Market Vegetable Gardens: Planning for Success

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Introduction

Market gardens are generally small plots of land (0.25–2.0 acres) where farmers produce diverse vegetable, fruit, and/or flower crops to sell directly to consumers (Jeavons 2006). Sales can occur via community-supported agriculture shares (CSA), directly from the farm, at local farmers markets, and to local restaurants, stores, and co-ops. In this publication, market gardeners are referred to as growers or farmers and market gardens as farms. Market gardens may be located either within or outside the boundaries of incorporated cities.

Market gardens are generally managed to supply the greatest diversity of high-demand crops as long as possible throughout the year, as well as to optimize economic returns for growers. Crops are planted close together and rotated quickly to maximize the time that land is used for profitable crop production. High-value crops help ensure the most return per unit area. Greenhouses or high tunnels may be used to increase market garden production and sales.

Organic production practices are desirable to minimize risk of pesticide exposure to farm workers and the surrounding community. In addition, urban consumers are often willing to pay more for organic produce. Disadvantages include higher labor costs, especially for weed control and nutrient management, and potentially burdensome record keeping and application requirements for "certified organic" status. For some customers, growing practices that are either labeled or considered sustainable but are not certified organic may be acceptable. At the very outset, market gardeners should carefully survey customer preferences before determining their farm production practices.

Urban and suburban areas provide both opportunities and challenges for market gardeners. The most critical opportunity is the close proximity to year-round markets. Some fundamental challenges are potential objections by neighbors to noise, dust, and pesticide applications. However, market gardens can bring many advantages to communities, including a source of nutritious fresh food; added green space; more involved neighbors; educational opportunities for youth, seniors, low-income individuals, and speakers of different languages; and seasonal income for individuals and community organizations.

This publication presents guidelines for successful production and marketing of a market garden in Washington or Oregon west of the Cascades emphasizing annual vegetables. The plan is divided into two parts to emphasize the different and yet interrelated agricultural and economic issues involved. The reference section lists sources of additional support for effective production and marketing strategies. Three appendices provide planning templates that can be adjusted to individual needs and regions.

Part I: Field Considerations

Site History and Challenges

When choosing a site for your vegetable market garden, make sure it has full sunlight exposure (i.e., is not shaded by tall trees or buildings). This is especially important in western Washington and Oregon, where sunlight is naturally limited due to the number of overcast days. Most vegetable crops require at least six hours of direct sunlight a day to be productive (Taber et al. 2009); otherwise they will become leggy and mature late.

In urban areas, the soil may be contaminated with heavy metals such as lead, arsenic, or cadmium. Heavy metal contamination is generally due to past industrial operations (such as smelter plants), agricultural practices (such as the use of arsenic for apple orchard maintenance), or residues from lead-based paints or gasoline additives. Research has found that the greatest risk lies in direct intake of the soil rather than through consumption of vegetables grown in the contaminated soil. To learn more about heavy metal contamination, refer to Peryea (2001). To find out if your soil is contaminated, collect a soil sample and have it analyzed. Refer to Washington State Pest Management Resource Service (2009) for the nearest company that tests for heavy metals.

In urban and suburban areas, you may need farm security to prevent trespassing and theft of vegetables, tools, equipment, or water. Fences and locks will likely mitigate losses, but involving neighbors is usually a more comprehensive safeguard. Some mutually beneficial options are to host an open house for neighbors to visit the farm, contribute to local food banks, and employ local youth.

Field Conditions and Soil Fertility Management

The first step to understanding your farm's production capacity and fertility needs is to test your soil. Collect representative soil samples for each production block in late spring each year. For directions on how to collect a soil sample, refer to Hart et al. (1995). If the farm has the same type of soil throughout, combine the samples and submit a single representative soil sample for analysis. If there are distinctly different soils in various blocks, submit soil from each block as a separate sample.

Select a laboratory and follow its directions for submitting soil samples, which vary according to what you need tested. For a list of soil testing laboratories in the Pacific Northwest, refer to Washington State Pest Management Resource Service (2009). Utilize the same laboratory each time soil tests are conducted for measurement consistency. Analyze for soil pH; organic matter; macronutrients, including nitrogen (N)[1], phosphorus (P) and potassium (K); and micronutrients, including calcium (Ca) and magnesium (Mg). Soil test results will provide information regarding current levels in the soil and recommended application rates for the next crop.

Refer to North Willamette Research and Extension Center (2009) for vegetable crop nutrient application rates. Knowing what nutrients are needed will allow you to judiciously apply fertilizers, thereby saving money and reducing environmental damage due to over-application.

Compost. Many organic and sustainable farmers use compost to add nutrients and organic matter to improve soil tilth. In general, compost contains 0.5–3% nitrogen, phosphorus, and potassium. Refer to Antonelli et al. (2004b) for more information about the nutrient content of different composts. Use the percent nutrient content of compost to calculate its application rates. That is, every 1% of nutrient is one pound of nutrient per 100 pounds of compost. A general recommended compost application rate is two or more tons per acre or a layer of approximately two inches per vegetable bed. Use the actual nutrient content of the compost to more precisely calculate compost application rates. Ask your compost supplier for a copy of the compost nutrient analysis. If this is not available, collect a compost sample and send it to your soil testing laboratory for analysis.

Many small-scale farmers, especially in urban and suburban areas, have difficulty applying compost to field plots. Compost is heavy, and large volumes are needed to provide significant amounts of nutrients. Some low-tech solutions are to use a tractor-pulled wagon or wheel barrow for transporting compost to the beds, and then spread it evenly on the soil surface at a depth of about two inches. Till the compost into the soil before planting in late spring, mid-summer, and early fall. It is important to delay tilling if the soil is saturated, as this will damage the soil structure and cause soil compaction and heavy clods,

If the compost rate does not meet your crop's nutrient needs, supplement the remaining nutrients with purchased fertilizer. A useful online organic fertilizer calculator available from Oregon State University at http://smallfarms.oregonstate.edu/calculator/ enables you to determine the cost of fertilizer per nutrient unit (for example, cost per pound of nitrogen).

Crop Selection, Rotation, and Management

Market farmers usually produce relatively small amounts of a large variety of vegetables. It may take years of trial and error to determine which vegetables you can grow well and market successfully. Table 1 presents an example 8-year crop rotation plan that assumes an intensive production calendar. Rotating by crop family will help prevent disease buildup in the soil and take advantage of nitrogen fixation by leguminous crops.

The rotation plan in Table 1 includes crops that command high returns in local markets and have high productivity per unit area. Sweet corn and potatoes generally have good market demand, but are commonly produced in abundance by larger farms in the Pacific Northwest and sold at relatively low prices. In addition, both sweet corn and potatoes require large amounts of space, irrigation water, and nitrogen while returning only modest revenue. However, market gardeners with plenty of these resources might grow sweet corn and potatoes profitably.

In the 8-year rotation plan in Table 1, one-eighth of the farmed ground is in a given family each

[1] Requires special handling procedures.

Table 1. Eight-year planting rotation for a market garden.

Crop Year	Family	Sample crops	Management
1	Alliaceae/Liliaceae	green and bulb onions, garlic, shallots, leeks	Plant garlic in the previous fall; plant green onions in spring and late summer for 2 crops; plant leeks in late summer (following garlic harvest) for fall harvest.
2	Apiaceae	carrots, celery, parsnips, parsley, dill, cilantro	Plant carrots every 2 weeks from spring through summer; plant celery, parsnips, and dill in late spring; plant parsley and cilantro in late spring and summer.
3	Chenopodiaceae	beets (for tops and roots), chard, spinach	Plant all crops in early spring; plant spinach again in late summer for fall harvest.
4	Cucurbitaceae	cucumbers (lemon & green), summer and winter squash	Plant all crops in late spring.
5	Fabaceae	snow and snap peas, green and dry beans	Plant peas as early as ground is workable; plant again in late summer for fall harvest; plant beans from mid-May to mid-June.
6	Solanacea	tomatoes, peppers, eggplant	Plant in late spring with select early varieties.
7	Asteraceae	lettuce, endive	Plant from mid-spring through mid-summer for head lettuce and salad mix.
8	Cruciferae	cabbage, broccoli, cauliflower, brussel sprouts, radishes, turnips, kale, Asian greens, arugula	Use seed or transplants as recommended per crop. Plant all crops in early spring. Plant kale again in mid-summer for fall harvest or overwinter for spring harvest.

year. To accomplish this, divide the farmed ground into eight equal blocks, or an integer multiple of eight. In Year 1, plant Block 1 to Family 1, Block 2 to Family 2, etc., so that each successive block is planted to the next family in the sequence (e.g., Block 8 is planted to Family 8). In Year 2, plant Block 1 to Family 2, Block 2 to Family 3, and so on, until Block 8 is planted to Family 1.

This 8-year rotation has several advantages:

- It offers good disease protection over the long term.
- All listed vegetables are available for sale in most local farmers markets and have a proven customer demand and high projected revenue.
- The wide diversity of crops lowers economic risk. If yields and/or prices for one crop family are down one year, others may be up.
- The range of crops provides a welcome weekly and seasonal variety of vegetables for direct market customers.
- The rotation plan includes crops that are well adapted to cool spring and fall seasons to maintain a diversity of crop offerings for a longer period and to capture higher prices during these shoulder seasons.

The long rotation outlined in Table 1 also has some disadvantages:

- It requires careful long-term record keeping and spatial identification (e.g., numbered steel posts) for each block on the farm.
- Drainage or soil variations over the farm may prevent growing all planned rotation crops on all blocks. For example, if one area of the farm is not suitable for early-planted crops due to saturated soils, that subsection would require a different or shorter rotation.
- Intensive vegetable production requires a steady and reliable labor supply from March through November.
- The diverse rotation may not be equally suitable in all climatic zones of the Pacific Northwest.

Each market garden has advantages and limitations due to its geographic location and the preferences of its potential customers. These

factors will influence which crops to grow. For example:

- Short-season varieties of winter squash and other Cucurbitaceae are good choices for low-input, high-value crops. An added advantage of vining crops is their relatively low requirements for weed control and irrigation, which can make good use of surplus land.
- The various ethnic groups that live within your market area are likely interested in particular vegetables.

Vegetable cultural practices. For an overview of suitable varieties and cultural practices for the Pacific Northwest, refer to North Willamette Research and Extension Center (2009). Appendices I and II provide sample seed ordering information and seeding dates. Refer to your local Extension office for more area-specific information such as planting and harvest dates and seed and compost sources.

Many vegetable crops are most productively grown on raised beds. Intensive beds, where crops are grown closely together both in space and time, are well suited for small, non-mechanized market gardens. A particular advantage of intensive beds is that most of the field space is devoted to crop production, leaving less area where weed control is required. A 4-foot bed width will accommodate all crops listed in the rotation plan in Table 1; however, different crops will have a different number of rows per bed. For example, one 4-foot wide bed will accommodate one row of squash, two rows of broccoli, four rows of lettuce, and eight rows of green onions (Figure 1). See Kumar et al. (2009) for recommended row spacing for each crop. Use off-set rows to further optimize space.

Bed length depends on field size and available space. Raised beds with permanent retaining walls are not compatible with market gardens tilled with tractors. Some rototillers can operate in permanent raised beds, but most work best in beds that are at least 20 feet long.

Perennial crops. This publication is primarily devoted to annual vegetables; however, there are several perennial crops well suited to market gardening, such as asparagus, artichokes, herbs, and berries. These crops are promising because of their short establishment time (all but asparagus and some berry crops are harvestable in their first year), customer popularity, and high market value. Refer to Moulton and King (2008a and 2008b) if you are interested in growing tree fruit and alternative fruits.

Figure 1. A bed with four rows of different lettuce varieties.

Winter vegetable production. Winter vegetable production and marketing is an option, especially if the climate is mild. Several crops in the Cruciferae, Chenopodeaceae, Liliaceae, and Asteraceae families, such as hardy leafy greens, overwintering cabbage, broccoli, beets, leeks, radicchio, and endive, are suitable for winter production in some areas of the Pacific Northwest without weather protection. In regions that receive heavy rains, use raised beds for soil drainage and row covers for protection from damaging rains. Tunnels (also called hoophouses) provide protection from snow and frost, and row covers within tunnels add insulation from low temperatures. For winter production of tender leafy greens, tunnels are advisable throughout the Pacific Northwest (Figure 2). Labor availability is key during this time. For more information on winter vegetable production, refer to Coleman (1999).

Transplants

Greenhouse transplants are critical for successful market gardens. Relying on commercial suppliers is not cost-effective due to the diverse crops required, variety limitations, and seasonal demands for these crops. By growing your own starts, you can plan for timely availability, ensure variety selections, and obtain high-quality seedlings (Figure 3). In addition to using transplants on your farm, plant starts have good market value at farmers markets and farm stands.

Figure 2. Winter-grown greens in a tunnel.

If you do not have a greenhouse at your farm, a low-cost plan is available in Miles and Labine (2009). Another option is to rent space in a nearby greenhouse. The following questions should be considered when making this arrangement:

1. What is the cost for a leased greenhouse and what services are provided for this fee?
2. Is the greenhouse heated and does it have grow lights?
3. Who will be responsible for planting and maintaining seedlings?
4. If seedlings are to be transferred to pots prior to transplanting into the field, who will do this? Is there adequate space available at the greenhouse?
5. Who will be responsible for disease and insect pest management?
6. How will seedlings be "hardened off" before planting on the farm?
7. How will seedlings be moved from the greenhouse to the farm?

Tillage

Access to farm equipment can be a significant issue for small-scale farmers, so many rely completely on hand labor or small machines such as rototillers and lawn mowers. However, manual tillage for field preparation is probably too time consuming for all but very small farms, in which case permanent crop beds are advisable. Maintain alleyways between beds with mowed grass, a mowed cover crop, bark, or other mulch so you can concentrate fertilizer and weed management within beds.

Figure 3. On-farm transplant production in a heated, unlit greenhouse.

No-till and selective-tillage methods offer both opportunities and challenges. If you minimize soil tillage, weed seed germination and soil organic matter breakdown will decrease, and earthworm activity and soil tilth will increase. Nevertheless, tillage is usually the primary technique used to control weeds on organic farms.

It is easiest to maintain a no-till area after removing primary weeds. Add compost to the top of beds early in the season and leave on the surface to act as a mulch, thereby decreasing water evaporation and weed germination. Move the compost aside to plant direct-seeded crops and transplants into soil. For transplants, dig a suitable hole, place a few inches of compost into the bottom, insert the transplant, fill in the hole with soil, and cover the top with a few inches of compost.

Irrigation and Crop Water Use

In the Pacific Northwest, vegetable crops require summer irrigation. In order to irrigate a commercial crop from a well or any surface water supply, you must have a water right. The other option is to use city water, which can be very expensive. To reduce irrigation needs and take advantage of growing during spring and fall rainfall, the vegetable rotation plan provided in Table 1 emphasizes early spring planting of crops such as snap peas and beets, and mid-summer planting of crops such as kale and lettuce.

Overhead irrigation, such as sprinklers, is the least expensive to purchase, set up, and maintain, but has several significant drawbacks:

- Uses up to twice as much water as drip irrigation systems, substantially increasing water costs (Locascio 2005).
- Tends to irrigate a relatively large area, which is likely to result in over- or under-irrigation of some crops.
- Provides water for weed growth between plant rows, in alleyways, between beds, and on farm margins.
- Promotes many diseases that commonly attack vegetable crops in this region because it creates moist, cool conditions (Locascio 2005).

Compared to overhead irrigation, drip irrigation systems provide more precise and controllable water delivery to crop beds and in the long run are more cost-effective. Drip tape can be purchased from several suppliers in the region, and is easy to set up and move each year. Technical support staff and information are generally available at no cost from manufacturers and suppliers to aid in the planning of a system. Soaker hoses are an easy first step into drip irrigation, but are expensive, easily damaged, difficult to repair, and short lived. For more information regarding irrigation, refer to Peters et al. (2010).

Track water usage by recording the flow rate and the number of hours the irrigation system is on each day. A moisture probe is a good investment. This simple instrument can determine if moisture in the rooting zone is adequate even if the surface appears dry. Monitor crop growth and productivity and soil moisture to ensure each crop type is receiving an appropriate amount of water on a regular basis.

Mulch

Placing mulch over the drip irrigation tapes on your vegetable beds will conserve water. Mulch also controls weeds. Black plastic mulch can increase soil temperatures and is relatively inexpensive. On a small scale, lay plastic mulch over each bed and secure on the sides with a shovelful of soil every 5–6 feet. Another technique is to roll out the plastic and then run a wheel hoe next to it to throw soil onto the side. At the end of the season, roll up the plastic and store it for the next year or discard it. Do not leave plastic remnants in the soil or around the farm as they can easily become a serious pollutant. Many urban areas have agricultural/landscape plastic recycling programs. Check with your local Extension or recycling office.

Paper mulch is also available and effective, though it does not have the durability of plastic and usually begins to deteriorate within 3 months of application. An advantage of paper mulch is that it can be tilled into the soil at the end of the season. There are several commercial paper mulch products available. For more information regarding paper and plastic mulch, refer to Mount Vernon Northwestern Washington Research and Extension Center (2010b).

Weed Control

Weed control is the primary maintenance cost in vegetable farming. Many annual weeds can be effectively managed with hand weeding; however, perennial weeds such as quack grass and thistle are difficult to control with hand tools. If the farm is very weedy and has not been cultivated in several years, it will likely take 3–4 years to gain good weed control through cultivation. It may be worthwhile to plant a dense, unharvested cover crop that will control weeds in the first year. Mow the cover crop as needed to prevent weeds that have germinated in the field from going to seed. Another option is to plant vegetables in only a small area that can be effectively managed and cover crop the remaining ground. Thereafter, bring additional ground into cultivation, only expanding when the weeds are under control in the cultivated area.

To convert cover-cropped ground to vegetable ground, you will need to kill the cover crop by mowing or spraying an herbicide, followed by tilling. If you opt to spray, check with your local

Extension office to determine an appropriate product, and read the label for application directions. Depending on the capacity of the machine you use to till the soil, you may need to first remove the mowed crop debris.

As mentioned above, black plastic mulch and landscape fabric are effective and affordable for controlling weeds in beds and alleyways (Figure 4). Herbicides can also minimize weeds, but repeated applications over several years are required for complete control. Judicious use of synthetic herbicides is permitted on some sustainable farms, but not on certified organic farms.

Figure 4. Weed barrier in the alleys surrounding a bed of carrots.

Disease and Insect Pest Management

Because vegetable crops are susceptible to many diseases and insect pests, a good pest management program is necessary to maintain high quality, marketable crops. See North Willamette Research and Extension Center (2009) and the Pacific Northwest pest management handbooks (Hollingsworth et al. [2010], Ingham et al. [2010], and Peachey et al. [2010]) for the most comprehensive and current local management options.

Part II: Financial Aspects of Production and Sales

Revenue from Selected Crops

Table 2 displays a production and marketing plan for a sample market garden that optimizes revenue and balances production risk. This example is based on a 14,208 square foot market garden (approximately one-third of an acre, which does not include land needed for tool and equipment storage or vegetable cleaning, sorting, and packaging facilities) in the South Park neighborhood of Seattle (Taylor et al. 2010). The production area is divided into eight equal field blocks that each contain eight 4-foot by 35-foot raised beds. There are 2-foot alleys between beds.

Within a rotation sequence, each crop is assigned a proportion of space based on production need and market opportunity. For example, in rotation Sequence 2 (Apiaceae family), carrots are allotted 83% of the space, celery 5%, parsnips 5%, cilantro 5%, parsley 1%, and dill 1%. Accordingly, carrots occupy 6.6 beds (0.83 x 8 beds), as shown in Table 2. To best take advantage of this example, change the proportion of space allocated to each crop within a family, number of crops per rotation, size of the raised beds, and path sizes to meet your specific needs.

The total number of farmed square feet used to estimate revenues for one year in Table 2 is 20,957 square feet, which exceeds the 14,208 square foot garden due to double cropping. Double cropping means multiple crops mature over the course of a year from a single bed; for example, in rotation Sequence 8, radishes, broccoli, and Asian greens are harvested until mid-summer, followed by kale for autumn harvest. Revenue projections should also account for multiple saleable products from crops such as beets (roots and tops) and garlic (scapes and bulbs; Figure 5).

The third rotation sequence (Chenopodioideae) balances product timing and risk with revenue by combining lower-revenue chard (50 cents per square foot) with higher-revenue spinach and

Table 2. Potential yield and revenue for a 1/3-acre market garden.

Rotation	Planning Season	Crop	% of Spacing	Plots	Sq Ft	Yield/ Sq Ft	Unit	Price/Unit	Revenue/ Sq Ft	Total Revenue
1	previous fall	garlic	50	4.0	888	2.6	count	0.50	1.28	1,120.00
		garlic scapes	50	4.0	888	2.6	count	0.25	0.64	560.00
	early spring	onions, green	50	4.0	888	1.3	bunch	1.50	1.92	1,680.00
	late spring	onions, green	50	4.0	888	1.3	bunch	1.50	1.92	1,680.00
	late July	leeks, baby	100	8.0	1,776	1.5	count	0.50	0.75	1,317.65
2	spring	carrots	83	6.6	1,474	0.8	pound	2.00	1.53	2,231.04
		celery	5	0.4	89	0.4	plant	1.10	0.39	34.50
		parsnips	5	0.4	89	0.5	pound	1.00	0.53	46.67
		cilantro	5	0.4	89	11.5	bunch	2.50	28.63	2,507.46
		parsley	1	0.1	18	6.2	bunch	1.00	6.16	107.95
		dill	1	0.1	18	2.6	plant	1.00	25.6	44.80
3	spring	beets	50	4.0	888	0.7	pound	1.25	0.88	770.00
		chard	50	4.0	888	0.9	plant	0.50	0.43	373.33
	late summer	spinach	100	8.0	1,776	0.3	pound	4.50	1.44	2,520.00
4	late spring	cucumbers, trellised	40	3.2	710	1.6	count	1.00	1.60	1,120.00
		squash, summer	40	3.2	710	0.4	pound	2.00	0.80	560.00
		squash, winter	20	1.6	355	0.4	pound	1.50	0.60	210.00
5	early spring	peas, sugar snap	30	2.4	533	0.5	pound	3.00	1.41	739.20
		peas, snow	30	2.4	533	0.5	pound	3.00	1.41	739.20
	mid-summer	peas, sugar snap	30	2.4	533	0.5	pound	3.00	1.41	739.20
		peas, snow	30	2.4	533	0.5	pound	3.00	1.41	739.20
	June	beans, fresh shell	8	0.6	133	0.2	pound	6.00	1.34	176.40
		beans, dry colored	8	0.6	133	0.1	pound	3.00	0.19	25.20
		beans, green	25	2.0	444	0.2	pound	1.50	0.34	147.00
6	late spring	tomatoes, staked	70	5.6	1,243	0.9	pound	2.00	1.71	2,090.67
		eggplant, Asian	15	1.2	266	0.8	pound	3.00	2.40	630.00
		peppers	15	1.2	266	0.8	pound	2.00	1.60	420.00
7	early spring	salad mix	50	4.0	888	2.6	bag	3.00	7.67	6,720.00
		lettuce, head	50	4.0	888	0.6	count	2.00	1.28	1,120.00
8	early spring	radishes	20	1.6	355	1.3	bunch	1.95	2.49	873.60
	early spring	broccoli	40	3.2	710	0.4	pound	3.00	1.06	739.20
	early spring	greens, Asian	40	3.2	710	0.9	plant	1.50	1.28	896.00
	summer	kale	20	1.6	355	1.3	pound	2.00	2.56	896.00
Grand Total				**94.4**	**20,957**					**34,574.26**

Note: The square footage of the garden area is composed of 4 ft x 35 ft plots surrounded by 2 ft paths on all sides. This table assumes a garden area of 14,208 sq ft, which is slightly less than one-third of an acre. This total square feet of 20,957 exceeds 14,208 because of double cropping in some rotations. Yields are based on Antonelli et al. (2004a). Prices are based on information from local supermarkets and investigators' estimates.

Figure 5. Garlic scapes, which are a secondary crop harvested from garlic plants that can be sold as a niche-market vegetable.

beets. While chard has a low sales value, it also has relatively low production risk. Chard leaves can be harvested multiple times throughout the growing season, are productive with relatively low inputs, and continue to be productive in the heat of the summer after spinach goes to seed.

The fourth rotation sequence (Cucurbitaceae) includes cucumbers, summer squash, and winter squash. Winter squash—including delicata, acorn, butternut, spaghetti, small sugar, and many others—can be successfully grown in the Pacific Northwest, are nutritious, and keep well in storage for late-fall sales. Storage can also improve eating quality for many types of winter squash. For later maturing varieties, leave fruit on the vine until just before the first killing frost.

The fifth rotation sequence (Fabaceae) includes peas and beans. Pea harvest declines by mid-July, and the crop can be removed and replanted to peas for a fall harvest. Plant both green bean and dry bean varieties. Dry beans can be harvested at two stages of maturity—fresh shell bean and dry bean. In this way, it is possible to harvest beans in mid-summer (green beans), late summer (fresh shell), and fall (dry beans). For more information on fresh shell and dry beans, refer to Mount Vernon Northwestern Washington Research and Extension Center (2010a).

The seventh rotation sequence (Asteraceae) includes head lettuce and salad greens in multiple plantings for early summer through late fall harvest and sales (Appendix III). Lettuce is ideally suited to spring, summer, and fall production in the Pacific Northwest, and, with rain cover or tunnels, it is also productive during winter. Transplant head lettuce into the beds as soon as the soil is workable and every two weeks thereafter until June 15. Depending on the climate in your area, it may be possible to plant lettuce as early as February. For a fall harvest, plant into field beds no later than August 15. Crop quality will be limited in the fall by heavy rains, cold temperatures, or snow, but can be cost-effective in some years and regions.

Projected yields and revenue per square foot are presented in Table 2. Three principles underlie this high-revenue plan and help to avoid excessive risk:

- Select the highest revenue crops within plant families. For example, in rotation Sequence 6 (Solanaceae), staked tomatoes (Figure 6) generate $1.71 per square foot and are therefore preferable to unstaked tomatoes, which generate only $1.32 per square foot.
- Utilize double cropping to grow high-revenue crops during shoulder seasons in some rotation sequences. These shoulder-season crops include radishes, green onions, baby leeks, kale, and spinach for spring and/or fall harvest.
- Harvest multiple products from the same crop when possible, such as garlic scapes in early summer and garlic bulbs in mid-summer; beet tops harvested as greens in

Figure 6. Staked tomatoes as an example of a high quality product with marketable yield.

early summer and beet roots harvested in mid-summer through fall; and fresh shell beans harvested in late summer and dry beans harvested in fall.

Once revenue from doubled-cropped and multiple-product crops is accounted for, the estimate of annual gross revenue for the 14,208-square-foot market garden increases to $34,574. This estimate describes gross revenue, not profit or net return.

Gross revenue versus net return. To obtain net return, subtract annual capital costs and annual variable costs from the farm's gross revenue. Tally your durable equipment and supplies to determine capital costs. The durable items detailed in the following section impose annual capital costs in the form of depreciation, interest, personal property taxes, equipment housing, and insurance, if any. Although these costs do not vary by crop choice, they depend highly on the degree of mechanization, type of irrigation system, length of time durable items are used, and equipment salvage values. For more information on how to account for fixed costs on your farm or garden, see Carkner (2000) and School of Economic Sciences (2009).

Variable costs for seeds are relatively small. While water needs vary by crop, the recommended water-conserving drip irrigation system will maintain water costs at moderate levels for all crops. However, compost and other fertilizer costs can be substantial. Careful record keeping is critical to accurately account for particular variable costs.

Labor costs. Labor is by far the largest variable cost if you formally hire employees. Many market farmers prefer to see the returns to their labor as part of their take-home earnings rather than as a cost. Others may not want to deduct a cost for their own or family labor if it has recreational value or few alternative paid opportunities are available. In situations where there is a volunteer, rotating, untrained labor force, work times are often difficult to track. If you decide to deduct labor costs, you will need to keep records of labor hours and costs per activity and crop.

Equipment and Supplies

Successful, intensive vegetable production requires durable equipment and supplies. While the initial costs for good quality may seem high, in the long run you will spend less time and money because of reduced needs for repair and replacement.

Trellises. Intensive tomato, cucumber, pea, and pole bean production requires strong, durable trellising. Allowing plants to sprawl requires at least one and one-half times and up to twice the space compared to trellised crops. In addition, trellising increases yields, reduces diseases, and increases market quality.

One cost-effective trellis system is posts and twine. This system is easy to install, maintain, remove, and store in the off-season. Use 8-foot posts buried at least 2 feet deep. This leaves up to 6 feet to support crop growth. Install posts after emergence (if direct seeded) or transplanting, and strand the first level of twine when plants are 6–8 inches tall. Refer to Horticulture and Landscape Architecture (2009) for more detail.

Drip irrigation. Access to sufficient water at convenient locations throughout the farm is critical to successful market gardening. For the short term, set up drip irrigation tape annually in each bed and a regular garden hose to connect the drip tape to outlets. For the long term, consider installing underground pipe within each farm section and outlets at the top of each bed. Refer to Peters et al. (2010) for recommendations regarding flow rates, dimensions, and other design issues. Roll drip tape at the end of the season and store in a shed or outside under a tarp.

Black plastic mulch. Effective weed control and moisture retention is essential for successful market gardening. Black plastic mulch can be purchased at local suppliers or via the Internet. It can cost less from Internet suppliers even with shipping. For annual weeds, 1.0-millimeter thickness or less is adequate. For aggressive perennial weeds, use a thickness of 1.0 millimeter or greater. Landscape fabric that is 4.0 millimeters thick is more effective and durable, but more expensive. Plastic mulch of any thickness can be rolled and stored over the winter or recycled through local agricultural recycling programs.

Mechanical tillage. Hand tilling soil requires substantial labor. Options include contracting with a local farmer to custom till your farm, leasing equipment, or purchasing your own equipment. A walk-behind tractor-tiller can be cost-effective for a market garden smaller than 1 acre. However, issues to consider are:

- Will there be a long-term need for a tiller if no-till or selective-tillage practices are feasible?
- Will cash flow or savings permit purchasing a tiller during start-up years before production and marketing practices are adequately resolved?
- Will cash flow permit paying annual expenses for a tiller (e.g., maintenance, repairs, storage, and operations training)?

Tunnels. Tunnels are used successfully throughout the Pacific Northwest to provide increased air temperatures during the summer months in cooler subregions for crops such as peppers and tomatoes (Figure 7), and for protection from heavy rains, hail, or snow in winter months. However, reinforced tunnels are needed in areas that receive large amounts of snow or strong winds. Another important consideration for using tunnels is the added labor and management they require, including irrigation. Winter vacations for farmers and staff will negate plans for winter production protected by tunnels.

Labor Supply and Management

Unless your market garden is so small that you can do all the needed work, labor availability and quality can pose a continuing challenge. Some of the many considerations include both training and oversight of seeding, trellising, installing and monitoring drip irrigation, controlling weeds, composting, harvesting, and marketing.

A small market farm of the size discussed in Revenue from Selected Crops requires a general manager from mid-March through mid-November, up to six days per week, to be responsible for farm planning, ordering supplies, hiring, scheduling, and market delivery. Scheduling includes farm operations such as seeding, transplanting, and harvesting, as well as assigning work days and tasks to field crew members. It is very helpful to have one or two reliable field crew members who can pick up task lists each morning and carry them out with minimal supervision. If your market garden is one-half acre or larger, you will need a field manager who is responsible for scheduling, assigning, and supervising farm operation tasks as well as participating in these tasks.

Estimating labor needs and the ability to pay for labor will be a challenge in the first year.

Figure 7a. Peppers grown in a low tunnel; cover is off when days are very hot.

Figure 7b. Tomatoes grown in a high tunnel; ends and sides are open for maximum ventilation and cooling during hot weather.

The following are additional labor issues and recommendations:

- Job descriptions and expectations that identify who is responsible for what tasks when, how and when employees are paid, unemployment and health benefits, and who to call at what number if an employee is sick or late.
- Farm safety and security precautions regarding vehicles, tillage equipment, the irrigation system, and fertilizer and pesticide application (if applicable). This includes specifying what is required and who is responsible for shutting down the farm at the end of the day.
- Instructions on how to safely handle, maintain, and store tools, and what to do when something breaks.
- Organic regulations, practices, and record keeping, if applicable.

- When and who will create the annual production plan, including crops grown, where grown, sequence of crops, harvest plan, and farm map.
- Marketing, customer relations, pickup and delivery of vegetables, money handling, and record keeping.

Direct Marketing Plan

In addition to a production plan, a business or marketing plan should guide both current and future management decisions. In urban and suburban areas, there are several market options to consider.

Farmers markets. Probably the most common form of direct marketing is through a farmers market. Farmers markets are an attractive market outlet because they are held in an established location on specified days, and they have an established customer base. In most farmers markets, farmers rent stall spaces and provide their own tables, awnings, and other supplies. By joining an existing market, you can avoid some of the startup costs of location selection and advertising.

The success of farmers markets varies depending on the quality and number of vendors, as well as the size, tastes, and disposable income of the customer base. While some markets in Seattle, for example, have waiting lists for vendors, markets in smaller areas readily welcome new vendors. These differences tend to reflect the reputation of the market and size of the customer base.

Community-supported agriculture. Another market outlet to consider is a community-supported agriculture (CSA) program. Sometimes referred to as subscription farming, a CSA allows customers to purchase a share of the farm's production for a full-season price. The variety of produce customers receive varies across the growing season and the total volume can be affected by growing conditions. Shareholders commit to their CSA farmer for a full season and often have the opportunity to visit the farm or participate in harvest[2]. It is common for shareholders and CSA farmers to communicate via newsletters or email about the progress of crops, suggested recipes, or other interesting aspects of the farm.

Marketing strategies for CSAs should be adapted to the arrangements that best suit the farmer and their customers. Examples of some marketing strategies are presented here to give a more detailed idea of the opportunities that a CSA can offer. Typically, a grower will sell shares in the CSA to customers at the beginning of the year. This share allows the customer to become a member or subscriber entitled to a regularly scheduled box of produce that is seasonal and locally grown. Some CSAs allow weekly, biweekly, or monthly subscriptions.

A summary of share prices gathered from a survey of CSA websites in the Seattle area is given in Table 3. Most of the CSAs in this survey provided organic produce and some offered half shares or weekly rates. The weekly delivery season usually starts in June and lasts through October, an average of 21 weeks. However, the production plan in Table 2 extends deliveries from May through November, or about 28 weeks.

The sale of CSA shares at the beginning of the growing season provides a stable income source that you can use to secure resources and materials needed to get the CSA started for the year. Recruit subscribers by targeting the program to a group of centrally-located shareholders. You can then choose a single drop-off site for the group to reduce delivery costs and increase pickup convenience, such as a subscriber's place of work at a large corporation or business park.

[2] Before you allow on-farm visits or participatory harvest, talk to your farm insurer about the potential need for additional liability insurance.

Table 3. Community-supported agriculture share prices in the Seattle area, 2009.

	Average	Standard Deviation	Minimum	Maximum	Number of Observations
Season Price	$665.27	$150.84	$475.00	$990.00	11
Season Duration (weeks)	21	2	20	25	9

Note: Share prices were collected by the authors and based on weekly delivery of a medium-sized basket which feeds 2 to 3 people.

While the projected production in Table 2 serves as a guide for estimating the appropriate number of shares for the CSA, over-production and under-production may occur during the growing season. These situations provide both challenges and opportunities. Over-production relative to the needs of CSA shareholders must be marketed or donated in a timely fashion to avoid spoilage. Often, surplus or poor-quality produce is tilled back into the soil.

The following are three possible outlets for surplus quality produce:

- Establish a farm stand and sell to customers directly from the farm.
- Allow neighbors to glean or pick up a free box.
- Donate to a local food bank.

Consistent over-production could lead to expansion of CSA shares or an on-farm store in the future. Under-production of high-quality vegetables is a more likely situation during the first few years. Learning to grow new vegetables, irrigation shortfalls, labor scarcity, and adverse weather can all lead to crop failures, thereby limiting your ability to fill CSA shares at the promised level. In this situation, it is advisable to use a weekly email newsletter to keep shareholders apprised of the situation and reasons for under-production.

Another way to maintain good customer relations is a policy to reimburse or compensate shareholders for under-production. Include this policy in the CSA membership information and emphasize it when money is collected for the share. One possible form of compensation is to refund the value of the lost produce at the end of the season. Another option is to extend the delivery season if late-season crops are available. Additional experience with both production and marketing will allow you to adjust these plans and maximize the returns for your efforts.

Other direct market outlets. In addition to farmers markets and CSAs, you should consider roadside stands, pick-your-own produce, and selling directly to restaurants or co-ops. The location of your farm or stand will have a large effect on the customer base and regular flow of traffic, while selling to restaurants or stores will require contracts for regular shipments and the ability to provide a consistent quantity of specific quality products. A combination strategy is a good option so that you do not depend solely on one type of market outlet. Ultimately you need to consider the benefits, costs, and requirements of various marketing strategies when deciding how to sell your produce.

Conclusions

Market gardening can provide both personal satisfaction and supplementary, or even full-time, income. Many people derive great satisfaction from seeing plants grow and produce nutritious food for themselves and their communities. An even greater source of satisfaction is learning from your successes and failures. Farming can be a great outlet for a curious and scientific mind because there is always more to learn.

Earning an income commensurate with the mental and physical efforts demanded from market gardening requires careful planning and discipline. The authors hope that the information provided here and in the listed references will make this planning process more enjoyable and likely to result in a successful market garden. There is, however, no substitute for direct experience on your particular farm and with your customer base. Place some seeds in your soil, survey your potential customers, and enjoy learning how to tend, harvest, and market your crops.

References and Further Reading

Antonelli, A., R.S. Blyther, S.J. Collman, R.E. Thornton, and R. Van Denburgh. 2004a. Home Gardens. Washington State University Extension Publication EB0422. http://cru.cahe.wsu.edu/CEPublications/eb0422/eb0422.pdf.

Antonelli, A., C. Cogger, H. Kennell, C. Foss, R. Van Denburgh, and V. Bobbitt. 2004b. Organic Gardening. Washington State University Extension Publication EB0648. http://cru.cahe.wsu.edu/CEPublications/eb0648/eb0648.pdf.

Bachmann, Janet. 2009. Market Gardening: A Start Up Guide. National Sustainable Agriculture Information Service. http://attra.ncat.org/attra-pub/marketgardening.html.

Bary, Andy, Craig Cogger, and Dan M. Sullivan. 2000. Fertilizing with Manure. Washington State University Extension Publication PNW0533. http://cru.cahe.wsu.edu/CEPublications/pnw0533/pnw0533.pdf.

———. 2002. Fertilizing with Yard Trimmings. Washington State University Extension Publication EB1926E. http://cru.cahe.wsu.edu/CEPublications/eb1926e/eb1926e.pdf.

Burt, Larry, Curt Moulton, and Jim Kropf. 2008. Marketing Alternatives for Fresh Produce. Pacific Northwest Extension Publication PNW241E. http://extension.oregonstate.edu/catalog/pdf/pnw/pnw241-e.pdf.

Carkner, Richard. 2000. Using Enterprise Budgets for Making Decisions on your Farm. Washington State University Extension Publication PNW0535. http://cru.cahe.wsu.edu/CEPublications/pnw0535/pnw0535.pdf.

Cogger, Craig. 2000. Soil Management for Small Farms. Washington State University Extension Publication EB1895. http://cru.cahe.wsu.edu/CEPublications/eb1895/eb1895.pdf.

Coleman, Eliot. 1999. *Four Season Harvest*. White River Junction, VT: Chelsea Green Publishing Company.

Fairplain Publications. 2010. *Growing for Market*. http://www.growingformarket.com/.

Hart, J.M., M. Robothom, and E.H. Gardner. 1995. Soil Sampling for Home Gardens and Small Acreages. Oregon State University Extension Service EC 628. http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/18696/ec628.pdf.

Hollingsworth, Craig S., Art Antonelli, and Ronda Hirnyck, eds. 2010. Pacific Northwest Insect Management Handbook MISC0047. http://insects.ippc.orst.edu/pnw/insects.

Horticulture and Landscape Architecture. 2009. Trellising Systems: The Florida Weave. Colorado State University. http://www.specialtycrops.colostate.edu/techniques/trellis.htm.

Ingham, R. , J. McMorran, C.M. Ocamb, J.W. Pscheidt, and M. Putnam, eds. 2010. Pacific Northwest Plant Disease Management Handbook MISC0048. http://ipmnet.org/plant-disease/index.cfm.

Jeavons, J. 2006. How to Grow More Vegetables, Fruits, Nuts, Berries, Grains, and Other Crops than You Ever Thought Possible on Less Land than You Can Imagine. Berkeley, CA: Ten Speed Press.

Kumar, G.N.M., F.E. Larsen, and K.A. Schekel. 2009. Propagating Plants from Seeds. Washington State University Extension Publication PNW0170. http://cru.cahe.wsu.edu/CEPublications/pnw0170/pnw0170.pdf.

Locascio, Salvadore J. 2005. Management of Irrigation for Vegetables: Past, Present, and Future. *HortTechnology* 15(3): 482-485.

Miles, Carol and Pat Labine. 2009. Portable Field Hoophouse. Washington State University Extension Publication EM015. http://cru.cahe.wsu.edu/CEPublications/em015/em015.pdf.

Miles, Carol A. and Madhu Sonde. 2003. Pea Shoots. Pacific Northwest Extension Publication PNW0567. http://cru.cahe.wsu.edu/CEPublications/pnw0567/pnw0567.pdf.

Miles, C., J. Roozen, E. Maynard, and T. Coolong. 2010. Fertigation in Organic Vegetable Production Systems. Washington State University Extension eOrganic. http://www.extension.org/article/29712.

Moulton, Gary A. and Jacky King. 2008a. Fruit Handbook for Western Washington: Varieties and Culture. Washington State University Extension Publication EB0937. http://cru.cahe.wsu.edu/CEPublications/eb0937/eb0937.pdf.

———. 2008b. New Alternative Fruit Crops for Western Washington. 2006. Washington State University Extension Publication EB2002. http://cru.cahe.wsu.edu/CEPublications/eb2002/eb2002.pdf.

Mount Vernon Northwestern Washington Research and Extension Center. 2010a. Vegetable Research and Extension. Washington State University. http://vegetables.wsu.edu/.

———. 2010b. Vegetable research and Extension: Plasticulture. Washington State University. http://vegetables.wsu.edu/plasticulture.html.

North Willamette Research and Extension Center. 2009. Commercial Vegetable Production Guides. Oregon State University Agricultural Experiment Station and Extension Service. http://nwrec.hort.oregonstate.edu/vegindex.html.

Peachey, Ed, Dan Ball, Andy Hulting, Joseph Yenish, Tim Miller, Don Morishita, and Pam Hutchinson, eds. 2010. Pacific Northwest Weed Management Handbook MISC0049. http://uspest.org/pnw/weeds.

Peryea, Frank J. 2001. Gardening on Lead- and Arsenic-contaminated Soils. Washington State University Extension Publication EB1884. http://cru.cahe.wsu.edu/CEPublications/eb1884/eb1884.pdf.

Peters, R.T., H. Neibling, and M. English. 2010. Irrigation in the Pacific Northwest. http://irrigation.wsu.edu/.

Puyallup Research and Extension Center. 2010. Organic Farming Systems and Nutrient Management: Composts. Washington State University. http://www.puyallup.wsu.edu/soilmgmt/Composts.htm.

School of Economic Sciences. 2009. Farm Management: Budgets. Washington State University. http://farm.mngt.wsu.edu/budgets.htm.

Seattle Youth Garden Works. 2008. Unpublished farm records from the Marra Farm, Seattle, Washington, Spring.

Small Farms. 2010. OSU Organic Fertilizer and Cover Crop Calculator. Oregon State University Extension. http://smallfarms.oregonstate.edu/calculator.

Small Farms Team. 2010a. Composting. Washington State University. http://smallfarms.wsu.edu/soils-compost/composting.html.

———. 2010b. Marketing. Washington State University. http://smallfarms.wsu.edu/marketing_CSA.php.

Taber, H.G., R. Jauron, and D. Nelson. 2009. Where to Put Your Vegetable Garden. Iowa State Extension PM 814. http://www.extension.iastate.edu/Publications/PM814.pdf.

Taylor, M., D. Young, and C. Miles. 2010. Direct Marketing Alternatives in an Urban Setting: A Case Study of Seattle Youth Garden Works. *Journal of Natural Resources and Life Sciences Education* 39: 165-172.

Washington State Pest Management Resource Service. 2009. Analytical Laboratories and Consultants Serving Agriculture in the Pacific Northwest. Washington State University. http://www.puyallup.wsu.edu/analyticallabs/.

Services

Cascade Harvest Coalition. A mentoring program for farmers trying to stay involved in production agriculture.
4649 Sunnyside Avenue North, Room 123,
Seattle, WA 98103
Phone: 206-632-0606, Fax: 206-632-1080
http://www.cascadeharvest.org/programs/washington-farmlink

Environmental Assurance Monitoring, LLC. Test kits for dioxins and PCBs.
10336 Long Street, Overland Park, KS 66215
Phone: 913-825-9000, Fax: 913-825-9000,
Email: info@eamonitor.com

Washington State University County Extension. http://ext.wsu.edu/locations/

Appendix I

Sample list of seeds to purchase for a vegetable market garden (adapted from Seattle Youth Garden Works 2008).

Crop	Source[1]	Cost/Unit[2]	Unit/s	Total Price
Asian Greens—Mei Qing Choi	Johnny's	12.20/5,000 seeds	1	12.20
Asian Greens—Mizuna	Johnny's	5.55/oz	1	5.55
Asian Greens—Tatsoi	Johnny's	5.80/oz	1	5.80
Asian Greens—Braising Mix	Johnny's	55.80/lb	1/4	13.95
Basil—Siam Queen	Territorial	2.53/gram	2	5.05
Basil—Aroma I	Territorial	1.93/gram	2	3.85
Basil—Sweet	Territorial	0.81/gram	4	3.25
Beans—Provider Bush	Johnny's	11.80/lb	1/2	5.90
Beans—Carson Yellow Bush	Johnny's	4.85/1,000 seeds	1	4.85
Beans—Kentucky Wonder Pole	Territorial	2.45/packet	1	2.45
Broccoli—Umpqua	Territorial	2.90/sampler	1	2.90
Carrots—Pelleted Nelson	Johnny's	3.50/packet	1	3.50
Carrots—Rainbow	Johnny's	4.25/packet	1	4.25
Carrots—Scarlet Nantes	Johnny's	3.05/packet	1	3.05
Chard—Bright Lights	Johnny's	5.20/1,000 seeds	1	5.20
Coriander—Santo	Territorial	0.58/gram	4	2.35
Cucumber—Lemon	Johnny's	2.30/mini	1	2.30
Escarole—Natacha	Johnny's	49.20/oz	1/8	6.15
Kale—Dinosaur	Territorial	3.45/packet	1	3.45
Lettuce—Red Sails Oak Leaf	Territorial	4.50/packet	1	4.50
Lettuce—Simpson Elite	Territorial	4.50/packet	1	4.50
Lettuce—Romaine, Volmaine	Territorial	3.10/packet	1	3.10
Lettuce—Deer Tongue	Johnny's	3.75/packet	1	3.75
Lettuce—Salad Mix	Johnny's	125.20/lb	1/4	31.30
Onions—Purplette	Johnny's	4.75/packet	1	4.75
Peas—Sugar Sprint Snap	Territorial	3.10/packet	1	3.10
Peppers—Ancho Magnifico	Territorial	7.75/100 seeds	1	7.75
Peppers—Early Jalapeño	Territorial	3.20/packet	1	3.20
Peppers—Golden Star	Territorial	8.05/packet	1	8.05
Peppers—Gypsy	Territorial	6.95/100 seeds	1	6.95
Peppers—Islander (lilac)	Johnny's	14.95/100 seeds	1	14.95
Peppers—Miniature Bells	Territorial	3.05/sampler	2	6.10
Radiccio—Chioggia Red	Johnny's	72.80/oz	1/8	9.10
Radiccio—Fiero	Johnny's	66.00/oz	1/8	8.25
Scallions—Deep Purple	Johnny's	5.35/packet	1	5.35
Spinach—Tyee	Johnny's	0.85/1,000 seeds	5	4.25
Tomatoes—Stupice	Totally Tomatoes	116.00/oz	1/8	14.50
Tomatoes—Manitoba	Totally Tomatoes	76.00/oz	1/16	4.75
Tomatoes—Taxi	Totally Tomatoes	158.40/oz	1/32	4.95
Tomatoes—Prudens Purple	Totally Tomatoes	176.00/oz	1/32	5.50
Tomatoes—Margherita Hybrid	Totally Tomatoes	100 seeds	1	10.50
Tomatoes—Amish Paste	Totally Tomatoes	148.80/oz	1/32	4.65
Tomatoes—Isis Candy	Totally Tomatoes	184.00/oz	1/32	5.75
Tomatoes—Juliet Hybrid	Totally Tomatoes	198.40/oz	1/32	6.20
Tomatoes—Sun Gold	Totally Tomatoes	308.00/oz	1/8	38.50
Tomatoes—Tiny Tim	Totally Tomatoes	95.20/oz	1/16	5.95
Tomatoes—Black Krim	Tomato Growers	156.80/oz	1/16	9.80
Tomatoes—Snow White Cherry	Tomato Growers	192.00/oz	1/32	6.00
Tomatoes—Early Girl	Tomato Growers	243.60/oz	1/8	30.45
Turnips—Scarlett Queen	Johnny's	2.85/mini	1	2.85
			Sub-total	$375.30
			Handling	18.20
			TOTAL	**$393.50**

[1]The use of a company name is not intended to endorse or detract from any company listed or not listed, respectively.
[2]Units presented in this table are specific to each seed supplier; read supplier information carefully to determine how many seeds are in their packet, sampler, and mini.

Appendix II

Sample seeding calendar for a Seattle, WA, vegetable market garden[1] (adapted from Seattle Youth Garden Works 2008).

Month	Time to Maturity	Month																												
		Feb		March				April				May				June				July				August				Sept		
		18	25	3	10	17	25	7	14	21	28	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25	1	8	15
Arugula	3-6 wks				X			X			X			X			X								X			X			X
Basil	6-8 wks						X	X	X					X				X			X										
Beans, Bush	7-8 wks														X		X		X												
Beets	8-9 wks				X				X				X			X			X			X			X						
Bok Choy	6-7 wks			X		X		X			X			X			X							X			X		X		X
Braising Mix	4 wks				X				X				X				X							X				X			
Broccoli	8-9 wks		X				X					X										X									
Carrots	9-11 wks						X	X		X			X			X			X		X										
Cauliflower	8-12 wks					X		X				X			X																
Celery	15-19 wks			X																											
Chard	7-8 wks	X		X				X										X		X											
Cilantro	7-8 wks						X				X														X			X			
Collards	12 wks		X			X	X											X													
Cucumbers	7-10 wks									X																					
Dill	6-8 wks				X																										
Eggplant	10-11 wks								X																						
Fennel	10-11 wks							X								X															
Garlic	50-52 wks																													X	
Kale	8-9 wks		X			X	X			X				X									X								
Leeks	16-24 wks	X																X													
Lettuce, Head	8-10 wks			X			X			X			X			X			X			X			X						
Onions, Bulb	16-20 wks				X																										
Onions, Green	10-12 wks	X				X				X												X									
Parsley	8-10 wks				X																										
Peas, Snap	10-11 wks		X					X														X									
Peppers, Hot	10-12 wks		X		X																										
Peppers, Sweet	8-12 wks			X		X																									
Radishes	3-4 wks				X			X			X			X											X			X		X	
Salad Mix	4 wks				X			X			X			X			X			X			X			X			X		
Spinach	4-7 wks					X			X			X			X													X		X	
Squash, Summer	7-9 wks								X																						
Squash, Winter	12-17 wks									X																					
Tomatillos	8-10 wks						X																								
Tomatoes	8-13 wks			X	X		X																								
Tomatoes, Husk	9-11 wks					X																									
Turnips	5-10 wks					X				X		X														X					

[1]Shaded cells indicate direct sowing in the field; non-shaded cells indicate seeding in a greenhouse. Transplant into beds 4-6 weeks later or when seedlings have their first two true leaves.

Appendix III

Sample monthly harvest schedule for a vegetable market garden.

May	June	July
Asian greens Baby beets Beet greens Bulb onions Chard Cilantro Dry beans[1] Leeks Radishes Salad mix Snow peas Spinach	Asian greens Baby parsnips Beet greens Beets Carrots Chard Cilantro Garlic scapes Head lettuce Leeks Parsley Radishes Salad mix Spinach Snap peas Snow peas	Asian greens Beet greens Beets Bulb onions Carrots Chard Cilantro Cucumbers Dill Green beans Head lettuce Kale Parsley Parsnips Radishes Salad mix Snap peas Summer squash

August	September	October
Asian greens Beet greens Beets Broccoli Carrots Celery Chard Cilantro Cucumbers Dill Fresh shell beans Head lettuce Garlic Green beans Kale Parsley Parsnips Radishes Salad mix Summer squash Tomatoes	Asian greens Beet greens Beets Broccoli Carrots Celery Chard Cilantro Cucumbers Dill Eggplant Fresh shell beans Garlic Green onions Kale Parsnips Parsley Peppers Radishes Salad mix Snap peas Snow peas Spinach Summer squash Tomatoes	Asian greens Baby leeks Beet greens Beets Carrots Chard Cilantro Dry beans Garlic Green onions Head lettuce Kale Parsley Parsnips Salad mix Snap peas Snow peas Spinach Winter squash

November	
Baby leeks Beet greens Beets Carrots Chard Dry beans Garlic Green onions	Head lettuce Kale Parsley Parsnips Salad mix Spinach Winter squash

[1]From the previous year.

Use pesticides with care. Apply them only to plants, animals, or sites as listed on the label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

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