IOWA STATE UNIVERSITY

# Potential for Machinery

## A Case Study of Fruit and Vegetable Growers in Iowa

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LEOPOLD CENTER

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NOTE: Names of farms and farmers have been changed to protect privacy. Photos are not related to actual case studies.

# Introduction

Midwestern fruit and vegetable farms face new opportunities and challenges to meet the rising demand for locally grown foods. To increase production, many growers will look to expand their farming operations by extending the season, adding acreage, or changing crop mixes. However, planning fruit and vegetable farm expansions can be complicated. An important dimension of scaling up production involves evaluating options for mechanization and understanding the associated trade-offs between employing additional labor and/or purchasing additional equipment.

Labor is an important but expensive input to the fruit and vegetable industry; labor expenses currently account for 42% of the domestic industry's total variable costs (Calvin and Martin 2010). Adding labor to allow for expansion is challenging in many parts of the Midwest due to declining rural populations and higher than average farmworker wages (Bureau of Labor Statistics 2011). Using machinery to help complete farm tasks can reduce labor expenses and is one method to increase energy efficiency on a farm (Landers 2000, 1-2). Mechanizing may enable local fruit and vegetable farms to expand with the same labor force or to reduce the amount of laborers on the farm while sustaining their acreages.

At the same time, mechanization has its own challenges. Equipment employed in fruit and vegetable production often is highly specialized, crop specific and relatively expensive. For some production tasks, particularly harvesting, mechanization is not a good option. For example, mechanical harvesting can visibly damage produce, which reduces its marketability (Sarig, Thompon, and Brown 2000). As a result, much direct-to-consumer produce primarily is harvested by hand. Furthermore, fruit and vegetable farmers often grow a highly diverse mix of crops, generally devoting a relatively small amount of acreage to any one crop. If crops are especially dissimilar, requiring unique pieces of machinery for production, it can be hard for growers to make sufficient annual use of equipment to justify the investment.

# Methodology


NE Iowa Food & Fitness Initiative

The primary goal of this study was to explore the role of field machinery in aiding expansions of Midwestern fruit and vegetable enterprises to meet rising demand for locally grown produce. We sought to understand how size, diversification, marketing strategies, and production methods impact machinery adoption, as well as gain insights into how growers view labor/machinery trade-offs and how they prioritize their purchases as they build their machinery sets. The case studies that follow describe six examples of Iowa growers who have undertaken an expansion of their fruit and vegetable operation. These cases provide descriptions of growers' machinery decisions, how machinery acquisition fit into their expansion planning, and how crop selection and production intensity impacted these decisions.

Case study participants were identified with the help of Iowa State University Extension staff working with fruit and vegetable producers. We selected cases based on a set of criteria that would ensure a range of examples that were diverse enough to provide a sense of the range of possible strategies used in the industry. All participants had at least eight years of experience growing fruits and vegetables and had undergone some expansion. In addition, efforts were made to include a range of farm size and diversity in marketing strategies. Interviews were conducted in January and February of 2013. The identities of the individuals and organizations included in these case study profiles have been changed to protect their privacy. **Table 1** provides a summary of key characteristics of the six case study farms.

Farmer interviews focused on collecting descriptive information about their operations as well as when, how and why they expanded their production. Based on their expansion plans, we sought to understand how their use of machinery and labor changed, including what pieces of machinery they considered acquiring, what they actually did acquire or did not acquire, and how they acquired it (purchased outright, custom hired, shared, etc.). Finally, interviews solicited information on their thought process and decision-making related to machinery and labor use within the context of their expansion.

These cases demonstrate a variety of approaches growers have used to successfully expand their fruit and vegetable production. We hope you will find valuable information for evaluating machinery adoption in your farm operation in the stories that follow.

## Table 1: Case Farm Criteria Summary

| | Kent Family Farm | Green Farm | High Ridge Farm | Dynamic Acres | Arrowhead Farm | Star Farm |
|---|---|---|---|---|---|---|
| **Related Machinery** | -- | Potato Digger | -- | -- | -- | -- |
| **Hired Machinery** | -- | Manure Spreading Equipment | -- | -- | Large Tillage Equipment | Larger Tilling Equipment, Compost Spreader |
| **Shared Machinery** | Green Bean Picker | -- | -- | Tractors, Tillage Equipment, Refrigeration Truck | -- | -- |
| **Primary Cool Crops** | -- | Potatoes, Onions, Lettuce, Greens | -- | Beets | -- | Greens, Spinach |
| **Primary Warm Crops** | Sweet Corn, Green Beans, Watermelon | Tomatoes | -- | Squash, Tomatoes, Peppers, Cucumbers | Sweet Corn, Cantaloupe, Pumpkins, Melons | Tomatoes |
| **Primary Perennials** | Asparagus, Watermelon | Garlic | Asparagus | -- | Melons | Spinach |
| **Other Farm Activities** | Row Crops | -- | Row Crops, 12 Laying Hens | 100 Laying Hens, 10 Sheep | -- | -- |
| **Number of Machines** | 13 | 8 | 5 | 16 | 8 | 8 |
| **Number of FV Acres** | 50 | 5 | 4 | 5 | 21.5 | 3.5 |
| **Number of Workers** | 12+ | 3 | 2 | 5 | 2 | 3 |
| **Expansion Types** | Scale, Diversification, Seasonal | Scale, Diversification, Seasonal | Scale | Scale, Seasonal | Scale, Seasonal | Scale, Diversification, Seasonal |

Names of farms have been changed to protect participants' privacy.

# Farm #1: Kent Family Farm

## BACKGROUND

| | |
|---|---|
| Primary Crops: | Sweet Corn, Green Beans, Watermelons, Asparagus, Tomatoes |
| Primary Marketing Outlets: | Farmers' Markets, Farm Stand, Grocery Store, Processor |
| Total Fruit and Vegetable Acres: | 50 Acres |
| Years of Experience: | 20+ Years |

Kent Family Farm is located in central Iowa and operated by Charlie and Lois Kent. Compared to most fruit and vegetable farms in the Midwest, Kent Family Farm is quite large with 50 acres in fruit and vegetable production. In addition to fruits and vegetables, the Kents also grow corn and soybeans on 750 acres. The Kents entered into fruit and vegetable production in the late 1980s when they were looking for an alternative to low profitability in corn, soybeans and livestock. In the years that followed, the Kents increased vegetable production partly as a way to bring their family together in a common and constructive goal. "It's been good for all of our kids," Charlie states.

The primary crops grown on the farm in rough order of importance are sweet corn, green beans, watermelons, asparagus and tomatoes. In addition to these primary crops, they also grow a variety of other crops including cabbage, lettuce, broccoli, peas and sugar snaps early in the season and peppers, cucumbers, herbs and onions during warmer months. To increase the variety offered at his farmers' market booths, while not growing a crop set that becomes overly diverse, Charlie shares crops with other farmers. "I have a friend that likes to grow strawberries so I let him grow them and I buy strawberries from him and take them to the market.… I've grown a lot of sweet corn and green beans for other growers too and trade," he says. "It's a lot easier if you just grow two or three crops."

## EXPANSION EXPERIENCE

Before beginning commercial vegetable production, the Kents grew corn and soybeans and raised 70 cows and approximately 1,000 hogs each year. During their first year of vegetable production, the Kents produced sweet corn to sell at their farm stand for RAGBRAI, an annual cross-state bicycle ride. After seeing the demand for locally grown vegetables, Charlie helped establish a local farmers' market in a neighboring town. In the years that followed, the Kents began introducing new crops and marketing to other farmers' markets. To ease the transition into commercial

vegetable production, they chose initial vegetable crops that were similar in terms of machinery needs to their established row crops: sweet corn and green beans. "Well, being as we grow field corn, it was easy to transition into sweet corn and it was easy to transition into green beans," he states. "I just saw that you can use a lot of our same equipment to plant a lot of this stuff."

Over the years the farm's fruit and vegetable acreage has varied between 50 and 80 acres but is currently around 50 acres. Although he acknowledges that his crop selection is in part determined by preference, crops ultimately must be marketable. By talking with growers at the farmers' markets and attending seminars, Charlie began to expand the crops that the farm raises by experimenting with recommended crops he thought would work for his operation.

## LABOR AND MACHINERY CONSIDERATIONS

Family members supply most of the labor on the farm. They hire eight people during an average week in the growing season: two workers to take produce to the farmers' markets and six field workers. Many of these non-family workers are local kids between high school and college age who work part-time when they are out of school. More labor is hired during the early part of the season when they are planting and transplanting their cool season crops. This period is especially busy since there are typically fewer workable field days during this wetter time of the year.

The Kent's fruit and vegetable operation is relatively mechanized. They have benefited from growing field corn and soybeans since the planting and cultivation equipment that is used for field corn is also useful for sweet corn and green beans. In fact, since the processes are so similar, Charlie stated that field corn is the primary alternative to growing sweet corn for processing as opposed to other vegetable crops. He extensively uses high tunnels, but notes that his smaller tractors and rototillers can be used inside of high tunnels. This means that in his case, tractors can complement high tunnel use. When the Kents purchase machines, their main considerations are cost, labor and time savings. To the Kents, labor and machinery are substitutes, especially at higher levels of acreage. Charlie advises his fellow growers: "The first thing you get is some kind of tractor if you are going to get bigger," he states. "Then your next thing is probably your tiller … the next thing … is some kind of planter. Most of these labor saving devices are so that you can get it in earlier and quicker … you don't need all of this [equipment] to get started."

| Machinery Used |
|---|
| **Power Unit** |
| 70-Horsepower Tractor |
| 50-Horsepower Tractor |
| 30-Horsepower Tractor |
| Walk Behind Tiller |
| Walk-In Cooler |
| **Implement** |
| Power Take-Off Driven Tiller |
| Plastic Mulch Layer |
| Transplanter with Water Wheel |
| 6-Row Sweet Corn Planter |
| 12-Row Sweet Corn Planter |
| 6-Row Small Seed Planter |
| Vegetable Specific Cultivation Equipment |
| Corn and Soybean Cultivation Equipment |

# Farm #2: Green Farm


NE Iowa Food & Fitness Initiative

## BACKGROUND

| | |
|---|---|
| Primary Crops: | Squash, Potatoes, Garlic, Onions, Lettuce, Cherry Tomatoes, Carrots |
| Primary Marketing Outlets: | Farmers' Markets, CSA, Cooperative, Restaurant |
| Total Fruit and Vegetable Acres: | 5 Acres |
| Years of Experience: | 15 Years |

Green Farm is located in northeastern Iowa and is operated by Hal Jordan. The entire farm is comprised of 41 acres but Hal grows fruits and vegetables on five of them. Due to the topography of the property, most of his acres are ill-suited for fruit and vegetable production: 25 acres are enrolled in the Conservation Reserve Program (CRP) and the remaining acreage not in production is timber. Roughly another half acre is used to produce a perennial cover crop. The farm has three high tunnels to help extend the season on cherry tomatoes, to cure garlic and onions, and to serve as a propagation area. Aside from the fruit and vegetable enterprise and CRP income, there are no other sources of on-farm income.

To provide a stable and diverse supply to CSA members and the local farmers' market, multiple plantings of a variety of crops are planned throughout the season. Harvesting the half-acre of garlic and the onion and potato harvests are the busiest times of the season. Unlike most of the other crops that are harvested throughout the season, the garlic harvest takes place at one time. Every year Hal experiments with these crops to find better mixes of marketable and manageable crops to grow. Some of these crops are harder to manage for Hal because they differ in some way from the other crops that he grows. "There's demand for sweet potatoes at the farmers' market," Hal states. "I've tried them a couple of times and I've had really poor luck. Part of it is not keeping on top of the management."

Hal is also experimenting with his marketing. In addition to providing traditional Community Supported Agriculture (or CSA) shares, he provides a CSA market share. Like a traditional CSA, market shareholders pay a flat fee at the beginning of the growing season. However, instead of receiving a bag of produce that the farmer prepares, market shareholders open a prepaid account that is used at the farmers' market. This allows market shareholders some choices regarding the kinds of vegetables they receive and when they receive them. Approximately three quarters of the farms' production goes toward the CSA and the farmers' market. The rest is marketed wholesale or to local restaurants.

## EXPANSION EXPERIENCE

Hal began producing on two acres of rented land in 1998. Before farming on his own, Hal apprenticed at a five-acre CSA for a summer in the mid-1990s. During his apprenticeship he learned how a farm can operate economically on five acres and was inspired to start a local fruit and vegetable farm of his own. He modeled his farm on this apprenticeship experience. "The first four or five years in particular of doing our own stuff here, we very much basically started with their model," Hal remarks.

Hal continued to rent the two acres for three years and grow for the local farmers' market. In 2001 he purchased five tillable acres of his own. Though his crop mix remained roughly unchanged throughout this acreage expansion, the fact that the expansion traded rented for owned acreage meant that improvements to the property became prudent. He installed a deer fence as the owned property was surrounded by timber. He also installed a pump system and drilled a well to facilitate drip irrigation and a washing area.

## LABOR AND MACHINERY CONSIDERATIONS

During the first three years when production took place on the two acres of rented land, Hal did not hire any workers. After the transition to the owned property, Hal hired a local high school student to work about 10 hours a week over a few weeks in the summer. For about four years this was the extent of the farm's hired labor until the birth of Hal's second child in the middle of the summer. Taking care of a newborn while maintaining the CSA and farmers' market production was simply too much work. He hired an employee to work 20 hours a week for the rest of the season. The following year he continued to hire an employee for 30 hours a week. Over the past four seasons Hal has hired an additional laborer where one works about full-time and the other works half-time. Hal's kids are young and his wife has a full-time job in town, so with the exception of his wife's help during garlic harvest, most of the labor comes from himself and his employees. He cites the level of crop diversification as the primary reason for adding on another employee. "Working the amount of ground we have and the variety of crops, harvesting isn't just go[ing] out and pull[ing] onions, you're harvesting 25 different things in the whole summer," Hal explains. "It's hard for one person trying to get all of that stuff done."

Hal has made many changes to his machine fleet since he began farming. Over the first three years he used only hand tools and a walk-behind tiller while he was farming the two rented acres. Most of his initial machinery purchases were secondhand. His first major purchases were a Ford 9N tractor, a brush mower and a disk. These purchases were made so he could better manage the soil nutrient content. A walk-behind tiller cannot incorporate his cover crop very easily. Other early purchases included a used horse-drawn potato digger that had been retrofitted for a tractor and several small secondhand glass top freezers from a grocery store.

Throughout the last eight years, Hal has been updating his machine fleet with purchases of new equipment. These updates included a walk-in cooler to replace the smaller units, a new 30-horsepower four-wheel drive Kubota tractor to replace the old 9N, a three-point hitch tractor-drawn rototiller, a tractor-mounted broadcast seeder for cover crops, and a new one-row potato digger. Many of these purchases were made because the present equipment was outdated and caused too much downtime in the field. When purchasing a piece of equipment he considers how often he would use the machine throughout the year and whether there are cheaper alternatives such as custom hiring for things like spreading fertilizer. Extending the season also was important. He added two more high tunnels when production shifted to the five owned acres. The walk-in cooler and water well are especially important to Hal. "Having done it now for a couple of years we knew better what questions to ask other producers," Hal explains. "You've got to make sure you've got irrigation so you can grow quality crops, and you've got to have a way to get them fully chilled down to 33 degrees so when you take that lettuce in at [an] August market."

| Machinery Used |
| --- |
| **Power Unit** |
| 30-Horsepower 4-Wheel Drive Tractor<br>8-Horsepower Walk Behind Rototiller<br>Walk-In Cooler |
| **Implement** |
| Bush Hog Mower<br>5-Foot Rototiller<br>Tandem Disk<br>Broadcast Seeder<br>1-Row Potato Digger |

# Farm #3: High Ridge Farm

## BACKGROUND

| | |
|---|---|
| Primary Crops: | Asparagus |
| Primary Marketing Outlets: | Grocery Stores, Restaurants, Farmers' Market Indirectly |
| Total Fruit and Vegetable Acres: | 4 Acres |
| Years of Experience: | 8 Years |

High Ridge Farm is located in central Iowa and is owned by Barry Allen and Iris West. This farm is unique in that it grows only asparagus on four acres of land. In addition to commercial production of asparagus, Barry currently grows field corn and beans on an additional 40 acres. Unlike most of the other growers that were interviewed, the bulk of the on-farm income comes from one vegetable crop. They chose to grow only asparagus for its short growing season and, because it is a perennial, it does not require planting each year. "We just do asparagus because it's a 30 day crop and then we're done," Barry explains. "I can handle a month even though there's a lot of pressure."

Most of the output is marketed through grocery stores and a handful of local restaurants. These outlets request asparagus periodically throughout the growing season and sometimes vary on the amount that they request each week. Any of the excess production over these weekly orders is sold to another grower who has a booth at the local farmers' market. This excess production can be as large as 500 pounds of asparagus. One of the reasons why Barry does not grow for farmers' markets directly is that he only grows one crop and cannot maintain a supply of the crop over the entire market season. "Last year we started picking by the middle of April, and by the middle of May we were done," Barry states. "Basically we were almost done before the first market even started."

## EXPANSION EXPERIENCE

Barry's asparagus production started humbly with two gardens that were originally planted as a way to grow asparagus to give away to friends. While producing in the gardens, Barry and Iris learned how to produce high quality asparagus efficiently. Asparagus requires a strict daily harvest regimen for about a month each year to prevent waste. After producing in the gardens for several seasons they realized that commercial production was feasible, so they expanded to four acres.

Barry described the transition into these acres as fairly quick and effortless. No stoop labor was needed to plant since the initial roots could literally be thrown into a ten-inch furrow and covered up. During the second season after the expansion, Barry allowed a close friend's son and his friends keep the profits from the first crop if they harvested and marketed it themselves. This arrangement allowed Barry to learn about production and marketing considerations under the new acreage without directly investing time and effort. No further expansions are currently planned. Barry has considered expanding in the past but cites labor requirements and asparagus demand as constraints.

## LABOR AND MACHINERY CONSIDERATIONS

Labor is an important input on the High Ridge Farm. Harvests must be conducted over the entire acreage without fail every day of the growing month. Asparagus grows faster on warmer days so it may require multiple harvests during warmer periods. Barry has hired the same worker for the last six seasons. For most days, this one worker can harvest the entire four acres every day. On warmer days the asparagus grows faster, requiring Barry and sometimes Iris to help as well. In the evening, Barry and Iris snap, wash and bundle the asparagus harvested that day. Being able to see how the boys fared in the first season was a helpful gauge of how much labor was needed to maintain a steady harvest throughout the month of production.

Machines are not used much on the High Ridge Farm and are mainly devoted to cultivation. These are tasks that are associated with maintaining the soil and crop between seasons. Barry experimented with harvesting equipment after the expansion. He purchased a harvesting assistant, an implement on which workers lie face down on low-hanging platforms to avoid stooping during the harvest. They sold the implement after only two seasons for several reasons. The harvesting assistant required two pickers and a tractor driver to operate, meaning that their labor use would actually rise. The variable rate of asparagus growth also made it difficult to effectively match the work speed of the two pickers. "I can remember hearing them out there yelling at each other, 'you're going too fast, too slow, don't hit that rock [dink, dink, dink],'" Barry recounts.

| Machinery Used |
| --- |
| Power Unit |
| Lawn Tractor<br>2-Foot by 48-Foot Refrigeration Trailers |
| Implement |
| Spring Tooth<br>4-Row Sprayer<br>6-Row Lister |

# Farm #4: Dynamic Acres

## BACKGROUND

| | |
|---|---|
| Primary Crops: | Beets, Tomatoes, Peppers, Cucumbers, Summer Squash |
| Primary Marketing Outlets: | Farm Stand, Farmers' Market, Co-op |
| Total Fruit and Vegetable Acres: | 5 Acres |
| Years of Experience: | 15 Years |

Dynamic Acres, located in northeast Iowa, is owned by Jonathan and Mary Gray and operated by a close-knit family group including Mary's sister, Martha. Dynamic Acres works closely with the farm of Mary's parents, James and Barbara Gordon, located in southern Minnesota, approximately 40 miles north of Dynamic Acres. These farms often make joint decisions including purchasing and sharing machinery and sharing crops at either location. One of the benefits of this arrangement is that it diversifies the risk of adverse weather and allows for a degree of crop specialization. "This year was a good example," Jonathan explained. "They got every rain that we missed out on. We'd be down here trying to break in the ground and you'd go up there and you'd be kneeling in mud."

Their primary crops include beets, tomatoes, peppers, cucumbers and summer squash; however, they also grow an assortment of herbs, onions and a variety of cold crops with the exception of spinach and other greens. Besides their fruit and vegetable acres, they generate on-farm income from three acres of hay and from livestock including a flock of 10 sheep and 100 laying hens. They market in several ways throughout the season. Early in the season when the scale of production is not appropriate for cooperatives and farmers' markets are not yet open, they operate a small farm stand. Aside from this short period, production is mainly marketed through a co-op and through farmers' markets in two nearby towns. "The farm stand is just a drop in the bucket compared to everything else … normally it's about 80-20 wholesale [co-ops] versus farmers' market."

## EXPANSION EXPERIENCE

When they first bought the farm in 1998, Jonathan and Mary had seven acres of tillable ground. They started producing corn and soybeans but discovered it wasn't profitable for them. The next season they started a garden, built a 12-foot by 24-foot greenhouse, and connected themselves with a co-op. At this level of production, they performed all their tasks by hand and with a walk-behind tiller. The following season they increased production to one acre. They purchased a small garden tractor and a tiller

to transition from garden-level to field production. In their third season, they purchased a 35-horsepower AGCO tractor and a larger tiller. After the purchase of the AGCO tractor, the farm expanded approximately a half-acre each year until 2008. One reason for the expansions was to have a better way to handle crop spacing issues. Jonathan explains, "… when we started using the bigger tractor and tiller we started obviously tearing more up and trying to figure out better ways of laying it out so it wasn't quite so crowded and we had a little bit more space to use."

Dynamic Acres has gone through an expansion and currently is undergoing an expansion into tree crops and adding a certified commercial kitchen. Both the kitchen and the expansion into fruit trees are planned so that value-added products like pies, canned fruit and jams can be offered at farmers' markets on a larger scale. In addition to using their kitchen themselves, they also plan to rent it out to generate an additional source of income.

## LABOR AND MACHINERY CONSIDERATIONS

Dynamic Acres is unique with respect to both their labor and machinery usage. For the most part, farm jobs are specialized between Jonathan, Mary and Martha. Aside from some help from James and Barbara, these three provide most of the labor for the farm. Jonathan works in the parts department for the local branch of the Case IH dealership and Mary works as a tax preparer during the tax season, but both are highly active on the farm during off-work hours. Jonathan primarily handles the weeding, harvesting and the preparation to get the vegetables ready for market. Mary plans out the planting and seeding schedules, performs planting and greenhouse work, and harvests as well. In addition to her on-farm duties, Mary is the sitting president of their co-op and is active in organizations that advocate for healthy eating and activities. Martha primarily handles the marketing side of the fruit and vegetable enterprise. This includes creating advertisements, working in sales, and washing and packing vegetables for market. Martha also assists Mary during the tax season with secretarial duties and supplements her greenhouse duties during the busier times. Working hours tend to vary over the season due to obligations from off-farm work and the needs of the farm. The Grays' and Martha's younger children, around 12 and nine years of age, also help with tasks around the farm.

Through Jonathan's ties with the Case IH dealership, Dynamic Acres has been able to borrow fruit and vegetable equipment. This borrowing arrangement began when the dealership began selling small-scale fruit and vegetable equipment five years ago. Jonathan borrows most of the farm's equipment that is specific to fruits and vegetables: their transplanter, mulch layer, ecoweeder, potato digger, and Jang three-row seeder. In exchange for the privilege of borrowing machines from the dealership, Dynamic Acres hosts an annual field day for the dealership. This field day allows prospective customers to see fruit and vegetable equipment working in the field.

**Machinery Used**

| Power Unit | Implement |
|---|---|
| 35-Horsepower Tractor | Tiller |
| 45-Horsepower Tractor | Disk |
| Four Wheeler | Cultivator |
| Walk-In Cooler | Ecoweeder |
| | Potato Digger |
| | Transplanter |
| | Mulch Layer |
| | Mower |
| | Four Wheeler Harvest Trailer |
| | Jang 3-Row Planter with 9 Plates |
| | Jang 1-Row Planter with 9 plates |
| | Earthway Seeder |

Since many of the implements on the farm do not have to be purchased, it is challenging to get a sense of what the machinery is actually worth to the farm. However, since they have so many implements, they are able to offer perspective on nearly all of the machine options that a small fruit vegetable farmer has at an equipment dealership. Since they started borrowing from the dealership, the farm has not expanded but production has increased and fewer hours are required to work their five acres. Equipment efficiency, versatility and the availability of alternatives are important factors when Jonathan considers equipment. Martha discusses their sizable machine fleet, "We've discussed the fact that if we had to buy one piece of equipment, it would be the ecoweeder … that is by far the [biggest] time saver."

Not all of the machines on the farm are borrowed. The tractors and cultivation tools were purchased to be community property between Dynamic Acres and Mary's parents' farm in Minnesota. Until a year ago, the farms had to share one tractor between the two farms. Since the tractor was used so often and had to move so far, they purchased a Farmall 45 tractor to keep at the Minnesota farm. Now sharing machinery is much easier since the two farms mostly share implements that are small enough to be transported with a pickup truck.

# Farm #5: Arrowhead Farm

## BACKGROUND

| | |
|---|---|
| Primary Crops: | Sweet Corn, Watermelon, Cantaloupe, Pumpkins |
| Primary Marketing Outlets: | CSA, Grocery Stores, Farmers' Market, Farm Stand |
| Total Fruit and Vegetable Acres: | 21.5 Acres |
| Years of Experience: | 11 Years |

Arrowhead Farm is operated by Oliver Green and located in central Iowa. The farm is comprised of 21.5 tillable acres divided between an acre and a half section on the homestead property, a five-acre section across the road, and a 15-acre section within a 10-minute walk of the homestead. Aside from vegetable production, there are no other activities on Arrowhead Farm. The primary crop grown on Arrowhead is sweet corn, which makes up 10 acres of tillable ground. Oliver grows watermelons, cantaloupe and pumpkins as well as a variety of other crops. In rough order of gross sales Oliver markets these crops through a farm stand, several grocery stores, wholesale to local university, a farmers' market and a 40-person CSA.

Oliver tries to minimize the amount of labor used in marketing his produce. To ensure that fieldwork does not have to stop and to avoid having to pay an extra person, the farm stand sales rely on the honor system and the CSA customers pick up their produce at the homestead. Oliver noted that his various marketing outlets can have unique demands. For example, beyond the size of orders, Oliver notices that certain crops like carrots which are included in CSA orders, may not sell well at the farmers' market. One of the major challenges in terms of marketing is the tradeoff between the premium of direct selling through the farm stand, CSA and farmers' market versus the more guaranteed income from wholesale production to grocery stores. He finds it difficult to market through grocery stores because of price competitiveness, but he may be disappointed at farmers' markets when he has to bring home the excess that wasn't sold.

## EXPANSION EXPERIENCE

Before Oliver started farming, he lived on the acre-and-a-half homestead and worked full-time off-farm. During this time Oliver rented the property to another experienced fruit and vegetable farmer. While renting the property out, Oliver developed a friendship with his renter. Over the next eight years, Oliver learned how to grow fruit and vegetable crops with the renter's model of production. "He basically got to

the point where he'd come plant on the property around me and he'd never come back," Oliver explains. "I would harvest all the tomatoes for him, I would weed it, I'd take care of it … I would go to farmers' markets with him, so I was learning lots."

After eight seasons of helping the renter on the homestead property, Oliver decided to start farming independently. After several growing seasons, Oliver decided to expand to increase production and become more competitive at farmers' markets. Sweet corn, cantaloupe and watermelon production increased after these expansions.

Over the life of the farm, Oliver obtained acreage from several sources. When the farm was first started, it was hard to find rented land to expand on. The farm's first two expansions were on rented acreage seven miles away from the homestead. This distance meant that it took a lot of time and fuel to transport machinery to prepare and harvest crops. After six years in production, neighbors closer to the homestead became more open to selling land to Oliver, enabling him to add 20 acres within a 10-minute walk from the farm house. "I'd been begging to find land around, but in 2008 I was offered up 40 acres if I wanted it. I think partially the reason was that people realized that I'm not just a fly-by-night deal and I'm big enough.… I got the five acres and the 15 acres plus the acre and a half at my house."

## LABOR AND MACHINERY CONSIDERATIONS

Oliver's machine use has changed a lot since he began. The first two years were challenging since Oliver had to perform most of the farm's tasks by hand. Unlike the other farmers in the case study, Oliver does not use any commercial refrigeration besides air conditioning to keep produce cool. To help with the transition, the former renter came out with a tiller and a plastic layer to help start the farm's production. Because there was a source of off-farm income, most of the profits from the farm went into machinery investment. Initially, the biggest machinery concern was tilling equipment. The first major purchases were a 25-horsepower 8N Ford tractor, a six-foot disk and a brush mower. These initial machine purchases were not very efficient since it took several passes to get the soil ready for planting. Later on, Oliver sold the 8N tractor and purchased a 25-horsepower John Deere 850 tractor and a five-foot tiller followed by a water wheel transplanter and a plastic layer in the following year. Oliver made these purchases for three primary reasons. First, Arrowhead was beginning its first expansion and tasks still needed to be completed in a timely manner. Second, the last few seasons had been profitable enough to begin major investments in the machine fleet. Third and most importantly, from the experience working with the former renter, Oliver knew how to work with these machines and that they were cost effective before purchasing them.

Although Oliver does not plan on expanding acreage in the near future, he hopes to purchase equipment. However, since Oliver acquired the 15-acre section there has not been enough money for these machine purchases. A larger tractor and cultivation equipment would be especially useful for managing larger sweet corn fields. An additional tractor also would complement the current machine fleet since Oliver would not have to spend time switching implements on one tractor. "What I really need is a 70-horse [tractor] with a 20-foot disc cultivator.… [With] 15 acres, my little 25 horse tractor with a five-foot tiller gets a workout and it's a time consuming.… Just having one tractor with the cultivator on

**Machinery Used**

| Power Unit | Implement |
|---|---|
| 25-Horsepower Tractor | 5-Foot Tiller<br>Middle Buster<br>Cultivator<br>6-Foot Brush Cutter<br>Airblast<br>Plastic Mulch Layer<br>Transplanter with Water Wheel<br>6-Foot Disk |

it and the other tractor with the airblast on it and not have to switch out constantly would be nice.…"

Unlike machinery, changes to labor have not been as frequent. For the first six seasons, Oliver performed all of the farm's tasks while working full-time at his off-farm job. After purchasing the acreage across the road from the farm Oliver quit his off-farm job. Besides transitioning to farming full-time, the only major change to labor usage on the farm was hiring a part-time high school worker for the last two seasons. In addition to hired labor, Oliver also has a 15-year-old son who helps with fieldwork and a father-in-law who hand-picks green beans. Oliver carefully considers the net benefit of hiring additional labor. "We have hired this girl the last two years. Has she actually made us money? Probably not … but it is handy to have some help. But I need to be able to have that person make me money."

# Farm #6: Star Farm


NC Iowa Food & Farms Initiative

## BACKGROUND

| | |
|---|---|
| Primary Crops: | Salad Greens, Cherry Tomatoes, Peppers, Egg Plant, Cucumbers, Garlic |
| Primary Marketing Outlets: | Co-op, Grocery Stores, Farmers' Market, Restaurants |
| Total Fruit and Vegetable Acres: | 3.5 Acres |
| Years of Experience: | 8 Years |

Star Farm is located in northeastern Iowa. It is owned and operated by David and Courtney Whitmore, a husband and wife team. Besides vegetable production, there are no other sources of on-farm income, but David is also the part owner of an off-farm agribusiness. The Whitmores are primarily concerned with supplying high-value crops during times of the season when supply is typically low. Their strategy involves selecting differentiated crops to grow and focusing on season extension. Star Farm is highly invested in greenhouses and has approximately 6,500 square feet of space for organic production. The Whitmores hope that by providing a stable supply in these niche markets they will foster relationships that will lead to more opportunities with customers. Most of the output is marketed through a cooperative, which grants access to a large wholesale network that has sustained demand throughout the year.

Before farming David worked at a co-op. The Whitmores' first experience in commercial vegetable production was helping to manage a farm for an accomplished fruit and vegetable farmer for two years. This experience was influential in inspiring the Whitmores to start an organic small acreage fruit and vegetable farm and taught them how to produce and market profitably. After several of years of farm management and consulting experience, the Whitmores decided to start farming independently. They have been at the same level of acreage for the last four years and just this year decided to rent an additional three acres that has not been put into production yet. Along with this expansion of acreage, the Whitmores are also expanding acreage in late season production by adding an additional 1,500 square foot in high tunnel space. Adding these three acres however, does not constitute a proportional increase in the acreage that Whitmores grow on in a given season. The decision to nearly double the farm's tillable acreage was in part made to help maintain the soil through rotations. "The reason that we needed that land is because we were growing more garlic and more seed cucurbits than we had land for … we need five years between planting locations at a minimum," David explains.

## LABOR AND MACHINERY CONSIDERATIONS

The previous farm management job and being able to talk with other growers through their off-farm agribusiness helped educate the Whitmores on the labor and equipment needs for their level of production. Until two years ago, most of the farm's labor came from the husband and wife team. Two years ago they met a college-aged student who offered to work on the farm as a volunteer in order to learn about organic farming. Last year he was hired as a full-time worker and divides his time between on-farm duties and the off-farm agribusiness owned by the Whitmores. On average everyone works approximately 20 hours a week at Star Farm.

Because of the emphasis on high tunnel production and low acreage, the Whitmores use a walking tractor instead of a standard tractor. A walking tractor is a larger walk-behind tiller that has a power take-off and is able to run smaller implements like a standard tractor. The walking tractor is limited in some ways since it cannot operate a bucket lifter or have significant draw power. Since Star Farm is not very large relative to most row-crop operations, they can cheaply hire a neighbor to perform tasks such as incorporating cover crops. Although there would be use for a standard tractor on Star Farm, they are not willing to incur the price of the tractor. "… I can pretty well manage three acres with that walking tractor. It's a fifth of the cost of a standard tractor. Once you start talking about all the implements even less than that maybe a sixth to an eighth of the costs … the next point for me in growth once we really break into three additional acres and we're managing six acres, I can justify a tractor with a bed former and mechanized cultivation and things like that."

| Machinery Used |
| --- |
| Power Unit |
| Walking Tractor<br>Walk in Cooler |
| Implement |
| 30-Inch Bed Former<br>Flail Mower<br>6-Tooth Cultivator<br>Brush Mower<br>Blade<br>Hiller |

# Machinery Acquisition Methods and Themes


While each of the case farms had unique characteristics, a few common themes did emerge. Four of six farms in the case study began with a modest machine fleet, usually a walking tiller and hand tools. As they expanded, they tended to consider purchasing more and larger equipment. This was mainly attributed to the fact that labor would become relatively more expensive and the farm had more net income to reinvest. Several growers stated that it was difficult to obtain credit from a bank for their fruit and vegetable enterprise, so they had to reinvest profits in order to grow their machine fleet. This means that the timing of machine purchases may be especially important since they are impacted by cash flow as well as cost savings.

There are other ways to gain access to machines besides purchasing them outright. Renting, borrowing and sharing equipment are alternatives. Two of the growers also were able to access a degree of credit from a bank for a loan. Renting was a way for farmers to test equipment before a purchase. Sharing equipment helped individual farmers avoid the full brunt of the cost of obtaining machinery. Sharing was generally well, though cautiously, received. Some farmers avoided machinery acquisitions altogether by custom hiring. Under these arrangements, growers hire equipment owners to perform work on their farms, gaining access to both machines and competent operators. This seemed especially attractive to growers with smaller farms, possibly because custom hiring is a relatively inexpensive alternative when the jobs are small, allowing farmers to pay only for the amount of capacity needed.

## FARMS SHARING EQUIPMENT

Sharing equipment is one strategy for farmers to acquire machinery needed to expand, but with lower upfront financial contributions. The original hypothesis was that sharing would reduce the cost of acquiring machinery by dividing the initial investment and the fixed ownership costs. Out of the six case study farms, two shared equipment. In both instances, the sharing occurred between family members. One of the reoccurring issues with shared use of machinery is timeliness. Timeliness relates to performing tasks during a suitable or optimal time. Given the weather dependent nature of growing fruits and vegetables, timeliness issues are compounded when farms are sharing equipment and both would like the use of the equipment at the same time. The two case study farms that shared equipment noted that timeliness was a consideration. Each had developed their own way of managing the time schedule.

Charlie Kent's arrangement involved a bean picker, a heavier piece of equipment that is difficult to move from farm to farm. To avoid moving the picker, one of the farms would plant all of the joint green bean acreage each year so the green bean picker would stay at one location. The

cost of the green bean picker and the harvested green beans would be divided between the two farms. The joint acreage would change from season to season to avoid a single farmer having to bear the costs of operation and opportunity cost of holding the other farm's green bean acreage. "… you want to be fairly close if you're going to share, that's important," Charlie remarks. "A lot of it is timeliness, that's why it's hard to share. When they want to plant then you want to plant … you just work it out." Charlie is not currently sharing the picker anymore but still owns it. At the time the arrangement started, green beans were in high demand at the farmers' markets and both farms had substantial green bean acreage. Green bean pickers are a pricy but highly efficient alternative to hand picking. As the demand for green beans started to decline, it was not as economical to grow as many acres of green beans. For the Kent Family Farm's current level of production it does not make sense to employ the green bean picker at all and it remains idle.

Jonathan Gray's sharing arrangement started as sharing a tractor and implements with his in-laws. These two farms cooperate in many joint decisions outside of machinery including sharing production and joint projects such as building greenhouses. As soon as there was enough money between the two of them, the farms purchased another "community" tractor that could be located at the other farm on a more permanent basis. The second tractor made it easier to share equipment between the farms since they no longer needed to transport their larger, multipurpose equipment. "It would never fail, when [the tractor] wasn't here, we could have been using it and when it was [here] it was raining … [the second tractor] made a big difference this last year," Jonathan stated. "We just drop the tiller in the back of the truck and away they go … that's a lot easier."

Charlie and Hal Jordan both saw sharing as potentially a good way to acquire machinery. Hal believes that, given that farmers can succeed with co-ops, arrangements where farmers can agree on the pricing and production, sharing equipment is a viable option. "I think there's a lot of potential there," Hal remarks. "The potato digger is a great example of that. I don't use it very much. It is nice to have it when I need it, but if someone else wanted to buy a share of that machine it would make sense."

## FARMS CUSTOM HIRING AND RENTING MACHINES

Hal Jordan, Oliver Green, and the Whitmores all gained access to machinery through custom hiring. Their farms were similar in many respects including machine fleet size and labor usage. Farmers custom hired for similar reasons. Tasks that were hired out typically required larger and more expensive equipment, were larger in scale, and took place once over a growing season. All three farms custom-hired neighbors to help with tillage on a larger scale and two out of the three custom-hired to help with spreading fertilizer. All three farmers cited that since these larger pieces of equipment only were going to be used once in a season, they would not be worth purchasing. Since these pieces of equipment are common on row-crop farms, it is easy to hire a neighbor to do the work for them. Hal justifies his custom-hiring arrangement saying, "I always think about getting a small manure spreader and a bucket loader for my tractor. When I get in semi truckloads of compost I wouldn't have to call my dealer to spread it.… But that's about all I would need those two implements for and so it's a big chunk of change to buy those two things for once a year."

With respect to larger tillage equipment, custom-hiring makes sense. These implements are more commonly suited for farms that grow corn and soybeans, staple crops among Iowa farmers. This means that more than likely these implements and their operator are close to these farms and since the equipment is suited for larger fields, they can cover the smaller fruit and vegetable farms' acres relatively quickly. Oliver's brother-in-law primarily grows row corn and soybeans, so he can hire him to disk his 20 acres very quickly and cheaply. "I think it costs me like $100 for him to do that," he states. David does not have a tractor, but he also gets by with custom-hiring. "For any year for everything that I could possibly want I'm not paying in more than $300," he explains. "It doesn't make sense for me to buy a $5,000 tractor that can mow and till a field, I can pay my neighbor to do that." Only one of the farms rented equipment but interestingly, renting was not used to avoid fixed costs of ownership. Instead Hal rented a potato digger as a way of trying it out before purchasing it.

# Farm Diversity

Fruit and vegetable farms are diverse in terms of marketing outlets, size, number of crops grown, and whether they are specialized in fruits and vegetables or have other crop and livestock operations as well. These farm characteristics impact farmers' machinery decisions.

## SCALE AND SCOPE

We expected that larger farms would be more mechanized, and that farmers who specialize in fewer crops would tend to purchase more machinery since they are better able to exploit economies of scale. In other words, they can spread the fixed costs of the machinery over more acres, lowering the cost per acre. The six case study farms provide some evidence for this, but also some exceptions.

The largest farm among the cases is the most mechanized. Kent Family Farms, with 50 acres of vegetable production, had the largest machinery set in terms of size of equipment (for example, the largest horsepower tractor) and also in terms of number of machines except for Dynamic Acres, which has a special arrangement with an equipment dealer and is therefore not a "typical" example. In addition, in spite of growing many crops, the Kents have the highest number of acres dedicated to a single crop with 20 to 30 acres of sweet corn. Arrowhead Farm, the second largest farm in terms of acreage, also is somewhat specialized, with approximately 10 acres in sweet corn, as well as several acres devoted to pumpkins and melons. While Oliver Green only owns a single 25-horsepower tractor at this time, he plans to purchase a second 70-horsepower tractor and a 20-foot disk cultivator. The second tractor would eliminate the need to switch implements as frequently, saving time, especially for tilling and mulch laying. He cited cash constraints as the reason for delaying equipment purchases. Oliver's land purchase meant that there was little money leftover to scale up machinery. "That was another $90,000 and lawyer fees and that pretty much said goodbye to another tractor and any new equipment," Oliver explains.

Green Farm and Dynamic Acres, both five-acre farms, use similarly sized tractors for field work. Hal uses a 30-horsepower tractor and an eight-horsepower walk-behind rototiller and Jonathan uses a four-wheeler and a 35-horsepower tractor. Barry and David had the fewest fruit and vegetable acres. David has only a walking tractor as a power unit and these units generally range between 8- and 13-horsepower. David was the only farmer in the case study that did not have a conventional tractor. He justifies this saying, "I can manage most of it with just that walking tractor because it's just on a small scale." Barry uses a small lawn tractor. In general, these cases do suggest that increasing the scale of production encourages the purchase of larger machinery.

Though there are incentives to purchase machinery when a farm scales up, this does not necessarily reduce the

importance of labor on the farm. Barry said that he is not interested in increasing the scale of his asparagus production for several reasons including increasing labor. Growing four acres of asparagus requires a lot of hand labor hours. Increases in asparagus acreage would almost certainly require hiring more workers to help with harvesting. "I suppose if we had more then you just couldn't walk it all if you had more [acres], you'd have to have more people," he explained. "Right now one person working every day can do this for our acres." Barry also would need to find other marketing outlets if he increases production. Likewise, Hal is not interested in expanding acreage but is focused instead on making changes to his crop mix. While he does see purchasing machinery as a way to increase his production, he realizes labor will still be important due to lack of alternatives to hand labor for certain tasks. "If I took and invested more in machinery I could maybe get rid of some of the labor, but not all certainly," Hal explains. "Most of the harvesting we do on this scale is handwork so there's not a really good way to mechanize some of that stuff."

Mechanization's relationship to scope seems to be a bit more complex and mostly varied with the heterogeneity of the crop mix. Several growers cited that the amount of tasks for which a machine could be used was an important consideration. Charlie uses the same tillage and planting equipment for sweet corn as he does for green beans but not for other vegetable varieties. Hal uses mulching equipment for many different crops. Jonathan uses the same potato digger to harvest all of their root crops and their Jang planter has changeable plates to handle seed of different shapes and sizes. Oliver transplants several crops with his mechanical transplanter. This makes sense since if two crops are similar, the same machines can be used to produce them. In this case, increasing the sum of acreage for these similar crops mimics an acreage increase for a single crop since the fixed machinery costs can be spread over more output.

As the farm's crop mix became more diverse, growing more crops tended to discourage machinery use. The same farmers who seemed to purchase machines with a wider scope of crops also stated that they had trouble growing certain ones. For instance, Jonathan spaces certain crops closer than his transplanter is able to plant so these are done by hand instead. Hal said that a more diverse crop mix led him to hire more workers since he needed to carry out more tasks simultaneously. His level of crop diversity also discouraged the purchase of a transplanter. "I grow so many different things," he explains. "If I were actually growing acres of broccoli I would definitely have a transplanter that worked for the broccoli … it's ten different things I'm planting in a couple different beds … you have to redo the spacing and so think 'no, let's just do it by hand.'"

## FARMS WITH OTHER ON-FARM ACTIVITIES

For farmers who engage in other activities on the farm besides growing fruits and vegetables, acquiring machinery that applies to a broader range of activities may encourage acquisition. Case study farmers tended to have mixed feelings on this. Charlie said that his acres of corn and soybeans required that he have a larger tractor. This larger tractor was a good implement to have for his fruit and vegetable crops since he can use it for his initial tillage of all 50 of his acres. Barry also grows corn and soybeans but did not use his larger equipment for his asparagus crop.

## MARKETING OUTLETS

The way a farm markets its crops may impact machinery decisions. From the farmers' perspectives, marketing outlets differed in four ways: scale of production, the level of crop diversity, predictability and prices. Growers marketing through farmers' markets need to grow more types of crops so that they can sustain production throughout the entire market season. Since CSA customers typically receive an assortment of vegetables each week, CSA growers also need to have a diverse crop set. Wholesale outlets such as grocery stores and restaurants generally ask for a larger and more uniform set of crops.

Since CSA customers receive a weekly allotment of produce of a standardized value and usually pay up front at the beginning of the season, this might give the grower the cash-on-hand as well as the certainty of production quotas to make more informed mechanization decisions. This idea extends to wholesale marketing as well, when pricing and production quotas are more certain and the farmer knows the revenue impact of production. Wholesale outlets also may allow for some specialization at a larger scale, making mechanization more economical. No farmer in the case study stated a direct connection between machinery acquisitions and marketing, but they did say that cash flows were important. Charlie, Hal, Oliver and David said that the amount of cash-on-hand impacted the timing and selection of machinery. Some farms cited that as a fruit and vegetable farm, obtaining credit from a bank was more difficult. These

farms tended to reinvest farm profits in the machine fleet and other farm improvements.

Most of the wholesale outlets were through grocery stores or restaurants. These relationships rarely involved a formal contract but rather relationships between the farmer and the grocery store produce manager or chefs. This means that for many growers, their deliveries to grocery stores are subject to some variation in volume and price. This may downplay the role that grocery wholesale outlets play in machine investment decisions since it does not necessarily imply a consistent income throughout the season. Farmers with strong relationships or good reputations with the produce managers may not see as much demand or price variation. Charlie states, "Some stores are better than others just because the produce managers say, 'I like your produce or I like your sweet corn.… I'd rather pay a little more and keep [you].'"

The input that marketing outlets seem to impact the most is labor hours. Different marketing outlets require different delivery systems to the customer. CSA farmers typically need to advertise in order to cultivate business each year. Farmers' markets require workers to staff stands and transport produce to the market each week. Depending upon the arrangement, the farmer may have to make deliveries to wholesale or CSA customers or they may be picked up at the farm.

## FARMER PREFERENCES AND CONSTRAINTS

Machine purchases for the case study farms seemed to take place in two contexts: farmers more or less followed a template from a previous employer or farmers learned by experimenting with what works on their farm. The prior group tended to justify purchases by saying things like, "because I've seen this work for this similar farm." For Hal, Oliver and David, the primary crops, the machine fleet, and the production techniques were selected from what they knew from previous employment. These farmers had all worked for other growers before venturing out on their own. "I had been farming long enough that I knew exactly what [we needed]," David remarks. "The farm that I worked on … had tractors as well but that [walking tractor] was what we used everyday … we managed his farm, learned his operation." Charlie started with crops that were similar to his row crops and learned by word of mouth and experimentation. Decreased cost and reduced effort were the two most often cited explanations farmers gave for acquiring machinery **(Table 2)**. Timeliness concerns, labor savings and lack of viable hand labor alternatives also were important factors.

In many cases, farmers decided against purchasing equipment that they considered. Many farms were averse to taking out loans to purchase machinery, so the amount of cash-on-hand often determined when machinery investments were made. Certain machines did not offer enough savings in costs, labor or time to justify their purchase. Both Hal and David cited that compost equipment such as spreaders and bucket loaders did not offer sufficient savings. Some pieces of machinery required production changes that kept growers from purchasing them. To make multiple crops easier to produce with their machine fleets, case study farmers had to adopt standardized production practices such as setting row widths for multiple crops. The use of certain machines would require changing these practices. Sometimes preferences also dictated machinery purchases. For example, Barry decided to sell his asparagus harvester since his primary employee preferred to harvest by hand.

## Table 2: Explanation for Machinery Choices in Case Study

| | Kent Family Farm | Green Farm | High Ridge Farm | Dynamic Acres | Arrowhead Farm | Star Farm |
|---|---|---|---|---|---|---|
| **Acquisition Justification** | | | | | | |
| **Decreased Costs** | Tillage Equipment, Tractor | Mulch Layer | | Planting Equipment, Mulch Layer, Seeders | | Riding Tractor, Walking Tractor |
| **Decreased Effort** | Tillage Equipment, Tractor | Broadcast Seeder, Mulch Layer | | | Second Tractor | |
| **Decreased Labor** | | Tandem Disk | | Second Tractor | Transplanter, Second Tractor | |
| **Decreased Work Time** | | Tillage Equipment, Tractor | | Ecoweeder | Transplanter, Tillage Equipment, Second Tractor | |
| **Few HL Alternatives** | | Tillage Equipment, Tractor | | Seeders | Tillage Equipment, Mulch Layer | |
| **Other Income** | Large Tractors, Corn Equipment | | | | | |
| **Non-Acquisition Justification** | | | | | | |
| **Lack of Availability** | | | | | | |
| **High Cost** | | Manure Spreading Equipment | | | Green Bean Harvester | Riding Tractor |
| **Needed Farm Changes** | | Potato Digger | | Second Row Equipment | Green Bean Harvester | |
| **Insufficient Gains** | | Manure Spreading Equipment | | | | Mulch Layer, Bucket Loader |
| **Preferences** | | Potato Digger | Asparagus Harvester | Walking Tractor, Transplanter | 8N Ford Tractor | |

Names of farms have been changed to protect participants' privacy.

# Case Study Conclusions


These case studies highlight the variety of approaches that fruit and vegetable growers have used to expand production. While there is clearly no one-size-fits-all strategy, a few common themes do emerge from these examples. Farms producing large quantities of similar crops tended to use more and larger pieces of equipment. Those that grew a more diverse set of crops tended to use more labor. Mechanization can help to offset labor costs but does not eliminate the need for labor entirely. In general, harvesting remains a particularly labor intensive task.

Farmers sold their crops in several ways. The impact that these marketing outlets had on machinery decisions was somewhat unclear, but the cash-on-hand clearly factors into major purchases. In general, the degree of crop specialization also seemed to impact the farm's ability to mechanize. However, since certain crops have few machine options, crop selection is highly important. No single narrative holds for every farmer in the case study. These farms were multifaceted and usually a number of reasons went into a given purchase. Before planning expansions, farmers should talk with other growers to understand what their expansion entails, consider their goals, and account for their own farm's unique features.

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