,000/acre, while the organic grower average revenue ranged from $10,000 to $15,000/acre, reflecting more fresh and/or direct sales. Organic market average revenue also exceeded NASS values in all but two cases.

Thus, lower yields appear to be compensated with higher gross returns. However, without solid information on cost of production, it is not possible to say whether organic production produces positive net returns, and if so, how they might compare with conventional returns for the same crops. Given that organic production entails greater risk due to fewer production tools, greater net returns would be expected.

The market for organic vegetables continues to grow, for both fresh and frozen products (OTA 2014). Sales of organic fruits and vegetables grew 15% for fresh product and 19% for frozen product in 2013. Fresh product accounted for 90% of all organic fruit and vegetable sales, compared to 4% for frozen. Yet organic vegetables are still niche crops where growth of production can overshoot demand. This was demonstrated in 2008 to 2010, when ramped up production to meet anticipated demand growth led to excess inventory of frozen product that accumulated when the expected demand growth did not occur during the 2008 recession. Washington State is a major national producer of the six organic vegetables reported here, and thus is in a good position to expand production as demand grows, creating opportunities for producers in the state.

Acknowledgements

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Appendices

Appendix 1. Production Cost Estimates and Information Sources Relevant to Organic Vegetables

Few if any formal enterprise budgets or cost of production studies exist for the six organic vegetables discussed in this report. Budgets do exist for all of these crops under conventional management, some for production in Washington, and some for production in other states, which may or may not be comparable to growing conditions and costs in Washington. The authors searched on-line for budgets that might be relevant and helpful for individuals trying to estimate costs for producing the six organic crops in the absence of published organic budgets. Older budgets exist for conventional sweet corn, green peas, potatoes, onions, and carrots in the Columbia Basin, and budgets for both conventional and organic sweet corn and snap beans in the Willamette Valley of western Oregon. Total costs in these were normalized to 2011 using the USDA-NASS Agricultural Prices summary, specifically the index for Production, Interest, Taxes, and Wage Rates (PITW) as this encompasses most all of the factors influencing a grower's costs.

Other information sources include budgets from other states (organic and conventional), other technical documents (e.g., Pest Management Strategic Plan for Organic Potatoes in the Western U.S.), and conversations with growers and agricultural professionals familiar with organic vegetable production.

For potato, onion, and carrot, an exploratory organic budget was derived from the conventional Washington budget by removing those costs that are clearly prohibited by organic standards (e.g., synthetic fertilizers, soil fumigation, herbicides and most other pesticides) and adding back in an estimate of the organic alternative (e.g., compost, mechanical cultivation, hand weeding, biological insecticides), and its cost where this was known. In most cases, a detailed organic pest management program could not be determined, and a cost for organic pest management (greater than conventional) was added as a placeholder. Thus, these three organic cost estimates should be considered very tentative. The conventional budgets for these three crops represent larger scale production and are likely less relevant to smaller, diversified growers who may have costs lower than the conventional example for some aspects, due to more diverse crop rotations, different choice of variety (e.g. more resistant to disease), lower fertility inputs and more reliance on cover crops, and tolerance for more crop damage from pests and diseases due to the markets they sell into. Table A1 contains the cost of production information gleaned from these various sources.

Table A1. Estimates of costs of production for major conventional and organic vegetable crops in Washington, indexed to 2011 costs.

Crop	Conventional	Organic	Major differences	Source and Notes
	$/acre			
Sweet corn, Washington	1,220[a]	1,570 Estimated from conventional budget and industry input	Conventional yields of 11-12 ton/ac are common. Organic average yield was 8.5 ton/ac. Organic price was double conventional in 2010. Industry input showed organic sweet corn direct costs 25% greater than conventional for Columbia Basin, versus similar cost in found in Willamette Valley.	2002 budget, irrigated sweet corn for processing, Columbia Basin, WA. Processor normally does harvest and hauling, pays half of insect control cost.
Sweet corn, Oregon	1,118[b]	1,081[c]	Assumed yields (ton/ac): conventional, 10; organic, 7. Organic had higher weed control costs, lower pest control costs, and included a cover crop for fertility.	2008 and 2010 budgets, irrigated sweet corn for processing, Willamette Valley. Overall costs likely higher in Columbia Basin for fertility and irrigation.
Sweet corn, Wisconsin	442[d]		Yield: 7.5 ton/ac.	2011 budget, irrigated sweet corn for processing, Wisconsin. Processor provides seed, some insect and disease control, and harvest.
Sweet corn, Kentucky		2,300-2,600[e] total variable costs.	Higher costs for weed control, corn earworm management. Estimated yield of 1,033 dozen in North Carolina[f].	2011 budget, irrigated sweet corn for fresh market, Kentucky. Labor: hand harvest and pack (55-65 hr/ac), compared to machine harvest and pack (20-30 hr/ac). Need price of $2-$2.50/dozen for positive return to land and management.
Sweet corn, California		5,184[g]		1992 budget, diversified vegetables, California. Hand harvest and pack.
Green peas, Washington	1,194[a]	1,206 Estimated from conventional budget and industry input.	Budget yield 6,500 lb/ac; NASS average 2009-2012, 5,855 lb/ac; average organic yield 4,537 lb/ac. Industry input showed organic pea (double crop) direct costs to be 1% higher than conventional, but yields 32% lower.	2002 budget, irrigated green peas, Columbia Basin, WA. Production costs are considerably higher than comparable production in Wisconsin (weed control, water, seed, interest, fixed costs).
Green peas, California		2,724[g]	Hand weed control was 18.3 hour/ac, or 33% of pre-harvest production costs.	1992 budget, diversified vegetables, California. Excludes harvest cost. Budget uses hand harvest and pack and grade, total cost is then $12,873/ac.
Green peas, Wisconsin	290[h]		Yield: 2.5 ton/ac. Organic requires some hand weeding and additional tillage or flaming. Fertilizers and pesticides are more expensive. Untreated seed can lead to extensive seedling loss.	2011 budget, irrigated peas for processing, Wisconsin. Processor supplies seed, some pesticides, harvesting.

[a]Hinman et al. 2002.[b]Julian et al. 2010b. [c]Julian et al. 2008b. Barnett [d]2011d. [e]Univ. Kentucky 2012. [f]Davis 2005. [g]Klonsky et al. 1994. [h]Barnett 2011b. [i]Julian et al. 2010a. [j]Julian et al. 2008a. [k]Barnett 2011c. [l]Taylor 2010. [m]Hinman and Pelter 2004. [n]Wilson et al. 2011. [o]Barnett 2011a. [p]Hinman et al. 2000. [q]Meister 2004. [r]Nuñez et al. 2008.

Table A1 (continued). Estimates of costs of production for major conventional and organic vegetable crops in Washington, indexed to 2011 costs.

Crop	Conventional	Organic	Major differences	Source and Notes
	$/acre			
Snap (bush) beans, Oregon	1,371[i]	1,268[j]	Assumed yields (ton/ac): conventional, 6.1; organic, 3; Average organic yield, WA: 3.75. Organic had similar weed control and fertility costs (including a cover crop), and no expense for insect or disease.	2008 and 2010 budgets, processor market, Willamette Valley.
Snap beans, Wisconsin	448[k]		Yield: 4.0 ton/ac.	2011 budget, irrigated beans for processing, Wisconsin. Processor provides insect and disease control, and harvest.
Potatoes, Washington	5,030[l]	6,808 Estimated from conventional budget.	Assumed conventional yield: 30 ton/ac. Organic estimate has 50% higher seed costs (organic seed), $850/ac more in fertilizer, plus a cover crop, no fumigation (a $325/ac cost), and 3 cultivations for weed control.	2010 budget, irrigated Russet Burbank potatoes for processing, Columbia Basin, WA. Includes storage charges ($500-$600/ac).
Onions, Washington	4,547[m]	6,112 Estimated from conventional budget.	Assumed conventional yield 35 ton/ac. Organic estimate avoids fumigation ($265/ac), has approximately $865/ac higher costs for fertility, and $650/ac higher costs for weed control (cultivation plus hand weeding).	2004 budget, irrigated yellow onions for storage, Columbia Basin, WA.
Onions, California	3,422[n]	5,465[g]	Yield: 24 ton/ac. Conventional costs: fertilizer, $465/ac; hand weed, $206/ac; herbicide, $152/ac; insect control, $293/ac; disease control, $118/ac. Organic costs: fertilizer, $584/ac; hand weed, $1278/ac; flame weed, $75/ac; cultivate 5x, $83/ac.	Conventional: 2011 budget, dehydrator onions, northern CA. Organic: 1992 budget, yellow onion, fresh sales, diversified vegetable farm, California. Organic value had hand harvest cost removed and machine harvest cost added.
Onions, Wisconsin	3,490[o]		Yield: 16.4 ton/ac. Lower yields than WA, less irrigation, no hand weeding. Hand harvest was major cost.	2011 budget, dry bulb onions for storage, Wisconsin.
Carrots, Washington	3,805[p]	4,633 Estimated from conventional budget.	Conventional yields: 44 ton/ac field run, 40 ton/ac paid clean. Includes fumigation ($433/ac), synthetic fertilizer ($248/ac), herbicide ($162/ac), and other pesticides ($91) not allowed in organic. Includes 2 cultivations and one hand weeding ($93/ac) for weed control.	2000 budget, Chantenay carrot for processing, South Columbia Basin, WA. Grower harvested (harvest and haul $1,160/ac). Organic growers report higher fertilizer costs and hand weeding costs of $1,000/ac or more.
Carrots, California	3,435[q]		Assumed yield: 25 ton/ac. 5 yr. average yield (ton/ac): fresh carrot 19.6; processor 28.Weed control $150/ac for herbicide, cultivation, no hand weeding. Fresh market revenue per acre (about $6,000 in 2008) is about twice that of processed[r].	2004 budget, fresh market carrots, Imperial Valley, California. No harvest or hauling paid by grower.

[a]Hinman et al. 2002.[b]Julian et al. 2010b. [c]Julian et al. 2008b. Barnett [d]2011d. [e]Univ. Kentucky 2012. [f]Davis 2005. [g]Klonsky et al. 1994. [h]Barnett 2011b. [i]Julian et al. 2010a. [j]Julian et al. 2008a. [k]Barnett 2011c. [l]Taylor 2010. [m]Hinman and Pelter 2004. [n]Wilson et al. 2011. [o]Barnett 2011a. [p]Hinman et al. 2000. [q]Meister 2004. [r]Nuñez et al. 2008.

Appendix 2. Estimated Breakeven Price Tables

The following tables present breakeven prices (the price at which total revenue from the crop equals total production cost) at different assumed yields and production costs. Total production cost includes the variable costs (e.g., seed, fertilizer, field operations) and fixed costs (equipment depreciation, land charge, interest), and are explained in any of the budgets referenced. Individuals can use these tables to evaluate their estimated costs and yields, and whether prices they might receive could lead to a profitable outcome. Recent estimated organic prices for these crops in Washington are presented in the market and grower average tables in the main text. Data were derived from various university extension enterprise budgets. Most were conventional production budgets. Total production costs were indexed to 2011 using the USDA-NASS Agricultural Prices summary, specifically the index for Production, Interest, Taxes, and Wage Rates (PITW), as this encompasses most all of the factors influencing a grower's costs. A range of production costs from +30% to -30% of the cost value from the budget was calculated, based on input from industry experts who suggested that certain costs were higher in organic systems in a number of the crops. It is also possible that smaller, diversified, less capital intensive growers would have lower costs per acre, and thus those values were included. Similarly, a range of yields (+30% to -30%) from the base yield reported was used. The base yield was determined uniquely for each crop, using various combinations of the yield reported in the enterprise budget, NASS data, the WSDA organic market average yield data and yield frequencies reported earlier, as well as input from industry experts. Some of the factors affecting cost and yield are described for each crop.

Sweet corn

Results were derived from the organic sweet corn enterprise budget of Julian et al. (2008b) developed for processing sweet corn in the Willamette Valley. A comparable conventional budget was also done (Julian et al. 2010b), which allowed for a direct comparison of costs between the two systems. The USDA price index was nearly identical for both years. In addition, a 2002 Columbia Basin sweet corn budget (Hinman et al. 2002) was examined, and an exploratory calculation made for what an organic budget might look like. Estimated production costs were 28% higher than conventional. However, the conventional costs indexed to 2010 were quite similar ($1,074/ac) to those from the Willamette Valley budget ($1,016). Most of the organic sweet corn in Washington is grown under irrigation in the Columbia Basin. Industry input for double crop sweet corn in the Columbia Basin showed direct costs being 25% greater for organic. The Oregon budget assumed conventional yield of 10 ton/ac, similar to Washington NASS data. The 4-year organic market average yield from the WSDA data was 8.4 ton/ac, higher than the 7.0 ton/ac assumed in the Oregon organic budget, and similar to industry input. Our study showed 23% of observations in the 6 to 8 ton/ac range, and 16% in the 8 to 10 ton/ac range. Industry experts confirmed some Columbia Basin organic growers regularly exceed 10 ton/ac. The Oregon organic budget appears to underestimate fertility costs relative to what industry experts suggest is common in the Columbia Basin, likely due to the higher fertility soils in the Willamette Valley. The Oregon organic budget had 7% lower costs than in the conventional budget, 30% lower yields, and a 40% higher price, leading to a modestly higher net return (+$47/ac) for the organic production.

Table A2. Estimated breakeven prices ($/ton) for organic sweet corn (based on organic processing sweet corn budget, Willamette Valley, with irrigation).

Production cost	**Yield (ton/ac)**						
($/ac)	-30%	-20%	-10%	**8.5**[a]	10%	20%	30%
-30%	123.88	108.40	96.35	86.72	78.83	72.26	66.71
-20%	141.58	123.88	110.12	99.11	90.10	82.59	76.24
-10%	159.28	139.37	123.88	111.49	101.36	92.91	85.76
1053[b]	176.97	154.85	137.65	123.88	112.62	103.24	95.29
10%	194.67	170.34	151.41	136.27	123.88	113.56	104.82
20%	212.37	185.82	165.18	148.66	135.14	123.88	114.35
30%	230.07	201.31	178.94	161.05	146.41	134.21	123.88

[a]Base yield derived from WSDA organic market average yield and yield frequencies.
[b]Base production cost is from organic budget of Julian et al. (2008b), indexed to 2011 costs, and increased by 10% to reflect higher costs in Columbia Basin.

Green peas

Results were derived from the enterprise budget of Hinman et al. (2002) for irrigated green pea production for processing in the Columbia Basin, WA. The 2002 costs were inflated 76% to reflect estimated 2011 costs per NASS cost of production indexing. However, this estimated cost ($1,193/ac) appears high in light of the 4-year average price reported by NASS ($999/ac), which would not cover that cost of production. Thus, $1,200/ac was set as the high end of production cost, with a base of $925/ac, still much higher than the Wisconsin budget (which does not include all the same costs as in Washington). Industry input for double crop organic peas in the Columbia Basin showed direct costs only 1% greater than in conventional, but with a 32% lower yield. The conventional yield was assumed to be 6,500 lb/ac, which compares with NASS data (2009 to 2012) of 5,000-6,800 lb/ac. A comparable pea budget from Wisconsin uses 5,000 /b/ac, but has substantially lower production costs. The 4-year organic market average yield from the WSDA data was 4,537 lb/ac, and 30% of yield observations were in the 4,000 to 6,000 lb/ac range. Organic peas may experience yield reductions due to weed competition and seedling diseases which reduce the stand.

Table A3. Estimated breakeven prices ($/lb) for organic green peas (based on conventional processing pea budget, irrigated Columbia Basin, WA).

Production cost	Yield (lb/ac)						
($/ac)	-30%	-20%	-10%	**5000**[a]	10%	20%	30%
-30%	0.19	0.16	0.14	0.13	0.12	0.11	0.10
-20%	0.21	0.19	0.16	0.15	0.13	0.12	0.11
-10%	0.24	0.21	0.19	0.17	0.15	0.14	0.13
925[b]	0.26	0.23	0.21	0.19	0.17	0.15	0.14
10%	0.29	0.25	0.23	0.20	0.19	0.17	0.16
20%	0.32	0.28	0.25	0.22	0.20	0.19	0.17
30%	0.34	0.30	0.27	0.24	0.22	0.20	0.19

[a]Base yield derived from WSDA organic market average yield and yield frequencies.
[b]Base production cost is from conventional budget of Hinman et al. (2002) indexed to 2011 costs, and reduced by 20%.

Snap beans

Results were derived from the organic bush bean enterprise budget of Julian et al. (2008a) developed for beans for processing in the Willamette Valley. A comparable conventional budget was also done (Julian et al. 2010a), which allowed for a direct comparison of costs between the two systems. The USDA price index was nearly identical for both years. Most of the organic snap beans in Washington have been grown in western Washington under comparable conditions to the Willamette Valley. The Oregon budget assumed conventional yields of 6.1 ton/ac (12,200 lb/ac), but no NASS data were available for green beans in Washington for comparison. The 4-year organic market average yield from the WSDA data was 3.7 ton/ac (7,400 lb/ac), slightly higher than the assumed yield of 3.0 tons/ac in the Oregon organic budget. Our study showed 32% of observations in the 3.0 to 4.5 ton/ac (6,000 to 9,000 lb/ac) range, and 12% in the 4.5 to 6.0 ton/ac (9,000 to 12,000 lb/ac) range. The Oregon organic budget had 8% lower costs than in the conventional budget, 51% lower yields, and a 40% higher price, leading to a net loss for organic and a net profit for conventional production, with low yield being an obvious causal factor. The breakeven table used a base yield of 7,500 lb/ac (3.75 ton/ac) based on the organic market average yield.

Table A4. Estimated breakeven prices ($/lb) for organic snap beans (based on organic processing snap bean budget, Willamette Valley, with irrigation).

Production cost	Yield (lb/ac)						
($/ac)	-30%	-20%	-10%	**7500**[a]	10%	20%	30%
-30%	0.17	0.15	0.13	0.12	0.11	0.10	0.09
-20%	0.19	0.17	0.15	0.14	0.12	0.11	0.10
-10%	0.22	0.19	0.17	0.15	0.14	0.13	0.12
1268[b]	0.24	0.21	0.19	0.17	0.15	0.14	0.13
10%	0.27	0.23	0.21	0.19	0.17	0.15	0.14
20%	0.29	0.25	0.23	0.20	0.18	0.17	0.16
30%	0.31	0.27	0.24	0.22	0.20	0.18	0.17

[a]Base yield derived from WSDA organic market average yield and yield frequencies.
[b]Base production cost is from organic budget of Julian et al. (2008b), indexed to 2011 costs.

Potato

Results were derived from the processing potato budget update of Taylor (2010) for the Columbia Basin, which builds on the budget of Hinman et al. (2006). The budget is for Russet Burbank potatoes for processing, grown under irrigation. Taylor added storage costs. The 4-year organic market average yield from the WSDA data was 418 cwt/ac, but industry experts said top growers were achieving yields of 600 cwt/ac, and 30% of the WSDA yield observations were between 400 and 700 cwt/ac. Organic growers would incur increased costs for fertility in particular, as well as for organic potato seed and organic certification fees. In an exploratory calculation substituting assumed organic inputs and management for conventional, production costs increased to $5,972/ac, roughly a 35% increase over the indexed conventional total cost per acre.

Table A5. Estimated breakeven prices ($/cwt) for organic potato (based on conventional processing potato budget, Columbia Basin).

Production cost	Yield (lb/ac)						
($/ac)	-30%	-20%	-10%	**550**[a]	10%	20%	30%
-30%	9.15	8.00	7.11	6.40	5.82	5.33	4.92
-20%	10.45	9.15	8.13	7.32	6.65	6.10	5.63
-10%	11.76	10.29	9.15	8.23	7.48	6.86	6.33
5030[b]	13.06	11.43	10.16	9.15	8.31	7.62	7.03
10%	14.37	12.58	11.18	10.06	9.15	8.38	7.74
20%	15.68	13.72	12.19	10.97	9.98	9.15	8.44
30%	16.98	14.86	13.21	11.89	10.81	9.91	9.15

[a]Base yield derived from WSDA organic yield frequencies and industry experts.
[b]Base production cost is from conventional budget of Taylor (2010), indexed to 2011 costs.

Onion

Results were derived from the enterprise budget of Hinman and Pelter (2004) for conventional yellow storage onions grown under irrigation in the Columbia Basin. The 4-year organic market average yield for onions from the WSDA data was 31.1 ton/ac, an 11% reduction from the assumed conventional standard yield of 35 ton/ac. About 23% of the WSDA yield observations were in the 30 to 40 ton/ac range, with several exceeding 40 ton/ac, showing that equivalent yields can be achieved. Organic onions generally will incur higher costs for weed control (often considerably more hand weeding), higher fertility costs, and higher seed price. In an exploratory calculation substituting assumed organic inputs and management for conventional, production costs increased to $6,112/ac, roughly a 34% increase over the indexed conventional total cost per acre.

Table A6. Estimated breakeven prices ($/ton) for organic onions (based on conventional storage onion budget, Columbia Basin).

Production cost	Yield (ton/ac)						
($/ac)	-30%	-20%	-10%	**31.5**[a]	10%	20%	30%
-30%	144.35	126.31	112.27	101.04	91.86	84.20	77.73
-20%	164.97	144.35	128.31	115.48	104.98	96.23	88.83
-10%	185.59	162.39	144.35	129.91	118.10	108.26	99.93
4547[b]	206.21	180.44	160.39	144.35	131.23	120.29	111.04
10%	226.83	198.48	176.43	158.78	144.35	132.32	122.14
20%	247.46	216.52	192.47	173.22	157.47	144.35	133.25
30%	268.08	234.57	208.50	187.65	170.59	156.38	144.35

[a]Base yield derived from WSDA organic market average yield and yield frequencies.
[b]Base production cost is from conventional budget of Hinman and Pelter (2004) indexed to 2011 costs.

Carrot

Results were derived from the enterprise budget of Hinman et al. (2000) for conventional processing carrots grown under irrigation in the south Columbia Basin, with growers harvesting the crop. This publication also included a budget for fresh market (Imperator) carrots, which had 12% higher production costs. Assumed yields (paid, clean) for the processed and fresh carrots were 40 and 29 ton/ac, respectively, compared with NASS yields for Washington processor carrots (2009 to 2012) of 32.6 ton/ac. The 4-year organic market average yield from the WSDA data was 31.0 ton/ac, with 20% of observations in the 30 to 40 ton/ac range, and 9% in the 40 to 50 ton/ac range. Estimated total production costs were $3,805/ac for processing and $4,271/ac for fresh. In an exploratory calculation substituting assumed organic inputs and management for conventional, production costs increased to $4,308/ac, roughly a 13% increase over the indexed conventional total cost per acre for processing carrots.

Table A7. Estimated breakeven prices ($/ton) for organic carrots (based on conventional processing carrot budget, south Columbia Basin).

Production cost	Yield (ton/ac)						
($/ac)	-30%	-20%	-10%	**35.0**[a]	10%	20%	30%
-30%	108.71	95.13	84.56	76.10	69.18	63.42	58.54
-20%	124.24	108.71	96.63	86.97	79.06	72.48	66.90
-10%	139.78	122.30	108.71	97.84	88.95	81.54	75.26
3805[b]	155.31	135.89	120.79	108.71	98.83	90.60	83.63
10%	170.84	149.48	132.87	119.59	108.71	99.65	91.99
20%	186.37	163.07	144.95	130.46	118.60	108.71	100.35
30%	201.90	176.66	157.03	141.33	128.48	117.77	108.71

[a]Base yield derived from WSDA organic market average yield and yield frequencies.
[b]Base production cost is from conventional budget of Hinman et al. (2000) indexed to 2011 costs.

Appendix 3. National and State Rankings of Six Washington Vegetable Crops (All and Organic)

Crop	National Rank, All[a]			Rank of WA Crops by Value[a]	National Rank, Organic[b]		
	Acres	Production	Value		Acres	Production	Value
Sweet corn	2	1	2	13	1	1	1
Peas, green	2	1	2	25	1	1	1
Beans, snap	8 (estimate)	n/a	n/a	n/a	1	1	1
Potato	2	2	2	4	4	3	3
Onion	2	1	1	11	2	2	2
Carrot	2	2	2	38	2	2	2

[a]2012 data from NASS; [b]2011 data from NASS

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