Case Study: Intervale Community Farm

Member-owned Intervale Community Farm (ICF) is located in the heart of Burlington, Vermont, on the site of the city's last dairy farm. It was started in 1990 as a not-for-profit Community Supported Agriculture (CSA), and currently has nearly 500 members. Andy Jones has been the farm's manager since 1994. Andy, assistant farmer Becky Maden, and a staff of seven seasonal employees produce 20 acres of vegetables, flowers, and berries for member households. The farm is one of the oldest CSAs in Vermont, and is the single largest.

The Intervale is a 1,500-acre flood-plain delta at the mouth of the Winooski River, and is home to twelve other small farms, creating what Andy describes as a "collegial and supportive community of farmers and entrepreneurs." The farm sits on a level, well-drained soil that is suited to vegetable production. Although the weather at the Intervale is slightly moderated by Lake Champlain, the growing season is still relatively short. It is considered a cold Zone 5 or a warm Zone 4, with the average last frost on May 12, and first fall frost on October 1.

The farm's produce is distributed for about 22 weeks, from mid-June to early November. Members visit the farm each week during that period to pick up their shares and harvest their own flowers, herbs, peas, beans, berries, and cherry tomatoes. The weekly share includes baby salad greens, carrots, broccoli, cucumbers, and tomatoes, among other vegetables.

Andy says that the field-grown tomato season lasts five to six weeks—from early August through mid-September. Because member surveys indicated that tomatoes are favorite crops, Andy started using high tunnels in 1999 to ensure a steady supply of tomatoes to his shareholders.

ICF has a total of six tomato tunnels. Four are 14' x 96' units. Two measure 14' x 144', and have sides that are about 18 inches higher than in the other four. The gothic-shaped structures were made by Ledgewood Greenhouses in New Hampshire. Andy selected the structure for its strength, snow-shedding design, and economical cost, which was about $0.90 per square foot.

The frame cost between $1,200 and $1,250, not including the roll-up sides. The taller sidewalls added a couple hundred dollars to the purchase price but are well worth the price. In 2003, the four-year, six-mil greenhouse plastic that Andy uses costs about $350 for a 28' x 100' piece. The total cost of the high tunnel, including structural steel, wood for end-walls and sideboards, hardware, and the labor to construct it, was approximately $2,000 for a 14' x 96' house. Andy calculates a yearly cost of $400 to own the 14' x 96' structure, basing this figure on a ten-year payback. However, the metal tubing of the frames should last much longer. Andy estimates that the wood parts of the structure (hip boards, baseboards, and end walls) need replacing every 10 years.

Andy seeks a nice mid-size (7 to 10 ounce) red tomato for the bulk of the production. For the taller tunnels, which are trellised overhead, ICF has been using the 'Buffalo' variety and is currently trialing replacement greenhouse cultivars that are as flavorful and productive. In the shorter tunnels, where the tomatoes are trellised with a basket weave method, the main red tomato has been 'Jetstar.' This cultivar has a beautiful appearance, moderate size, and good flavor. 'Jetstar' is less resistant to *Fulvia*, though, so Andy continues to look for others. 'Big Beef' is a pretty good choice, but runs a bit larger than Andy likes for the CSA. Andy's trials of 'Fabulous' from Seedway looked favorable, though the fruit are not quite as tasty as 'Big Beef' or 'Jetstar.'

Some other types of tomatoes—heirlooms and other colors—are also grown at the farm, but these tomatoes represent no more than one-quarter of the total. Popular heirlooms are 'Cherokee Purple' and 'Rose d'Berne' which is pink. Every year a few new yellow and orange cultivars are tried, but the perfect combo of size, yield, and flavor is still elusive.

Andy sows his first tomato seeds during the first week of March. He seeds into row trays, and then, about two weeks later, pots into 4" square cells. The first tomato transplants are set out on May 1, about eight weeks after seeding.

Each tunnel has four beds. Tomatoes are planted in rows 42" on center, except for the two inner rows, which are just 34 to 36" apart since both rows are trellised overhead to the ridgepole. For winter greens production, they divide each tunnel into two outer beds 30" wide and two inside beds 36" wide, with three one-foot wide aisles.

The beds are usually rototilled in the spring, although when the residue is not heavy, they may be hoed instead. They add two to three cubic yards of compost per tunnel (roughly 65 cubic yards per acre) and other soil amendments as indicated by soil test results.

In addition to the compost, they generally apply 50 lbs. of greensand, a little over 20 lbs. of azomite and, for

calcium, about 25 lbs. of gypsum. Often they spread a little nitrogen starter fertilizer at a rate equivalent to 30 lbs. N per acre to give the early May planting a boost. Lately, they have been using a dehydrated chicken manure called *Cheap Cheap* from North Country Organics as their early nitrogen source. With a 4-3-3 analysis, this product provides a bit of soluble phosphorus and potassium as well.

The beds are covered with black landscape fabric, each outfitted with a single drip irrigation line. The same fabric has been in use for seven growing seasons and appears to be going strong. A 15' x 100' piece costs about $100.

X-shaped holes cut about 4" x 4" in the landscape fabric allow for easy transplanting. He has also tried cutting longer slits, but the strands of fabric tend to impede rapid planting as they pull free in later years. While burning makes tidy holes, Andy does not like burning plastic, and he and his crew found the razor-sharp edges of the torch-made transplant holes to be abrasive and objectionable. He said, "250 holes per house, 6 houses a year, 10 years per sheet of fabric…you get the idea."

Andy transplants one row of tomatoes down the center of each bed, using a 18" in-row spacing. This gives a plant population of about 250 plants per 14' x 96' tunnel.

Tomato irrigation is primarily accomplished with 0.6 gal/hr drip line. At transplanting, they typically soak the tunnel with an overnight watering. After that, the plants automatically receive about 25 to 30 minutes of water per day. A battery-powered timer ($35 from the local hardware store) controls the watering so no one has to remember to water. Once the fruit begins to ripen, they reduce watering to around 15 minutes a day. By mid September, they generally stop watering the tomatoes altogether.

Andy now uses determinate varieties in the shorter tunnels so that their vines don't overrun the structure. He uses a stake-and-weave system, where a stake is placed between every other tomato plant in the row. Andy finds that the effort of staking and stringing is rewarded by an increase in the proportion of marketable fruit and by easier harvesting. He prunes his tomatoes, removing all the suckers and leaving one leaf spur below the first flower cluster.

In the taller houses Andy uses an overhead trellis, prunes each plant to a single leader, and uses clips to hold the tomato vine to the trellis. Andy recommends taller structures because they offer more choices with respect to variety selection and because they give better air circulation. The additional air volume also helps to keep temperatures up in cooler spring and winter conditions.

Andy's planting schedule reflects his desire to extend his outdoor field production. Each year, about half the tunnels are planted early (from the end of April to early May). These are intended for the first four weeks of the harvest season. These tunnels have back-up heating units that are only used during very cold nights. The other houses are planted in mid-to-late June, and are harvested beginning at the end of August and continuing through the end of September. In between those picking windows are the field tomatoes, if the weather cooperates.

The tunnels have helped reduce insect pest and disease incidence in Andy's tomatoes. Insects in the tunnels have not been a problem, despite the absence of any kind of rotation. Diseases that were chronic problems in the field, such as the leaf blights caused by *Septoria* and *Alternaria*, are no longer a concern. An exception, however, is leaf mold, caused by the pathogen, *Fulvia fulvum.* This disease is particularly problematic where temperatures and relative humidity inside the tunnel have been high, chiefly in the late summer and autumn. Basket weaving, though beneficial in many ways, inhibits air circulation and field cultivars that are most suitable for basket weaving don't have the *Fulvia* resistance that some of the greenhouse varieties have.

The tunnels are ventilated by means of roll-up sides. There are no gable end vents and the tunnels' 8' x 4' doors (on one or both ends) are not deliberately used to manage air movement. The chief management activity associated with the tunnels is the time required for temperature and ventilation management. Andy estimates that during the "high maintenance phase," about a half an hour per day is dedicated to environmental management for the six-house complex. Spring tomatoes are pollinated with Class 'C' bumblebee hives. Late crop tomatoes rely on wind through the rollup sides to set fruit.

Andy has been very pleased with his yields. His six tunnels, along with about 800 field tomato plants on a quarter acre, are enough to provide each of his 500 members with 30 to 40 pounds of tomatoes over a period of eight to ten weeks. Harvest begins in earnest in mid-July, and winds down in late September, in time to plant a crop of fall salad greens. Andy estimates the cash value of the tomato crop at around $30,000 (17,500 pounds at $1.75 per pound).

Years of ICF member surveys have shown that tomatoes are always within the top five most popular crops and contribute one of the largest percentages to the overall CSA share value. Therefore it has made sense to invest in high tunnels to ensure success. Andy thinks the tunnels

might also be suited to trellised cucumbers and red peppers, but he has settled on tomatoes because they are the crop most valued by his members.

"With high tunnels, our members are pleased because we can provide them with more and better tomatoes over a longer period of time," said Andy. "And we are pleased because content members are likely to renew their memberships. Our financial stability stems from repeat business—it's far easier to make happy customers than to find new ones."

To increase the return on his investment in high tunnels, Andy has begun using them to grow cold-hardy greens offered as part of a winter CSA share. This share also includes stored squashes, cabbage, and root crops from ICF, supplemented with products from other local farms, such as organic eggs, goat cheese, and apples.

The kales, mustards, Tatsoi, Mizuna, arugula, and spinach are on Andy's short-list of hardy greens. Though ICF has experimented with other hardy greens such as Claytonia, Sylvetta arugula, Mache, and so forth, so far the standard field salad greens have outperformed them for ICF.

To prepare for the winter shares, Andy removes the tomato vines, twine, stakes, and plastic mulch by the end of September. In his experience, a winter salad crop must be direct-seeded in early October to be successful. Crop growth will be slow during the late fall because of the cooler temperatures and shorter day length. In unheated and unlit structures, most crop growth must occur before the end of November. After that period until the day length begins increasing again, Andy says, development virtually stops, except during particularly sunny days, and the crop temporarily enters a kind of suspended animation.

Andy's goal is to have a succession of salad greens harvests throughout the winter. Nevertheless, a single planting date is sufficient. The high tunnel is essentially a winter warehouse of salad greens. Once established, they will be available for harvest throughout the winter, as long as they are not exposed to extreme cold.

To help reduce the risk of freezing injury, Andy covers the crop with a medium-weight row cover that he suspends over low wire hoops. In his experience, the greens he grows are hardy down to about 21°F. So far, Andy has not felt the need to add supplemental heat. Nighttime temperatures inside the tunnel are generally 5 to 10°F warmer than outside temperatures, and the covers add another 5 to 10°F of warmth. As heat radiates from the soil, it is trapped under the low cover, offering protection to the plant canopy.

Andy direct-seeds his salad greens with a single row Planet Junior seeder. He had previously used a six-row pinpoint seeder for all these crops except for spinach. He counts on just one harvest, but sometimes a second cutting may be made in the early spring. By mid-February, when daylight exceeds ten hours, the crop shows signs of renewed growth. The mustard family crops do reasonably well through much of December, except for the kales which can thrive throughout the winter. Spinach is the mid-winter standout, and ICF is considering quitting all other green crops intended for harvest January or later.

To water their high tunnel greens, they set up Netafim DAN microsprinklers (these sprinklers don't put out much water) and soak the houses for 24 to 48 hours prior to planting. After that, they water overnight about once a week until later fall. The lack of irrigation water during winter months is a problem at ICF with its very sandy soil. Andy imagines that February and March yields would be greater if irrigation were possible. Given the opportunity, he supposes they would water once every three or four weeks during the winter.

Andy has also used the farm's heated 30' x 96' greenhouse for winter greens production. Even without supplemental heat, he saw significantly better greens growth in the greenhouse than the high tunnels. Andy suspects that the larger thermal mass afforded by the greenhouse structure provides a more consistent growing environment than the much narrower hoop house frames. This suspicion is reinforced by the fact that the taller hoop houses do better in the winter than the shorter versions.

The value of convenient mid-winter ventilation also has become apparent to Andy. He is currently examining the feasibility and cost of adding a small exhaust fan and louver to each hoop house for winter use. Last winter, which was warmer than usual, ICF had some disease problems in spinach that were largely a result of warmer, humid conditions. Andy has found the roll-up sides to be somewhat impractical for winter use, when a tight seal is often desired shortly after venting.

Enterprise Budget for a Six-Month Tomato Crop in a 2,000 sq-ft High Tunnel at the Interval Community Farm

Fixed Costs

Construction Costs	**Materials**	**Labor**
Site prep (tractor time, labor)	$60	$48
High tunnel layout	$10	$48
Frame & construction	$5,000	$576
Lumber, hardware, and labor	$800	$384
Endwall finishing	$250	$144
Water service	$50	$12
Irrigation (valve, tape, water timer, header, fittings)	$100	$32
Backup heater	$225	
Other -- weed mat	$200	
Other -- harvest containers	$200	
Subtotals	**$6,895**	**$1,244**
Total Construction Costs		**$8,139**
Fixed Costs		
High tunnel construction (divided by 15 years)		$543
Interest (construction financed at 7% for 15 years)		$285
Taxes, land, office expenses, fees		$800
Total Fixed Costs		**$1,627**
Total Fixed Costs (six-month tomato crop)		**$814**

Variable Costs (six-month tomato crop)

Materials and Machinery	
Plants	$700
Fertilizer and compost	$175
Irrigation supplies	$10
Stakes, string, clips	$200
Heater fuel	$75
Bees for pollination	$100
Poly covering (divided by 4 years)	$200
Misc. supplies, repairs, maintenance	$150
Subtotal	**$1,610**
Labor Costs ($12/hr)	
Bed preparation and fertilization	$144
Transplanting, laying drip tape and weed mat	$144
Site mowing and weeding	$144
Pruning & trellising	$576
Harvesting, grading, packing	$480
High tunnel clean-up	$120
Annual maintenance	$96
Environmental management	$360
Subtotal	**$2,064**
Total Variable Costs	**$3,674**
Total Costs	**$4,488**
Revenues*	**$8,750**
Net Returns	**$4,262**

*Revenues are based on a tomato yield of 3,500 lb per 14 X 144' high tunnel. The tomatoes are assigned a value of $2.50/lb, and revenues were $8,750.