INSTITUTE FOR AGRICULTURE AND TRADE POLICY

Frozen Local:

Strategies for Freezing Locally Grown Produce for the K-12 Marketplace

By JoAnne Berkenkamp, Lynn Mader and Madeline Kastler

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EXECUTIVE SUMMARY

Farm to School programs, linking children in K-12 schools with locally grown foods and the farmers who produce them are growing by leaps and bounds across the United States. In 2012, more than 12,400 schools were engaged in Farm to School activities.[1] In Minnesota, where the Institute for Agriculture and Trade Policy (IATP) is headquartered, two-thirds of the state's K-12 students attend school in districts that are participating in Farm to School.

Many schools are now looking for ways to extend their Farm to School programs beyond the season for locally grown fresh produce. One avenue for engaging in Farm to School year-round is preserving the local bounty through innovative strategies for freezing fruits and vegetables grown nearby.

In this report, IATP explores several potential avenues for freezing locally and regionally grown produce on a small-to-medium scale for the K-12 marketplace: schools freezing on-site in their own kitchen facilities; mobile freezing units; commercial kitchens and small freezing enterprises; and co-pack relationships with existing freezing companies that could potentially serve the K-12 market.

Our research draws insight from the first-hand experiences of a range of ventures around the country that are now exploring freezing strategies for fruits and vegetables grown in their region. While some of those ventures are aimed squarely at serving K-12 schools, others are seeking to process local farm products for other markets while providing fair prices to their farm partners. All shed light on the opportunities and challenges of modestly sized approaches for freezing produce. Our findings include the following:

Freezing on-site in K-12 kitchens

- Freezing locally grown produce on-site in K-12 facilities can be a positive and affordable strategy for interested schools when focused on appropriate crops and when freezing activities are tailored effectively to the school's operating environment. While freezing will not be a fit for all schools, it can be attractive for those that can conduct modified scratch cooking.

- The cost of the finished product is specific to the crop and varies greatly depending on the particular processing method used, the hourly cost of labor and the purchase price paid to the supplier. Identifying the most efficient processing method given available equipment and staffing is key to choosing effective freezing activities.

- A strong majority of the school food service staff interviewed reported that the finished cost of various local foods they had frozen on-site was within their budget for occasional use. As schools gain experience with freezing, they tend to hone in on crops and freezing methods that are most cost-effective given their particular operating environment.

- We collaborated with the Winona (Minn.) Area Public Schools to estimate per-pound costs for freezing three locally grown crops (zucchini, broccoli and winter squash) on-site in school kitchens, based on the equipment currently available. We used a wide range of hypothetical hourly labor rates for staff and raw product costs to illustrate the interaction between the cost of key inputs and the cost of final product.

    - Having staff process locally grown product on-site was estimated to cost somewhat more than purchasing commercially available frozen product under most of the scenarios tested.

    - On the other hand, the finished cost of product frozen on-site was found to be comparable to or, in some cases, half to one-third the cost of purchasing pre-cut, fresh product from commercial sources during the winter months.

    - The cost of freezing on-site was found to be significantly lower per-pound than commercially available alternatives when donated product is used (such as from a student farm).

- Schools we interviewed reported a wide range of benefits to their freezing activities, including high quality foods, strong student acceptance, incorporation of more vegetables into school meals, the potential for student and community engagement, and extended Farm to School programming.

- Among the barriers to broader adoption of freezing strategies in K-12 settings are busy schedules for school food service staff, limited federal and state reimbursements for school meal programs given the cost of providing quality nutrition, and insufficient public resources to adequately equip school kitchens across the country to handle minimally processed foods.

Mobile produce processing units

Akin to mobile meat processing units that travel from farm-to-farm, mobile produce processing units are in limited use and face a number of significant challenges. Among them are limited processing capacity given their modest size, significant management costs and potential mismatches with

farmers' interests in processing. Mobile units without a carefully crafted supply of raw produce may be challenged to meet K-12 schools' needs for a predictable, consistent frozen product.

Multi-use facilities and small freezing ventures

- Various small freezing businesses, business incubators and multi-use kitchens around the country are now exploring a range of approaches to freezing locally grown fruits and vegetables. Their experience illustrates the importance of focusing very strategically on suitable crops, finished products that are tailored effectively to the marketplace, and efficient processing methods. Several of these ventures are demonstrating that local produce can be frozen on a cost-competitive basis on a smaller scale, typically following considerable experimentation and honing of their strategy toward those products that can be processed most efficiently.

- Enterprises that invest heavily in facilities and equipment and focus exclusively on freezing crops that are highly seasonal may struggle to cash flow their operation. Helpful strategies include:

    - leasing or sharing space and equipment rather than owning it

    - handling crops that can be processed early or late in the growing season, or year-round if possible

    - complementing freezing activity with other types of processing that can occur year-round and maximize use of available facilities.

- Focusing on organic or higher-value specialty frozen items can help command the higher prices that may be needed to offset lower product volumes.

- Buyers seeking to freeze locally grown produce can be an attractive market for growers. Benefits identified through the examples highlighted in this report include limited marketing time, larger volume sales, sales contracts in advance of the growing season, repeat business, and a market for surplus produce and "seconds" that may otherwise be hard to sell.

- Additional public investment is needed to support quality feasibility analysis, business planning, business mentoring support and improved access to financial capital for start-up businesses in this sector.

Co-pack relationships with existing freezing companies

- Co-pack relationships with existing freezing companies appear to hold considerable promise and offer significant benefits to K-12 buyers. Among the potential benefits are flexibility in the crops to be processed, product quality that meets industry standards and limited investment of K-12 staff resources.

- Co-packers' sourcing protocols vary but may include elements like significant minimum drop sizes (e.g., by the 40,000 pound semi-load), trace-ability protocols, on-farm food safety audits and deliveries to the processing facility within very specific windows of time. This, in turn, may require growers to carefully coordinate planting, harvesting and delivery schedules.

- The availability of potential co-pack partners depends greatly on location. In Minnesota, intense consolidation in the produce freezing industry has sharply reduced the number of mid-scale freezing operations. Some produce distributors have the capacity to both cut and freeze produce, and may be potential co-pack partners if sourcing protocols and volumes can be synced effectively with suppliers. Other regions of the country that have more moderately scaled processors in place may offer a broader range of co-pack opportunities.

- In the process of exploring co-pack opportunities, we interviewed Sno Pac Foods, a fourth-generation processing company located in Southeast Minnesota. Although Sno Pac's frozen, organic products are primarily sold into the retail marketplace, they also offer products in bulk that are appropriate to institutional food service. Pricing for many of their products are competitive with prices currently paid by area school districts for frozen, conventionally grown vegetables. Depending on districts' volume needs and location, Sno Pac products may offer an attractive option for districts looking to expand their use of locally grown products beyond the local harvest season.

A. INTRODUCTION

As the local food movement explodes across the country, the use of locally grown produce in K-12 schools is on the rise. Locally grown fruits and vegetables are being served at more than 12,400 schools across the country.[2] However, the vast majority are used in fresh form and only when local produce is available in-season. Particularly in Northern climates, that "fresh season" often coincides to only a limited degree with the school year, primarily in September and October.

Farmer Gary Pahl at Minnesota District #196

There is a growing number of K-12 schools interested in "extending the season" for their Farm to School programs with locally grown foods that are available for a greater portion of the year. Similarly, farmer interest in the K-12 market is growing[3] and many farmers who grow fresh produce for local markets are seeking new channels for selling their produce profitably, including their seconds, quality products that might otherwise lack a reliable market. At the same time, a growing cadre of entrepreneurs is looking for business models that can help build profitable regional and local foods systems.

The Institute for Agriculture and Trade Policy (IATP) embarked on this study to assess the strengths and limitations of several small and mid-scale strategies for freezing locally grown produce for the K-12 market. We have focused our research on operational dynamics, logistical challenges and cost issues for the following approaches to freezing locally grown vegetables:

- in K-12 school kitchens, using equipment that is commonly available in those schools that are able to do some degree of modified scratch cooking
- mobile produce freezing units
- multi-use kitchen facilities and small freezing enterprises
- co-pack relationships with existing freezing companies

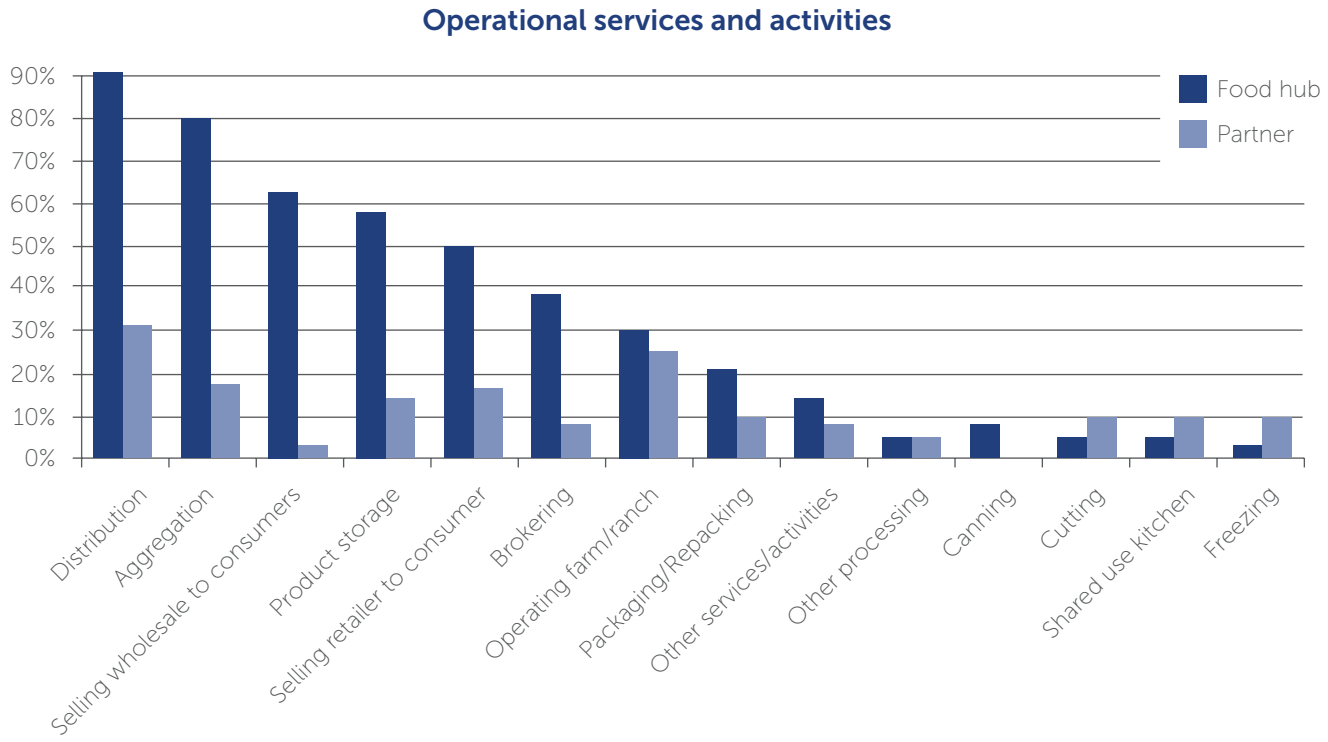
Our hope is to explore strategies that have the potential to serve multiple goals:

- Providing an attractive market and fair compensation for farmers
- Addressing the operational and budgetary realities currently faced by schools
- Providing opportunities to support the broader goals of Farm to School, including student education, healthy eating and community engagement

While smaller food-related ventures are now proliferating, the development of business models that are truly financially viable is very much a work in progress. A March 2011 study by the USDA, "Regional Food Hubs: Understanding the Scope and Scale of Food Hub Operations,"[4] identified the services provided by a growing cadre of "food hubs" across the country. Such "hubs" are generally businesses or nonprofits that facilitate the aggregation, storage, processing, distribution or marketing of locally or regionally produced food products. Many seek to foster local or regional food systems while addressing the rapid loss of modestly scaled food systems infrastructure in recent decades.

As depicted in the USDA chart on the following page, very few of the food hubs identified in the USDA's report focus are exploring freezing locally and regionally grown produce. We hope that our analysis will help illuminate some of the challenges and opportunities in this arena.

In the course of our analysis, IATP conducted numerous interviews with experts and practitioners around the country (see Appendix A), reviewed available research and partnered closely with food service staff at the Winona (Minnesota) Public Schools to inform our analysis of freezing activities conducted on-site, in K-12 kitchens. Staff at the Franklin County (Massachusetts) Community Development Corporation/Food Processing Center, which has several years of hands-on experience freezing local produce, consulted with us on various elements of the report.



Source: Jim Barham, USDA Agricultural Marketing Service, "Regional Food Hubs: Understanding the Scope and Scale of Food Hub Operations, Preliminary Findings from a National Survey of Regional Food Hubs," http://ngfn.org/resources/ngfn-database/knowledge/Food%20Hub%20Preliminary%20Findings_Mar.22.2011.pdf. (Accessed October 4, 2012).

We begin with a brief sketch of our regional context here in the Upper Midwest, an overview of methodologies for freezing fruits and vegetables, and then an exploration of four different strategies for small and mid-size freezing ventures noted above. Topics such as regional supply analysis, carbon foot-printing and the financial viability of specific enterprise models were beyond the scope of our research and remain important questions for future consideration.

While this analysis is rooted in the contexts of the Upper Midwest and K-12 food service, we hope that it will also be useful to readers working in other contexts.

B. OUR GEOGRAPHIC CONTEXT

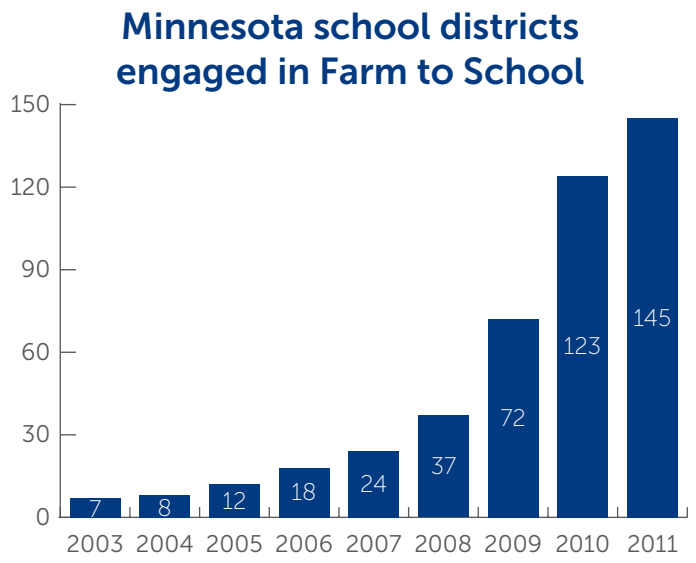
Below we provide a brief sketch of K-12 demand for fruits and vegetables, and related farming and processing dynamics in Minnesota.

On the "demand side" of the equation, demand for locally and regionally grown foods has grown significantly among K-12 food service buyers in recent years. In Minnesota, the number of K-12 school districts participating in Farm to School initiatives has risen from fewer than 20 districts in 2006 to 145 districts in 2011, as shown in the chart below.[5]

The school districts engaged in Farm to School in 2011 serve approximately 558,000 students, or roughly 68 percent of Minnesota's K-12 population. These districts range in size from about 100 students to 39,000 students, and range from small rural districts with one or two school buildings to large urban ones with 60+ feeding sites. Twenty-six types of fruits and vegetables grown in Minnesota and the four surrounding states were used by more than 10 Minnesota school districts in 2011 (see Appendix B).

Although budgetary dynamics can vary across school districts, K-12 schools typically have $1.00 to $1.20 to spend on the food value of each school lunch they serve (with the remaining costs covering labor and overhead). Of this amount, $0.25 to $0.40 has typically been spent (combined) on fruits and vegetables.

The advent of new federal school nutrition standards, which went into effect in July 2012, will require participating schools to provide more fruits and vegetables overall and to meet specific standards with regard to the provision of green and orange/red vegetables, in particular (among other requirements).



Source: Farm to School in Minnesota: Fourth Annual Survey of School Food Service Leaders, (Minneapolis, Institute for Agriculture and Trade Policy and Minnesota School Nutrition Association, 2012).

Schools in Minnesota commonly purchase fresh, frozen and canned fruits and vegetables from a broadline (or "prime") distributor, a produce distributor, or both. Fruit and vegetable products can also be obtained through federal commodity programs such as the Department of Defense Fresh Program, the Fresh Fruit & Vegetable snack program, and the USDA Commodity Program. More than 100 Minnesota school districts also purchased directly from farmers, farmer collaboratives or other types of more "direct" sources in 2011.[6]

Approximately 101 million[7] school lunches were served in Minnesota in 2011 under the Federal school lunch program. IATP estimates that the K-12 market for fruits and vegetables served at lunch is roughly $35 million per school year. This figure is likely to increase somewhat as the new federal standards take effect.

Of this amount, IATP estimates that Minnesota school districts participating in Farm to School purchased approximately $1.25 million of fresh fruits and vegetables that were grown in the five-state region in calendar year 2011. Additional fruits and vegetables are served in snack, breakfast and other school-based nutrition programs.

Interest among Minnesota school districts in "frozen local" products appears to be on the rise. When IATP began researching this issue in 2010, we identified and interviewed eight districts that had first hand experience with freezing locally grown vegetables. In most cases, these districts started freezing locally grown foods because they received more product than expected from their farm partners and wanted to preserve the product for later use rather than see it go to waste.

Overall, they froze a dozen different types of locally grown vegetables, reported their experience as "positive," said the cost of the finished product was within their budgets and planned to continue their freezing activities in future years. More details on their freezing activities and additional lessons learned are provided in Appendix C.

In the annual Farm to School survey that IATP released in March 2012, we also asked food service leaders at districts across Minnesota about their interest in purchasing frozen produce that was locally grown, certified organic and pre-cut if it was priced comparably to alternative sources of frozen produce. (Such product is currently produced in the region but has not been widely marketed to schools.) Ninety-two percent of responding food service directors indicated they were either "very" or "somewhat interested" in this type of product.[8]

In terms of the "supply side" of the equation, Minnesota currently produces vegetables for both the fresh and processing markets. Taking the processing side first, Minnesota and Wisconsin are among the national leaders in production of sweet corn, snap beans, green peas, carrots and potatoes grown expressly for the processing market (e.g., freezing and canning) as shown in the figures below:[9]

Minnesota

Vegetable	Acres harvested for processing	Percent of U.S. total production	National ranking based on acres produced
Sweet Corn	106,811	29.5%	1st
Green Peas	65,837	32.0%	1st
Potatoes	34,906	5.8%	4th
Carrots	888	3.6%	6th

Wisconsin

Vegetable	Acres harvested for processing	Percent of U.S. total production	National ranking based on acres produced
Snap Beans	69,862	35.3%	1st
Sweet Corn	83,644	23.1%	2nd
Carrots	3,942	15.8%	2nd
Green Peas	37,315	18.1%	3rd
Potatoes	29,956	5.0%	7th

In total, approximately 215,000 acres of Minnesota farmland is dedicated to growing vegetables for the processing market, with sweet corn and green peas representing 80.2 percent of processing acreage in the state. In Wisconsin, 241,000 acres are dedicated to vegetables for the processing market, with sweet corn and snap beans being most prevalent.

Crops grown for the processing market operate in a very different world than crops grown for the fresh market. Most farmers in the region who sell into the processing market operate under contracts with national and multi-national processors that have large processing facilities in the Upper Midwest. These include Birds Eye/Pinnacle Foods Group, Green Giant/General Mills, Lakeside Foods and Seneca Foods. Sno Pac is also a well-known provider of frozen, organic fruits and vegetables, many of which are sourced from within 75 miles of Sno Pac's processing plant in Southeast Minnesota.

Production methods related to crop quality (primarily disease, insect management and plant varieties) are tightly controlled to ensure uniformity of processed products and suitability for freezing. Plant varieties are often chosen for their agronomic and recovery traits (e.g., the percentage of the harvested crop that can be used in the finished product) over taste or nutritional value.[10]

The size of farms that grow for the processing market in Minnesota and Wisconsin range from a few dozen acres to over a thousand. The price per pound paid to growers in the processing market is typically lower than for fresh product, but contracting mechanisms and higher volume sales can offer these growers a more predictable income.

Planting and harvesting schedules are tightly managed to ensure that contracted product flows through processing facilities smoothly. Processing facilities are typically highly efficient and use very sophisticated handling equipment designed for large volumes of consistent product.

Image courtesy of Erin McKee VanSlooten

However, supply sometimes exceeds available processing capacity even among the major national processors, a problem known as "bypass." In these cases, the product is often left in the field unharvested or cut for animal silage (although farmers growing under contract are typically still paid for their crop). Hunger-Free Minnesota estimates that more than 210 million pounds of sweet corn, peas and potatoes destined for the processing market go unharvested annually in Minnesota.[11]

Given the leading national role that Minnesota and Wisconsin play in growing sweet corn, snap beans and green peas for the freezing market, many such products that are found on area grocery shelves have been grown and processed, in fact, within the region. Washington and California are also leading domestic suppliers of crops for the processing market such as sweet corn, tomatoes and broccoli.[12]

However, because such products are typically marketed under national brands without readily understandable identification of the products' origins, consumers are often unaware of where this food was grown. The supply chain is generally opaque to consumers, although large processors can typically trace specific products back to the place of origin in the event of a product recall or other concern.

In Minnesota and Wisconsin, vegetable production for the fresh market is much smaller than for processing markets. For instance, approximately 32,000 acres of Minnesota farmland were used for fresh vegetable production in 2007, compared with 215,000 acres for processing. Nearly half of these 32,000 acres were dedicated to potatoes grown for the fresh market. In Wisconsin, approximately 56,000 acres are in fresh vegetable production, less than one-quarter of the acreage used for vegetables destined for freezing or canning.[13]

Despite the more modest scale of produce acreage for the fresh market, Minnesota and Wisconsin are home to over 8,000 small and mid-size farms that produce a wide range of fresh fruits and vegetables ranging from apples to corn, peppers, squash, cantaloupe, watermelon, snap beans, carrots, tomatoes and many others.[14] These small and mid-sized growers are the most likely sources of locally and regionally grown fresh produce for K-12 schools participating in Farm to School, whether via farm-direct sales, distributors or other channels.

A March 2012 survey of producers in Minnesota and neighboring states generated the following input about the K-12 marketplace:[15]

- Eighty-four percent of those producers who have sold to K-12 buyers in the past rated the experience as "somewhat" or "very successful."
- Two-thirds reported that the prices they had received from their K-12 buyers were "about the same" as prices received from other wholesale accounts for comparable product. Eighteen percent characterized prices received from schools as "somewhat lower."
- Ninety-five percent say they felt they received "a fair price" from their school buyers.
- If a school/district made an advance commitment to purchasing product (e.g., in the winter for product the following fall), 87 percent of respondents said they would be "somewhat" or "very interested" in growing specifically for that school.

Further, the top two barriers to selling to schools producers identified were "seasonality of my products doesn't fit with schools' ordering schedules" and "we have difficulty guaranteeing a specific quantity on a specific date." School procurement for freezing has the potential to address both of these barriers as fresh product can be processed in the summer at the peak of harvest when schools aren't in session, and there can be more flexibility around delivery schedules than when very specific quantities need to be delivered and menued at schools on the same day.

While a detailed analysis of supply and processing issues was beyond the scope of this study, various supply chain dynamics in Minnesota should be kept in mind as they have bearing on the potential for small and mid-sized freezing opportunities:

- The growing season for fresh produce in Minnesota is relatively brief and primarily overlaps with the K-12 school year during September and early October, along with storage crops that are available into the fall and winter. The short growing season is a limiting factor for farm incomes as well as the supply of locally grown foods. There is a small but increasing supply of specialty product grown in greenhouses, hoop houses and through other season-extending production strategies.

- There is extensive infrastructure now in place for pre-cutting and distributing locally and globally-sourced produce through a cadre of existing national and regional broadline (or "prime") and produce distributors. These distributors are typically able to meet their clients' demand for local produce by purchasing from a relatively small number of mid-sized (e.g., 50 to 1000 acre), diversified produce growers in Minnesota and western Wisconsin.

- By contrast, there is very limited scale-appropriate infrastructure for aggregating, distributing and processing locally grown produce from farms that are not able to sell into the above wholesale distribution channels. Barriers include their smaller scale of operation, remote location, lack of post-harvest handling capacity or food safety certifications, and insufficient demand among distributors to purchase from additional, smaller suppliers.

- Those mid-size farms in our region that sell into existing wholesale distribution channels typically do so without benefit of the written contracts that are standard practice between distributors and national producers and packers. Local growers also face stiff competition from large suppliers in other parts of the United States and overseas.

- While the number of diversified Minnesota produce farms that are certified under USDA's Good Agricultural Practices (GAP) program is on the upswing, many smaller farms are challenged to meet rising market expectations for documented on-farm food safety protocols and third-party audits. The need for more robust post-harvest handling infrastructure is also prevalent among smaller farms.

- The region is also subject to climatic variability that leads to bumper crops in some years (when glutted markets sometimes cause growers to leave acreage unharvested) and shortfalls in other years when growing conditions are less favorable. The frequency and severity of extreme weather events such as droughts and flooding are on the rise, increasing risks for both farmers and schools that are seeking to partner with nearby growers.

Jaden Forbord conducting a demonstration at Prairie Horizon Farm

C. A QUICK OVERVIEW OF FREEZING PROCESSES

Before diving more deeply into different strategies for processing produce, we provide a brief overview of freezing methods at various scales.

Produce can be frozen in many ways, ranging from low-tech, small-scale methods to very sophisticated, capital-intensive facilities designed to maximize efficiency at high volumes. Labor and equipment requirements vary widely based on the scale and sophistication of the operation.

In a typical K-12 school setting that has some capacity for modified scratch cooking, or in a modestly sized commercial kitchen, a variety of approaches could be taken for preparing and freezing produce that is received in whole, uncut form. For instance, one illustrative approach would be to:

1. Inspect the produce upon receipt from the supplier.
2. Set up and sanitize the processing station.
3. Wash and trim the product.
4. Peel/chop/grate the product into the desired form either by hand or with available processing equipment.
5. For most crops, blanch the product by briefly immersing it in boiling water. (Note: delicate foods such as berries and zucchini are not blanched.)
6. "Shock" the blanched product in an ice water bath to lower its temperature.
7. Drain off excess water .
8. Depending on the type of product, place on trays or in shallow pans and place in a holding freezer until thoroughly frozen (e.g., 24 hours).
9. Place frozen product in appropriately sized containers given intended uses.
10. Move the product to freezer for storage.
11. Clean up and sanitize work area.

Food safety is always a key concern and care must be taken to maintain foods at appropriate temperatures and follow safe food-handling practices. Processing and freezing of product for use in K-12 settings needs to be supervised by properly trained staff and be conducted in certified facilities that meet applicable standards and requirements for safe food handling and sanitation. Specific concerns should be directed to the appropriate environmental health departments and other entities that regulate the facility's food handling practices.

CC image courtesy of USDAgov via Flickr

In a more fully equipped facility, processing can be handled on a larger and more efficient scale with the addition of equipment such as:

- peeling and cutting equipment tailored to specific crops and types of cuts, such as corn strippers, hard squash peelers and equipment for trimming the ends of green beans
- conveyer belts for moving product between and through various processing stations
- centrifuges to remove excess water after washing or blanching
- sophisticated freezing equipment such as blast or tunnel freezers that handle large volumes of produce at high speed and at very low temperatures. Such equipment produces Individual Quick Frozen (IQF) products that reflect the industry standard for commercially frozen produce.

A food's suitability for freezing and the quality of the finished product are affected by several factors, among them:

- The specific variety of crop used
- Post-harvest handling and the quality and freshness of the product at the time of freezing
- Blanching the product before freezing. This step is key to food safety and also helps foods retain their color, avoids browning, and extends the shelf life of the product while frozen
- Dropping the temperature quickly during the freezing process (for instance, by freezing individual pieces separately and quickly in more sophisticated freezing equipment that drops the temperature to a very low level very rapidly versus freezing foods in larger blocks and/or in a holding/storage freezer that is held at a higher temperature and drops the food's temperature slowly)
- Proper storage and packaging of the finished product. On a commercial basis, frozen fruits and vegetables are commonly held at -10 degrees Fahrenheit and retain their quality for one year or longer.

Next, we explore several scenarios for freezing produce at different scales and contexts, beginning with freezing produce on-site in K-12 school kitchen facilities.

D. FREEZING AT SCHOOL

While most of the locally grown produce associated with Farm to School programs is used in fresh form, efforts to freeze local produce are taking place in schools from Massachusetts and Vermont to Wisconsin and Missouri. In the course of our research, we interviewed numerous school food service staff around the country who have hands-on experience freezing locally grown produce.

We also partnered with the Winona Area Public Schools[16] in Southeast Minnesota to help us "ground truth" how freezing activities could play out in a smaller (3,300 student) rural district that is seeking to grow their Farm to School program.

Below we highlight some of the activities currently taking place to freeze local produce on-site at K-12 schools around the country, along with the benefits and challenges of these efforts. Then we take a deeper dive into the costs and logistics of freezing on-site in K-12 settings.

Current activities

- Among the schools we interviewed nationally, we found that a wide variety of fruits and vegetables had been purchased from local farmers and frozen on-site at schools. These include green and yellow string beans, beets, strawberries, raspberries, blueberries, broccoli, cabbage, carrots, celery, corn, cucumbers, eggplant, green peppers, onions, peas, pumpkin, rhubarb, summer squash, winter squash, tomatoes and zucchini.

- In some of these cases, schools found themselves with an unexpected surplus of fresh product and froze it as a way to avoid waste. This occurred, for instance, when schools received more produce than they could use immediately from school gardens, from people who donated produce, when farmers delivered more product than had been ordered, or when farmers had extra product for which they were seeking a market just prior to a hard freeze in the fall.

- In other cases (such as the Burlington, Vt.,[17] St Paul, Minn.[18] and Viroqua, Wis.[19] public schools), school food service staff purchased fresh produce with the intention of freezing it for later use. In these instances, the frozen foods were incorporated into menu plans well in advance.

- The schools we spoke with are freezing locally grown produce in a variety of forms. Items like broccoli are often frozen alone and then used as a side dish. In other cases, items are frozen individually but later thawed and used as an ingredient in foods such as chili, squash muffins, rhubarb crisp or lasagna.

- The Viroqua, Wis. schools have had considerable success combining a variety of fresh, locally grown vegetables to make ratatouille, then freezing the ratatouille for later use in soups, Stromboli, on top of pizza and as a side dish. They have also combined diced onions and carrots for soup mix frozen in 5-pound bags, and stir-fried and then frozen a sweet pepper and onion mix for fajitas and Philadelphia beef sandwiches. The St. Paul Public Schools make zucchini bread with fresh, locally grown zucchini and then freeze the finished bread for later use.

- All the schools we interviewed used processing equipment that they already had on hand, typically freezing cut produce on large trays, and then placing frozen items in bags or bulk containers for storage.

- Many schools we spoke with held a "freezing day" in July, August or September to freeze local produce at the peak of harvest. In some cases, this was done over the summer when a skeletal staff was in place or with staff who came in for a few extra hours of paid work. In other cases, schools brought in additional labor or staff worked later in the day or on weekends once the school year had begun. Other schools reported fitting their freezing activities into the regular workday without incurring additional labor costs. Some schools have engaged outside volunteers in these activities, with supervision by trained staff.

- Many interviewees were able to produce significant quantities of frozen product with just a few days of freezing activity. In Viroqua, Wis., for instance, this district of 1,100+ students was able to freeze approximately 2,000 pounds of produce in one day. St. Paul schools used 500 pounds of local zucchini to make zucchini bread in late August and early September and then froze the bread for use throughout the school year. They received the fresh zucchini from their distributor periodically over a two- to three-week period and processed it when received.

- There is growing interest in engaging high school– and college-level culinary students and community members in food processing activities. Use of these types of volunteer labor can support the goals of student education and community involvement in schools' Farm to School programs.

- Most schools we interviewed indicated that they could easily use more frozen local products than they have attempted to freeze thus far.

- Participating districts identified a wide variety of benefits to freezing locally grown foods as highlighted below.

More detailed insights from eight Minnesota districts that have frozen locally grown foods are provided in Appendix C.

Reported benefits of "frozen local"

- High quality product
- High reported rates of student acceptance due to higher food quality and better color than alternate products
- More vegetables added to multi-ingredient foods
- Extended Farm to School programming and the opportunity for year-round educational efforts with students
- Favorable reception from parents and community
- The opportunity to bring a positive spotlight to school nutrition programs
- Student and community engagement in school food service activities, like "freezing days"
- The opportunity to use produce grown in school gardens and foster a sense of pride and ownership among student gardeners
- Added economic benefit for local farmers through increased purchasing

Workflow and cost analysis

Below we look more deeply at the labor, food and packaging costs associated with freezing various locally grown vegetables in a K-12 setting. In selecting the crops to explore, we used criteria, including:

- Usefulness of the frozen product as an ingredient in school menus
- Palatability for K-12 students
- Raw product availability from local growers In Minnesota or Western Wisconsin
- Ease of preparing and freezing the produce given typical K-12 kitchen equipment and staffing
- Compatibility with recent changes to the federal school nutrition standards

After considering approximately 15 different locally available produce items, we selected three crops—zucchini, broccoli, and hard squash—for further exploration. Some of these vegetables can also be grown easily in school gardens, which could potentially be a source of product for schools, while providing learning opportunities for K-12 students both in growing and processing fresh produce.

The scenario analysis below addresses three key cost components—labor, the cost of the raw produce, and packaging. We experimented with varying costs for each. Given many schools' growing interest in expanding the student education and community engagement aspects of their Farm to School programs, we have included scenarios that reflect this type of volunteer, supervised labor.

Food service workers at the Sibley East, Minn. School District

In developing the cost scenarios below, we based our analysis on the following assumptions:

LABOR RATE: We explored a variety of labor scenarios ranging from unpaid, supervised volunteer labor (such as culinary students or community members) to paid workers compensated at various levels. Due to the wide variation in hourly rates and benefits for staff at different grade levels and from one schools district to another, the figures below are intended to illustrate average hourly rates of compensation (including wages and benefits) for all staff members involved in a given freezing activity. Given labor rates that are common among school districts in Minnesota, we provide scenarios using paid hourly rates ranging from $12.00 to $20.00/hr.

LABOR HOURS REQUIRED: The time required to process a given quantity of product will be influenced by a variety of factors, including workers' skill level, production facilities, equipment used, type and quality of the produce being processed, and the processing steps required for the particular food (e.g., blanched vs. unblanched, and the particular form of finished product that is desired). In projecting potential labor hours, we adapted actual production data provided by the Food Processing Center in Greenfield, Mass. and the Department of Nutrition and Dietetics, Saint Louis University (SLU).

SUPERVISION: We assume that a trained supervisor is present intermittently when paid staff are used. A supervisor would be present at all times when volunteers are used.

UNPROCESSED-TO-PROCESSED YIELDS: When produce is cut and processed, a portion of the original weight of the raw product is typically lost as unusable parts (such as stems or leaves) are trimmed off. In our analysis we used actual yield data from the Food Processing Center in Greenfield, Mass., Saint Louis University and *The Book of Yields*, Francis T. Lynch, 2008.

PRODUCE PURCHASE COST: The range of product costs we tested was determined by canvassing a selection of farmers in Southern Minnesota about their prices for first- and second-quality fresh product. Actual prices will vary given the quantity ordered, grade, packaging requirements, flexibility in delivery date, market conditions, weather and other factors, so a range of potential costs are provided in the scenario analyses below. We assume that product costs reflect uncut/whole product, delivered to the freezing site.

PRODUCE RECEIVED AT NO COST: Given the rapid growth in school gardens and school farms, we also explore scenarios using produce that the school food service receives at no cost (referred to below as "donated" produce). In some cases, schools might use a combination of purchased and donated product, leading to a lower average cost per pound.

PACKAGING COST: For all scenarios, we project packaging cost at $0.05 per pound of finished product based on data from the Food Processing Center in Greenfield, Mass.[20]

QUANTITIES: In determining quantities to explore, we collaborated with our Farm to School partner, the Winona Area Public Schools in southeast Minnesota, to gauge the potential demand for frozen produce at a modestly sized district. The district has 3,300 K-12 students and an active Farm to School program. The school district's food service director estimates that their yearly demand for the three focal products in frozen form would be:

- 500 pounds zucchini
- 2000 pounds broccoli
- 400 pounds winter squash

KITCHEN EQUIPMENT: Our scenarios are based on the equipment and facilities currently available at the Winona Area Public Schools as detailed below. The processes and time requirements would need to be adjusted to reflect different circumstances in other settings.

SERVING SIZES: The analysis below is calculated in terms of finished cost per pound. Typically a half-cup serving would equate to approximately four ounces of vegetables.[21]

PRICING FOR ALTERNATIVE PRODUCTS: To put the cost of freezing on-site into context, we compare these costs with the cost of alternative products, namely fresh (non-local) and frozen products that are available for purchase by the Winona Area Public Schools when locally grown fresh product is out of season. We compare the cost of processing cut, frozen product on-site to the cost of commercially purchasing pre-cut fresh and frozen products. The alternate costs discussed below reflect quotes obtained in Fall 2012 from distributors serving school districts in Southeast Minnesota.[22]

Zucchini

The Winona Schools estimate that they could use 500 pounds per school year of frozen zucchini. Producing 500 pounds of finished frozen product would require purchasing 533 pounds of usable raw product, assuming a 6-percent loss rate during trimming and processing. Unlike some other product items discussed below, zucchini is not blanched before freezing.

Preparation and freezing process

Several different approaches could be used to freezing this quantity of zucchini in a K-12 setting. The approach described in our analysis uses the equipment and staff skills that Winona currently has in place:

- Supervisors receive and weigh the zucchini and oversee the freezing processing operation.
- Workers wash the product, trim the zucchini with knives, slice the zucchini in a 4-quart commercial food processor, and pack the sliced zucchini in 5-pound plastic bags.
- The bags are vacuum-packed and sealed. Four bags are placed into a box.
- The 20-pound boxes are then stacked and frozen in a holding freezer.[23]

- Before and after freezing activities, the kitchen facility is cleaned and sanitized.

Five-pound bags would be used (rather than 20-pound bags, for instance) as this smaller size would better correspond with Winona's anticipated menuing needs and avoid the waste associated with thawing larger quantities than are actually needed at a given time.

We based our labor analysis on the projection that 500 pounds of zucchini could be processed by one supervisor and a team of two to five staff working at various times given the specific tasks at hand. With that approach, this quantity of zucchini could be processed over a span of 5.5 hours and then frozen. A total of 18 hours of staff time would be used (Three hours of supervisor time and 15 hours of non-supervisor time).

With a larger team, the elapsed time could potentially be reduced. The time allocated in our cost projections for setting up and sanitizing work stations and cleaning them up afterward could also be reduced if the processing occurs on a normal work day when this prep and clean-up would already be taking place at the school's kitchen facility.

An alternative freezing process could involve placing the cut, fresh zucchini on trays, placing the trays in the holding freezer, freezing the zucchini, unloading the frozen product from the trays, and then bagging and boxing the frozen product. This is likely to be a more labor-intensive approach, although the product would freeze more quickly and evenly when frozen in this manner.

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Cost comparison

To assess potential finished products costs, we ran scenarios using a variety of different labor and raw product costs. We assume that packaging costs are $0.05 per pound under all scenarios. As shown below, if fresh, uncut locally grown zucchini was purchased and delivered for a low average price of $0.40 per pound and overall labor costs averaged $12.00 per hour, the finished product cost is estimated to be $0.91 per pound. If the raw product is purchased at $0.90 per pound, the finished product cost rises to $1.44 per pound.

If donated zucchini (e.g., from a student farm) is used and processed by kitchen staff averaging $12.00 per hour, the cost is estimated at $0.48 per pound. If product is donated and volunteer labor is used (such as culinary students or community members), with 5.5 hours of supervision paid at $20.00 per hour, the finished product cost is projected at $0.27 per pound. The cost-per-pound could potentially be lowered if larger volumes are processed and greater economies of scale are realized during processing.

Zucchini: 500 lbs.

	Average cost for whole, uncut produce per pound	Paid labor hours required	Average hourly paid labor rate	Cost per pound of finished product
Scenario costs				
Purchase 533 lbs of fresh, uncut, locally grown zucchini	$0.40	18	$12.00	$0.91
	$0.50	18	$12.00	$1.02
	$0.60	18	$12.00	$1.12
	$0.60	18	$15.00	$1.23
	$0.60	18	$20.00	$1.41
	$0.75	18	$12.00	$1.28
	$0.90	18	$12.00	$1.44
Purchased product and volunteer, supervised labor	$0.60	5.5	$20.00	$0.91
Donated product and paid labor	$0.00	18	$12.00	$0.48
Donated product and volunteer, supervised labor	$0.00	5.5	$20.00	$0.27
Alternate costs				
Frozen, cut zucchini purchased commercially				$0.90
Fresh (non-local), cut zucchini purchased commercially				$2.92–$2.97

These figures compare to two alternate ways that the Winona Area School District could purchase zucchini when locally grown, fresh product is out of season:

- Purchasing frozen, cut zucchini from a distributor. In Fall 2012, Winona could purchase such product for $0.90 per pound.
- Purchasing fresh (non-local), cut zucchini from a distributor. In Fall 2012, this product was available commercially through distributors serving school districts in the region for $2.92 to $2.97 per pound.
- Zucchini was not available either fresh or frozen in Minnesota as a USDA Foods commodity product at that time.[24]

Under the conditions outlined here, the cost of freezing locally grown zucchini on-site would be comparable to purchasing commercially available frozen product under scenarios where raw product is obtained for a low price of $0.40 per pound with paid labor, or a more typical price of $0.60 per pound with supervised volunteer labor. Under the other scenarios tested, the cost of freezing on-site would be somewhat more expensive than purchasing frozen product commercially.

Under all scenarios, the cost of freezing on-site is estimated to be roughly one-third to one-half the cost of purchasing pre-cut, fresh (non-local) product commercially during the winter months.

Freezing locally grown product on-site is significantly less costly than the alternatives when using zucchini that is obtained at no cost to the school food service, such as zucchini grown in a school garden. The cost of freezing zucchini on-site would likely decline if volumes larger than 500 pounds were being processed.

Broccoli

We also explored the costs and workflow associated with freezing locally grown broccoli. Minnesota once had a thriving community of producers growing broccoli on a wholesale basis for national markets, particularly in the northern reaches of the state where growing conditions are particularly favorable. Rising competition led to the decline of that industry on a wholesale basis.

However, many smaller growers who produce for direct and co-op grocery markets continue to grow broccoli in the region and could potentially sell into the K-12 marketplace. Broccoli also fits well with the new federal nutrition standards, which specifically require increased offerings of green vegetables. Frozen broccoli has been a favorite among students in the highly successful "frozen local" program at the Chicago Public Schools. (That program is discussed at greater length in Section G of this report.)

Preparation and freezing process

The Winona Schools estimate that they could use 2,000 pounds per school year of frozen broccoli. The process for freezing broccoli differs from zucchini in that broccoli requires blanching in boiling water and then "shocking" to bring its temperature back down. In a school setting, the process for processing broccoli could be as follows:

- Receive and weigh the raw broccoli and supervise the freezing process.
- Set up cleaning and processing stations.
- Wash and trim the broccoli with knives and chop it in a 4-quart commercial food processor.
- Blanch it in 2-gallon perforated pans in a 25-gallon tilt skillet and drain excess water.
- Shock it in two 50-gallon basins over running iced water and drain it in perforated pans over sinks.
- Pack the broccoli into 5-pound plastic bags. Vacuum-pack and seal into the bag.
- Place four bags each box.
- Stack 20-pound boxes in the holding freezer.

The labor estimates in the following table are adapted from actual labor rates experienced by the Franklin County Food Processing Center in Greenfield, Mass. which used the

equipment and process described above to produce 500 pounds of finished product.[25] To process 2,000 pounds of finished broccoli, we anticipate some economy of scale for supervision, receiving, weighing, sanitation, set up and cleaning the processing stations. By contrast, the time needed to wash, trim, chop, blanch, shock, drain, bag, box and transfer boxes to the freezer is assumed to increase proportionately with product volume.

Cost analysis

Producing 2,000 pounds of total frozen product would require 2,150 pounds of raw product, assuming a 7-percent waste rate during trimming and processing. Packaging is assumed to be $0.05 per pound of finished product under all scenarios.

As shown in the following table, if fresh, uncut locally grown broccoli was purchased and delivered for $0.80 per pound and labor rates averaged $12.00 per hour, the finished product cost would be $1.27 per pound. If the broccoli is purchased for $1.10 per pound, the finished product cost is projected at $1.59 per pound. Using donated or school-grown product and paid labor would cost as little as $0.41 per pound. The cost of freezing donated product using supervised, volunteer labor is estimated at $0.17 per pound.

Broccoli: 2,000 lbs.

	Average cost for whole, uncut broccoli per pounds	Paid labor hours	Average hourly paid labor rate	Cost per pound of finished product
Scenario costs				
Purchase 2,150 lbs of fresh, uncut, locally grown broccoli	$0.80	61	$12.00	$1.27
	$0.90	61	$12.00	$1.38
	$1.00	61	$12.00	$1.49
	$1.10	61	$12.00	$1.59
	$0.90	61	$15.00	$1.47
	$0.90	61	$20.00	$1.63
Purchased product and volunteer, supervised labor	$0.90	12	$20.00	$1.13
Donated product and paid labor	$0.00	61	12.00	$0.41
Donated product and volunteer, supervised labor	$0.00	12	20.00	$0.17
Alternate costs				
Frozen, cut broccoli purchased commercially				$0.68–$1.12
Fresh (non-local), cut broccoli purchased commercially				$1.39–$1.66

To put these figures in context, the Winona Area Public Schools identified two alternative ways that they could purchase broccoli commercially when locally grown, fresh product is out of season:

- Purchasing non-local, cut frozen broccoli from a distributor. In Fall 2012, various frozen broccoli products were available to Winona at prices ranging from $0.68 to $1.12 per pound.
- Purchasing non-local, fresh, cut broccoli from a distributor. In Fall 2012, this product was available commercially through distributors serving school districts in the region at prices ranging from $1.39 to $1.66 per pound.
- Broccoli was not available either fresh or frozen as a USDA Foods commodity product at the time.[26]

Under the conditions outlined here, freezing a labor-intensive crop like broccoli on-site would be somewhat more expensive than purchasing commercially available frozen broccoli under all scenarios where purchased raw product and paid labor are used. Processing on-site resulted in finished costs that are comparable to purchasing fresh (non-local), cut broccoli out of season. The use of donated product costs a fraction of the cost of commercial available fresh or frozen product whether paid or volunteer labor is used.

Winter squash

We grounded our cost analysis for winter squash in the processing approach and actual cost figures provided by the Department of Nutrition and Dietetics at Saint Louis University (SLU).[27] SLU processed, froze and delivered locally grown butternut squash to nearby K-12 schools as part of an initiative called Healthy Eating with Local Produce.

The SLU figures reflect purchasing 119 pounds of winter squash at an average price of $0.50 per pound paid to the farmer and a 16-percent loss rate during peeling and trimming, yielding 100 pounds of edible product. With two workers, it took SLU a total of five hours to peel, clean, cook and package the squash in vacuum-packed bags. They paid $7.50 per hour for this labor. The cost of packaging was equivalent to $0.05 per pound of finished product. SLU added 5 percent to their cost figures as a margin of error. SLU's finished cost for frozen winter squash was $1.01 per pound (excluding university overhead and a facility maintenance charge).

The Winona Schools estimate that they could use 400 pounds per school year of pureed, frozen winter squash. The labor and cost estimates below are based on the following process:

- Supervisors receive and weigh the squash and oversee the freezing processing operation.
- Workers wash the product, peel it, and dice it with knives.
- Workers cook, puree and package the squash in 5 pound plastic bags.
- The bags are vacuum packed, sealed and frozen.

(Squash could also be processed using a variety of other, potentially less labor intensive approaches such as cutting it in half, rings or unpeeled chunks and baking it, then serving it in pieces rather than pureeing it.)

As shown in the following table, if whole winter squash was purchased and delivered for $0.35 per pound and labor rates averaged $12.00 per hour, the finished product cost would be $1.07 per pound using the approach described above. If locally grown, raw product is obtained for $0.60 per pound, the finished product cost rises to $1.36 per pound. Using donated or school-grown product and paid labor at $12.00 per hour would cost as little as $0.65 per pound. The cost of freezing donated product using 8 hours of supervision at $20.00 per hour and volunteer labor drops to $0.45 per pound.

Winter squash: 400 lbs.

	Average cost for whole, uncut winter squash per pound	Paid labor hours	Average hourly paid labor rate	Cost per pound of finished product
Scenario costs				
Purchase 476 pounds of uncut winter squash	$0.35	20	$12.00	$1.07
	$0.40	20	$12.00	$1.13
	$0.50	20	$12.00	$1.25
	$0.50	20	$15.00	$1.40
	$0.50	20	$20.00	$1.65
	$0.60	20	$12.00	$1.36
Purchased product and volunteer, supervised labor	$0.50	8	$20.00	$1.05
Donated product and paid labor	$0.00	20	$12.00	$0.65
Donated product and volunteer, supervised labor	$0.00	8	$20.00	$0.45
Alternate costs				
St. Louis University actual cost	$0.50		$7.50	$1.01
Frozen, cut winter squash purchased commercially				$0.70–$0.80 depending on type of squash
Fresh (non-local), cut winter squashed purchased commercially				$2.70–$3.57 depending on type of squash

By comparison, the Winona Area Public Schools identified two alternative ways that they could obtain processed winter squash when locally grown, fresh product is not available:

- Purchasing frozen (non-local) mashed squash from a distributor. In Fall 2012, this product was available to Winona for $0.70 to $0.80 per pound.

- Purchasing fresh, diced, non-local winter squash from a distributor. In late 2012, Winona could purchase this product commercially for prices ranging from $2.70 to $3.57 per pound.

- Winter squash was not available to the district either fresh or frozen as a USDA Foods commodity product at that time.[28]

In sum, the cost of freezing locally grown winter squash on-site would be significantly more than purchasing commercially available frozen, mashed squash under all the scenarios tested using paid labor. On the other hand, freezing on-site is projected to cost half (or less) than the cost of purchasing pre-cut squash commercially.

Using donated product (such as squash grown on a school farm) results in substantial cost savings when either paid staff or supervised volunteers are used.

It is also likely that the cost of freezing squash on-site would decline if volumes larger than 400 pounds were being processed. A different processing strategy that doesn't involve peeling and dicing the squash could also result in lower costs.

Image courtesy of Erin McKee VanSlooten

Lessons learned

Highlights

- Freezing locally grown produce on-site in K-12 facilities can be a positive and affordable strategy for interested schools when focused on appropriate crops and when freezing activities are tailored effectively to the school's operating environment. While freezing will not be a fit for all schools, it can be attractive for those that have some capacity for modified scratch cooking and are interested in expanding their Farm to School programs beyond the fresh season.

- The most suitable crops for freezing are likely to be those that stand up well when frozen, are less labor intensive to cut/trim prior to freezing, and have multiple, appealing uses in school menus.

Staff at Minnesota School District #191 with produce from Akerberg Acres Farm

Planning

- The cost of the finished product is highly crop-specific and varies greatly depending on the processing method used, the hourly cost of labor, and the cost of raw product. Packaging is typically a small factor. As a result, exploring a variety of processing methods is key to identifying which crops and specific forms of the frozen product will work logistically and most cost-effectively.

The "best" approach is likely to vary from one school context to another depending on staffing and equipment.

- Food service staff may require training on proper techniques for freezing fresh produce. (However, the schools interviewed generally felt that the need for additional training of their staff was modest. Several resources to support staff training are provided at the end of this section.)

- Schools should coordinate closely with their farm partners to "synch" their freezing plans with the timing and volume of product that farmers anticipate having available.

- Fresh produce that is of uneven size or misshapen (and thus considered "seconds") can be a good fit for freezing economically. When fall freezes are imminent, farmers may also welcome a last-minute use for frost-sensitive crops.

- Certain types of frozen produce may be available to schools through the USDA Foods (commodity) program. USDA Foods' prices are sometimes much lower than for similar products purchased on the open market. The food service staff we spoke with generally felt that the quality of frozen Commodity vegetables was good, but availability is not always predictable and some products are not available. The location where such food was actually grown may also be difficult for schools to discern.[29]

- Advanced planning can help ensure that freezing activities are synchronized with upcoming menu plans and that food is frozen in container sizes that correspond well with recipe needs.

- As with all food service activities, care must be taken to ensure that food safety practices in the school environment and among produce suppliers (and school gardens) meet all applicable regulations and that freezing activities are supervised by properly trained staff.

Processing

- Processing equipment (e.g., for slicing, dicing, cubing, grating), work space and freezer space to hold finished product will vary from one school location to another. Freezing strategies must be tailored to a given school or district's kitchen facilities, storage capacity, food budgets and staff skills.

- It is important to experiment with different ways of freezing a given food. For instance, incorporating grated zucchini into quick bread for later freezing may yield a better finished product than freezing cut zucchini alone (primarily due to zucchini's high water content). Combinations like ratatouille and veggie blends allow schools to use those vegetables that are most abundant locally when freezing activities take place.

Cost dynamics

- All but one of the nine the Minnesota school districts IATP interviewed reported that the cost of the local foods they had frozen on-site was within their budget for occasional use. More established school-based programs in Burlington, Vt. and Viroqua, Wis. have become fairly selective about which local foods are most cost effective to freeze on an ongoing basis.

- Under most cost scenarios that we tested using paid labor, freezing on-site was estimated to cost somewhat more than purchasing commercially available frozen product.

- On the other hand, the finished cost of product frozen on-site was found to be comparable to or, in some cases, half to one-third the cost of purchasing pre-cut, fresh product from commercial sources during the winter months.

- The cost of freezing on-site was found to be significantly lower per-pound than commercially available alternatives when donated product is used (such as from a student farm) when either paid staff or supervised volunteers are used.

- In general, greater savings were realized from using donated product than from using volunteer labor.

- The cost per finished pound is likely to decline as the volume of product increases. This can occur due to greater efficiencies in the processing effort (such as for receiving and weighing product, and setting up and cleaning processing stations) and potentially, volume discounts with the supplier when larger quantities are ordered.

- Schools may want to collaborate with neighboring districts (or other institutions in their community) to increase the volumes being frozen and improve the efficiency of their processing efforts. (Schools should confirm applicable food handling and transportation regulations with relevant regulatory bodies.)

- Costs are also influenced by how food service labor is deployed and accounted for. For instance, if freezing activities are worked into the normal school day when

staff are already present, additional labor costs may be minimal.

- The use of culinary students or community members (with supervision) can be a positive strategy for educating and engaging others in K-12 food service operations, and engaging in freezing activities economically.

- Numerous schools have had success when scheduling a "freezing day" in the summer or fall, sometimes using a combination of paid staff and volunteer support from students or their broader community.

- Other costs to be taken into account include the staff time to procure locally grown foods (although this may already be covered in the duties of salaried staff), storing frozen product until it is used, and transporting the product to multiple feeding sites if it is frozen in a central location.

- While cost is a key consideration, the many other potential benefits of freezing locally grown produce should also be factored into schools' decision making. These include expanding the use of high quality, tasty foods that may contribute to increased student consumption of healthy choices, extending Farm to School programming throughout the school year, hands-on cooking experiences for students, expanded opportunities to support the local farm economy, integrating school meal programs with school gardening, and community engagement

Additional Resources

- The National Food Service Management Institute (NFSMI) has a very helpful video for food service professionals that provides insights and resources from the Viroqua, Wis. schools' experience freezing locally grown produce. See NFSMI's Cooks for Kids program, Season Four: Chefs Move to Schools, which is available online at www.nfsmi.org/ResourceOverview.aspx?ID=402. NFSMI also provides helpful guidance about food safety and school gardens at http://www.nfsmi.org/documentlibraryfiles/PDF/20110106041333.pdf.

- The Sibley-East School District in Southern Minnesota has also frozen considerable quantities of tomatoes, zucchini, string beans, carrots, cabbage and pumpkin that were grown on the district's student farm. A video released in August 2012 highlights the district's farming, freezing and other Farm to School activities, available online at http://www.youtube.com/watch?v=NHVwChYm830.

- The University of Minnesota Extension website provides a variety of resources and training modules for K-12 food service staff including "Freezing Vegetables for Tasty Results" and "Freezing Fruit for Sweet Success" at http://www1.extension.umn.edu/food-safety/preserving/freezing/.

E. MOBILE PRODUCE PROCESSING UNITS

Next we turn our attention to mobile produce processing units. These are vehicles or trailers equipped to clean, cut, blanch, freeze, package and conduct other processing activities with fresh produce. Mobile units can travel to individual farms where produce is grown and serve as a processing hub for farms in a given vicinity.

While mobile meat processing units have gained some traction around the country, we found that units designed for processing produce are much less prevalent. However, two state agriculture departments—Vermont and North Dakota—have experimented with mobile produce processing units. Below we explore their approaches and some of the lessons emerging from their experience.

Vermont

In 2006, the owner of a Vermont-based pie making company approached the Vermont Agency of Agriculture (VAA) about the difficulties of sourcing locally grown blueberries. This prompted the VAA to apply for a USDA grant to conduct interviews with small-scale farmers about barriers to growing fruit for the processing market. As part of a longer-term strategy, the agency was also looking to build an Individual Quick Freeze (IQF) unit to provide infrastructure for local farmers to freeze produce.[30]

With support from the USDA grant, the agency designed an Individual Quick Freeze (IQF) mobile unit to flash-freeze berries and other produce. Farmer interviews occurred while the unit was being built. The IQF was completed in August 2008. The VAA designed the unit to flash-freeze berries and other produce that can be frozen without cutting or blanching.

The mobile berry freezing unit cost approximately $45,000 to build and was paid for through a USDA Rural Business Enterprise Grant. Transporting the unit cost approximately $2.50 per mile plus staff time.

Vermont mobile freezing unit

During 2008 and 2009, the mobile unit traveled from farm to farm, encouraging farmers to use the unit to preserve their produce. Unfortunately, farmers were not as receptive to the IQF unit as originally hoped. Most were accustomed to selling a fresh, seasonal product and had limited experience with processing and selling frozen product.

Beginning in 2010, the Vermont Agency of Agriculture allowed Green Mountain College (GMC) to use the mobile freezing unit. Green Mountain parked the unit adjacent to the college's commercial kitchen, enabling them to take advantage of the college's space and facilities to clean, cut and blanch produce, which the mobile unit did not have.

The college then made their commercial kitchen and the freezing unit available to local farmers and other entrepreneurs. GMC also obtained a $100,000 grant to support research and support operating costs during the 2011 and 2012 seasons. A coordinator was hired to explore potential markets and collect data.

During 2011, the coordinator used the unit with Farm to School and Farm to Institution projects and promoted its use among local farmers. The College collaborated with three schools and two prisons. The prisons were highly successful partners, as they had their own on-site gardens from which to source produce and inmate kitchen staff who were trained in food preparation and processing. Each prison froze over 1,000 pounds of produce.

The school partners did not have as much success as the prisons as they experienced challenges with infrastructure, scheduling and student labor. Each of the three schools froze approximately 300 pounds of local produce that year. The schools indicated that they are likely to source and freeze local

produce in the coming years, but process it in their own facilities. Farmers also did not utilize the unit as much as was anticipated. Farmers were either limited by logistical challenges, such as not having freezer storage, or had existing freezer storage and could freeze produce with their own equipment.

In 2012, Green Mountain College is recording their findings and will conduct a cost-benefit analysis at the end of the grant cycle. In addition, GMC, in partnership with a local organization, Salvation Farms, is participating in a pilot program to process and freeze surplus local produce for use in food access points in the region that serve vulnerable populations. The goal of the pilot is to provide a blueprint for a future statewide distribution system.

North Dakota

The North Dakota Department of Agriculture designed a mobile commercial kitchen to process North Dakota grown food into value-added products. The mobile processing unit contains a stove, oven, freezer, refrigerator, deep fryer, sinks, workspace, concession door, and a generator, with the potential to add flash freezing, dehydration and packing stations.[31]

The department advertised the kitchen to farmers, institutions, community members and small businesses. Renters may use the kitchen for activities such as processing local produce for Farm to School use, preparing meals for hunger projects, producing commercial products, promoting North Dakota foods and agriculture at fairs and festivals, teaching food safety and food processing, testing recipes and providing samples.

Inside the North Dakota mobile unit

The outside of the North Dakota mobile unit

The Department of Agriculture conducted a feasibility study[32] prior to building the mobile kitchen in which they identified a cost recovery structure designed to make the unit accessible to local growers. According to the feasibility study, the unit cost $62,000 to purchase and outfit. The study determined that the unit would need to be rented a minimum of 127 days per year at a rate of $125 per day to be economically sustainable.

The mobile kitchen became available for use in August 2010 and was used sparingly that year. In 2011, a few local producers used the kitchen to test recipes and prepare products for sale. The department traveled to fairs and farmers markets to serve dinners and offer samples of locally grown products. According to staff, the unit has been very effective as a tool to promote locally grown produce with consumers.

However, they also indicate less success using the mobile kitchen as a business incubator with vegetable producers. During the 2011 season, the unit was rented only intermittently. According to staff, the department has not been able to dedicate the staff time needed to maximize use of the mobile unit. Due to staff transitions and budget challenges, it is uncertain how the department will use and promote the mobile unit in the future.

Lessons learned

Properly-equipped mobile produce units may have the potential to be useful as test facilities and sites for freezing smaller batches of produce in remote locations where suitable commercial kitchens are not available. However, the challenges for effectively using mobile units to process foods for institutional markets like K-12 schools are significant:

- If the business concept behind a mobile unit is that farmers would do the processing themselves, it is essential to ground-truth assumptions about farmers' actual level of interest and their need for the types of processing capacity that a mobile unit could provide. (This caveat applies to commercial kitchens as well.) Freezing fresh produce for sale requires food handling skills, takes the farmer into a whole new product line (e.g., frozen vs. fresh) and may require different market channels.

- In some cases, mobile units may be more relevant to food entrepreneurs who are specifically interested in processing and marketing frozen foods.

- Small mobile freezing units with minimal processing capacity (e.g., are unable to blanch product or have modest work or freezer space) can be limited to just a few crops or small batches, reducing flexibility and the unit's relevance to a broader array of producers and entrepreneurs.

- Feasibility studies for mobile freezing units also need to address core questions such as:

    - What crops are available that are not already finding an attractive market when sold fresh? In what quantities and qualities is such product available?

    - What is a sensible geographic range for a mobile unit given the location of supply, the timing of harvest, staffing costs, travel costs and the like? Who would own and staff the unit?

    - At what level does the unit need to be utilized and with what rental rates to be economically sustainable and to recoup the costs associated with building, equipping, transporting and managing it?

    - What is the likely demand for frozen product and at what price points?

    - What returns to growers and food entrepreneurs are possible?

- While mobile units could potentially process small batches of product for the K-12 market, planners would need to carefully assess whether a unit could provide the predictability of product supply, consistency and volume that would be needed by potential K-12 buyers.

- Effective use of a mobile unit requires strong management skills and close coordination with participating farmers. These staffing needs can be significant and must be factored into cost analyses upfront.

- Scheduling the use of a mobile unit can be challenging, particularly given the volatility of harvest dates and the possibility that multiple farms within the relevant geographic region may be harvesting at more or less the same time. Clear protocols are needed for managing access to the unit.

- Maintaining safe food handling practices is essential for any food processing operation. This will require that the unit be used by individuals who have had the needed food safety training and that the unit is properly equipped for safe food handling.

- Mobile units should be designed to operate effectively with the infrastructure available at likely locations of use, such as electric power and water hook-up. Participating farms or food entrepreneurs will also need access to freezer space to store finished product and the means to transport it to buyers at temperatures that maintain the products' quality.

- Mobile units can provide a venue for value-added processing and the means to transport product off the farm (albeit in relatively small volumes). However, that mobility comes with a cost and significant logistical limitations. Those exploring mobile units should carefully assess whether processing capacity that is mobile, in itself, best suits the needs at hand, or if an approach that provides for aggregation and transportation of farm product to a central processing facility would be more effective.

F. MULTI-USE FACILITIES AND SMALL FREEZING VENTURES

In this section of the report, we explore a variety of multi-use kitchen facilities and small businesses that are focused on freezing locally and regionally grown produce. Several are selling to K-12 clients, while others are pursuing other institutional or retail markets. We also provide a sketch of the costs associated with equipping a modestly-sized freezing operation, and lessons learned that are emerging from some of the enterprises discussed here.

The nature of these ventures varies considerably. Among them are a commercial kitchen housed at a university, business incubators working to test new products, a nonprofit that provides meals for low-income residents and culinary training for hard-to-employ individuals, and a nascent for-profit company seeking to add value to locally grown, organic produce grown by freezing it and selling it to institutional accounts.

While each of these ventures engages in freezing activities, all are multi-functional in nature and their freezing activities complement a wider range of other food processing activities.

Salus Center at St. Louis University[33]

Farm to Family, a farmer cooperative that aggregates locally grown produce, has partnered with St. Louis University (SLU) to provide frozen, locally grown foods for area schools. The Salus Center is a commercial kitchen facility located at SLU. Farm to Family delivers its produce to the Salus Center and the Center processes and freezes it. The Salus Center then pays Farm to Family to deliver the finished product to schools. The Center freezes pizza sauce, spaghetti sauce, garlic mashed potatoes, applesauce, and a variety of vegetables and fruits.

Farm to Family typically pays its farmers $0.50 to $1.00 per pound for produce that will be frozen. The relationship with Salus provides participating farmers with a ready market for their "seconds" and the opportunity to sell relatively large volumes. The frozen product is also pre-sold at the beginning of the growing season, providing greater income security for participating farmers.

Marketing time for the farmers is extremely limited and the relationship with Salus enables them to generate income from a portion of their production that might otherwise go to waste. The use of seconds is also economical for the Salus Center.

The center reports that they can keep prices for their frozen, locally grown products competitive with products available to schools from USDA Foods' commodity program and that schools are willing to pay slightly more for locally grown, locally processed products. Participating schools indicate that the frozen local products are well-received by students.

DC Central Kitchen

The DC Central Kitchen in Washington, D.C.[34, 35] uses food as a tool to "strengthen bodies, empower minds, and build communities." The kitchen prepares about 5,000 meals daily using food recovered from restaurants, caterers, wholesalers, and farms. These meals are then distributed to over 100 social service agencies across the city. Additionally, they prepare around 4,600 scratch-cooked meals for nine D.C. Public schools and one private charter school.

Their school and production staff are drawn primarily from graduates of their 14-week Culinary Job Training program. The program provides job skills, life skills, and culinary skills to individuals who were previously incarcerated, struggling with addiction, homeless, unemployed or underemployed.

The kitchen incorporates produce and proteins purchased from local farmers into school meals whenever possible. In 2010 and 2011, the kitchen used a total of 348,300 pounds of local produce and proteins (with a purchase price of $209,000) in their meal programs. A significant portion of the product used for freezing is "seconds" that are wholesome and fit to eat but may be cosmetically flawed or under/over-sized.

Processing apples at the DC Central Kitchen

The photo above shows kitchen staff processing apples from a local orchard. Stephan Kendall, DC Central Kitchen's Procurement Manager, says, "The apples are from Kilmer's Orchard in West Virginia. Each bin weighs about 880 pounds. [Our workers] core and cut them, leaving them peeled, and then

cook them down in the large kettle in the background. Using an immersion blender, staff purees the product. The cook working the kettle is a graduate of our culinary job training program."

Kitchen staff and culinary students process and freeze a variety of local foods, including applesauce, collard greens, sweet potatoes and peaches. After the produce is broken down, it is either cooked in kettles or in a combination oven. It is then cooled to a safe temperature using a blast chiller. After it is cooled, it is vacuum sealed in bags, labeled, dated and inventoried.

The DC Central Kitchen has analyzed costs for various locally grown, frozen products and has found some items to be cost-effective and others cost-prohibitive. For example, the kitchen contracted with one school district to prepare 800 pounds of green beans for Farm to School Week. They found that the price received for the finished product was less than cost of production because:

- the product required a significant amount of staff hours to prepare and trim
- the green bean market was tight in that year, leading to higher-than-usual prices

In another example, the kitchen prepared and froze applesauce for their D.C. Public School meals. Here they found that costs were competitive but for the kitchen's commitment to providing fair wages and benefits.

The cost for a portion of non-local, canned applesauce available from a distributor was $0.18, while the all-in cost of the Kitchen's applesauce was $0.28 per portion.

"If we paid a minimum wage and did not offer benefits, the price would be closer to $0.17 per portion; however, we are committed to a triple bottom line and seek to provide good, competitive wages and full benefits. We believe that through continuing to innovate with regard to our processes we can maintain our mission and stay competitive," notes Stephan Kendall.

The DC Central Kitchen has been able to reduce some of their overall costs by reducing the amount of labor that goes into processing and increasing efficiencies. Additionally, while a product like their applesauce is slightly more expensive than an alternative (such as canned applesauce), the kitchen reports that their applesauce provides a more nutritious, less processed product that fits within the cost-per-serving they have allocated for fruit in their meal plans.

In 2012, the kitchen is continuing to purchase locally and improve their production techniques. Several equipment purchases will help their staff improve the speed and quantity of production while improving the quality of the product and the work environment.

They have also ventured into new types of produce. For instance, their fruit growers struggled with hail damage this year, cosmetically damaging much of their peach crop. The Kitchen purchased about 1,200 pounds of hail-damaged peaches which they processed, froze and are now using as dessert fillings and preserves.

Western Massachusetts Food Processing Center

The Franklin County Community Development Corporation opened the Western Massachusetts Food Processing Center (FPC) in 2001 to provide food businesses with commercial kitchen space.[36] From 2001 to 2010, over 200 businesses used their facilities. Kitchen equipment includes steam kettles, ovens, mixers, choppers and tilt skillets. The kitchen has 3,500 square feet of dry storage space, two walk-in coolers and two walk-in freezers.

FPC is now working with the University of Massachusetts Engineering Department to build a more efficient blancher and is exploring development of a "shocker" to rapidly drop a product's temperature after it has been blanched.

In addition to their production facility, the Food Processing Center offers consulting and business planning resources. They have been working closely with farmers, wholesalers, retailers and distributors to research and develop a regional value-chain for frozen and canned products designed to offer a fair price to farmers and a competitive price to purchasers.

In 2010, the FPC implemented a pilot project to source, freeze and package locally grown broccoli for sale to a local school district. They worked with one grower and an aggregator to source 3,000 pounds of broccoli for processing at the center. The school then picked up the finished product for storage in the school's freezers. The school served the broccoli over the winter months and received positive feedback from food service staff and students.

FPC paid the farmer $0.60 to $0.65 per pound and found it cost an additional $0.60 to $0.80 per pound to process and freeze the broccoli. For frozen unblanched products, such as zucchini and peppers, FPC's production costs tend to be a little less due to reduced labor requirements. (These figures reflect an hourly facility fee, which covers utilities and equipment

depreciation, labor, cost of the raw produce, and the price of vacuum-seal bags, but do not include costs associated with procuring, distributing and storing product.)

As part of their "Extended Season Farm to Institution Program," FPC had planned to freeze 100,000 pounds of regional produce for schools and hospitals during the 2011 growing season. Due to severe weather and flooding in the area they were not able to procure as much product as planned, but did process 60,000 pounds of local produce in the fall of 2011. Frozen storage space became a constraint and the reduced amount of produce proved to be sufficient. The frozen product was sold to K-12 schools and colleges.

By August 31, the center had processed over 50,000 pounds of local produce during 2012. Staff report that their operating efficiency has risen given their improved blanching process, doubling of their capacity to cool the blanched vegetables, and doubling of freezer space from the previous year. The center also added coined carrots and tomato sauce to its production.

Their goal for Fall 2012 is to freeze 200,000 pounds of locally grown produce. FPC is collaborating with additional farmers to obtain the product. The center indicates that freezer capacity remains a constraint given their expanded operations, so they will need their distributors to pick up frozen product periodically throughout the production season.

The FPC has secured a loan to install a 1,000-square-foot freezer to address their frozen storage needs in 2013. FPC expects that increased volumes will make their operation increasingly efficient and cost competitive over time.

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Mission Mountain Food Enterprise Center

The Mission Mountain Food Enterprise Center (MMFEC),[37] a division of Lake County Community Development Corporation in Ronan, Mont., has operated a food business incubator since the year 2000. MMFEC offers processing facilities, marketing support, cooperative development assistance and other business development services. It houses a commercial processing footprint, a USDA-approved meat room, a production room, a packaging room, and a grain milling room and warehouse.

In 2009, MMFEC initiated a Farm to Institution project, raising public and private funds to purchase vegetable processing equipment and to conduct an evaluation of the Center's operations. In 2011 MMFEC launched its Farm to Institution program through the support of a Montana Rural Food Corps service member.

MMFEC has worked closely with Western Montana Growers Cooperative, a producer-owned marketing and distribution cooperative, to evaluate the feasibility and processing costs for freezing locally grown products including apple wedges, cubed winter squash, shredded zucchini, and pitted cherries, and various fresh items for area schools that participate in the federal Fresh Fruit and Vegetable Snack Program.

MMFEC tracks their raw product costs, labor, equipment and distribution costs and compares them with school price points to assess the economic viability of potential products.

They have found that:

- Developing workers' processing skills and identifying efficient production flows can help make small processors more competitive. In 2010, MMFEC researched school purchases and found that nearby schools can purchase cut, delivered carrots for $1.30 per pound. MMFEC could procure carrots locally for $0.40 to $0.50 per pound. Initially, MMFEC's processing costs fluctuated between $1.00 and $1.20 per pound. The high costs of processing and the inconsistent and wide range of production costs made the product unfavorable to all but the most committed food service directors.

- In 2011, MMFEC focused on addressing these costing barriers through processing staff training. Since implementing the training program, MMFEC's processing costs for carrot coins dropped approximately $0.40 per pound.

- Frozen Flathead Sweet Cherries have become a signature product. MMFEC purchases locally grown, de-stemmed cherries at $0.75 per pound. The kitchen processes and packages the cherries in five-pound units,

which sell for $2.13 per pound. As a distinctive specialty product, the frozen cherries have proven highly successful with university dining clients.

Northern Girl

Northern Girl[38] is a for-profit fresh and frozen cut vegetable processing company focused on locally grown produce from northern Maine. It is the newest project of a family that has been involved in growing and distributing local, organic food in Maine since the 1990s. The family's distribution and marketing cooperative sells high-quality organic produce throughout Maine and neighboring states. The Northern Girl company was created in part to develop a market for produce that is not of high enough quality to sell in the retail market.

Northern Girl diced roasting medley

Having started in a temporary test kitchen, the company is building a larger, permanent facility in a former Air Force base that has an existing commercial kitchen. They received $300,000 from the State of Maine for equipment and have five investors that have helped finance the company. Their signature products are processed and packaged root crops. The company aggregates potatoes, carrots, rutabagas, beets and other root crops from several nearby farmers. In the spring and early summer, they process specialty items such as fiddleheads, strawberries and broccoli.

To process a typical 1,000-pound batch of rutabagas, for instance, the staff puts the produce through an industrial peeler and dicer, and a shaker to separate slivers and bad cuts. Kitchen staff load the prepared rutabagas into racks (15 pounds per rack, with 20 racks total) and roll it into a "combi-oven." The product is steamed for ten minutes and is then cooled and dried. From there, the racks are rolled into a blast chiller, which takes the prepared rutabagas down to zero degrees Fahrenheit in 2.5 hours.

Northern Girl has experimented with a variety of product types ranging from bulk-size packages for food service buyers to single-serving pack sizes for sale to schools. They have also processed small batches of a wide variety of produce items brought in by local CSA farmers when the farmers have excess product on hand. This range of experience has given Northern Girl considerable insight into the types of customers, products, pack sizes, product volumes and price points that are needed for them to craft a financially sustainable business model. The company employs four full time staff.

Northern Girl reports that the quality of their frozen vegetables is excellent and resembles a true IQF (Individual Quick Frozen) product. They are finding that the relatively modest investment in the combination oven and blast chiller makes this an attractive approach for small scale processing operations.

However, they also report that their costs are too high to gain mainstream market acceptance in their target markets. When they move to their new permanent facility in 2013, Northern Girl plans to invest in a tunnel freezer with true IQF capability and the capacity to process 10,000 pounds per day. In 2013 they also plan to operate the freezer for 100 days of the year, producing 1 million pounds of frozen vegetables.

Colorado State University Feasibility Study

Cooperative Extension at Colorado State University conducted a study[39] to determine the feasibility of building a processing plant to freeze Colorado-grown vegetables in 2002.

The study included an analysis for processing Colorado-grown spinach, summer squash and winter squash. The study assessed the potential financial performance of a proposed facility with the capacity to process 5,000 pounds of spinach or 2,000 pounds of squash per hour.

The study looked at three detailed scenarios, with one freezing tunnel, two freezing tunnels and an "expanded facility." All three scenarios were based on purchasing land and building a new facility from the ground up. The university concluded that such a plant would not be able to generate positive cash

flow under the scenarios explored. The study's authors attributed this primarily to the high cost of labor and land relative to the anticipated product turnover. Interested readers are encouraged to review the full report for additional detail on the scenarios tested in this study.

Equipment

The choice of equipment is crucial to a facility's functionality and cost structure. Below we highlight a range of different equipment types, potential costs, and performance qualities. The prices listed below are primarily for equipment purchased new and are based on price data primarily obtained from equipment suppliers. Many of these items can also be found used on auction sites and through other channels, significantly reducing the cost.

Processing equipment

Preparation tables, blanching, cooling and water extracting systems, general cutting machines, corers, and specialty product preparation equipment (e.g., squash peelers, corn huskers, green bean snippers, corn cutters) make preparing food for freezing much less labor intensive, but can involve significant capital investments. Each piece varies in cost, size, and flexibility of use.

Examples for equipment purchased new:

- Hard squash peeler, capable of peeling (300 pounds per hour): $13,500[40]
- Vegetable dicer: $53,000[41]
- Steam blancher (3-minute blanch system, 16,000 pounds per hour): $150,000[42]
- Coring machine: $550[43]
- Broccoli floreting machine: $21,000[44]
- Green bean snipper:[45]
  - 400 to 500 pounds per hour: $20,000
  - 3,000 to 4,000 pounds per hour: $30,000
- Root crop scrubber, peeler, washer (500 to 20,000 pounds per hour): $70,000[46]

Freezers

As highlighted above, many of the ventures that are freezing local produce on a small scale use relatively low-tech methods by freezing produce on trays, for instance, in walk-in "holding" freezers. More robust freezers designed to drop product temperatures very rapidly can sharply reducing freezing time and improve the quality of the finished product.

Commercial-quality freezers come in many sizes (from small mobile units to very large stationary units) and can combine different freezing methods (e.g., forced air, cryogenic) with different methods for moving product through the freezing chamber. While not comprehensive, below is a general description of some of the freezing options available. It is important to assess various options based on the variety of needs for a particular processing operation, including space availability, expected product flows and budget.

A cryogenic freezer uses nitrogen or carbon dioxide (in liquid or vapor form) to freeze products. Cryogenic freezers are more flexible in size and mobility and freeze products very quickly, but have higher operating costs due to the cost of CO_2 or nitrogen tanks. A blast freezer uses forced air to freeze products. This tends to be a cheaper, yet slower method of freezing than cryogenics.

From left to right, a root crop scrubber, squash peeler and a blancher

Freezing can be done in batches or by a continuous freezing method. With a continuous freezing approach, unfrozen product is introduced on one end of the system as finished product emerges on the other end. This can be done on a conveyor belt or on trolleys with trays. A tunnel (horizontal) or spiral (vertical) freezer is a type of continuous freezing system and can use forced air, CO2 or nitrogen.

An Individual Quick Freeze (IQF) system is designed to freeze small pieces of product as distinct, individual pieces (rather than in large blocks). IQF product can be batch processed, but continuous freezing is more common.[47] IQF product is considered to be the industry standard.

The cost of freezing units depends on the technology used to freeze, the size and the degree to which the process is automated, among other factors. It is also important to consider that the additional costs of compressor rooms or external refrigeration equipment that are typically required by larger freezing equipment.

Most commercial kitchens require freezers that can be integrated into their production line and can accommodate a variety of food types. Several of our interviewees conveyed the perception that available commercial freezers are often too small or too large to fit the needs of their mid-sized freezing businesses.

One equipment company echoed this sentiment, stating that they have been hearing demand for a medium capacity freezer (e.g., with processing capacity up to 15,000 pounds per day), and are currently developing that technology. Pricing for a unit this size could potentially be in the neighborhood of $150,000 including the refrigeration system needed to support it.[48] As with any piece of equipment, users need to balance speed and sophistication with the potential for cost recovery given the volumes to be processed.

Examples:

- IQF tunnel freezer (1,100 to 17,630 pounds per hour), new: $240,000 to $340,000[49]
- Band belt tunnel freezer (330 to 2,200 pounds per hour), new: $240,000 to $340,000[50]
- Liquid nitrogen tunnel freezer (4,000 pounds per hour), used: $45,000 to $67,000[51, 52]
- CO2 IQF tunnel freezer (3,500 pounds per hour), used: $33,000[53]
- IQF Spiral (1,000 to 13,000 pounds per hour), new: $350,000 and up[54]
- Spiral freezer (2,600 pounds per hour), used: $90,000 (originally $900,000)[55]

Tunnel freezer

Packing equipment

Scales, vacuum packers and bagging machines can make the final stages of the freezing process less labor intensive and give the finished product a professional look consistent with industry standards.

Examples:

- Bag conveyor, new: $11,000[56]
- Bagging machine, new: $37,500[57]
- Automatic wrapper machine (packages up to 120 items per minute), used: $5,000[58]
- Vacuum packer (10 to 18 bags per minute,) new: $12,000 to $18,000[59]
- Double chamber vacuum packer, new: $4,000[60]

Top to bottom: Automatic wrapper machine; Double chamber vacuum

Lessons learned

- The experiences of the freezing ventures highlight above illustrate the importance of focusing very strategically on suitable crops, finished products that are tailored effectively to the marketplace, and efficient processing methods. Several of these ventures are demonstrating that local produce can be frozen on a cost-competitive basis on a smaller scale, typically following considerable experimentation and honing of their strategy toward those products that can be processed most efficiently.

- Most interviewees noted that their cost structure improved significantly over time as they honed their processing methods, addressed bottlenecks in the flow of product through their facility, identified appropriate pack sizes, trained staff more fully, and managed staff resources with greater efficiency.

- As with many businesses, increased volumes often lead to lower cost-per unit. Focusing freezing operations on organic product, high-value specialty crops or other highly differentiated products can help generate the pricing needed to operate commercially on a smaller scale and avoid direct competition with larger players offering more conventional commodity products.

- Enterprises that invest heavily in facilities and equipment and focus exclusively on freezing foods that are highly seasonal may be challenged to cash flow their operation. Strategies that maximize utilization of property, plant and equipment for a larger portion of the year will be more likely to recover fixed costs within a workable time frame. Helpful strategies include:

    - processing product early and late in the growing season (or year-round if possible)

    - leasing or sharing space and equipment rather than owning it, and

    - complementing freezing activity with other types of processing that are less reliant on raw product that has limited availability.

- Thorough market research is critical for gauging the feasibility of a freezing venture and identifying appropriate products and markets. Among other issues, this includes potential clients' expectations for quantity, quality, scheduling and product specifications as well as the pricing, quality and packaging of competitors' products.

- Ventures should carefully weigh the pros and cons of investments in equipment of different types, levels of sophistication and processing capacity. If reliable used equipment can be found, used equipment can be a helpful way to keep capital investments down.

- Crop-specific equipment (such as squash peelers or green bean trimmers) can greatly improve efficiency but offer limited flexibility and can involve significant capital outlays. More sophisticated equipment can also require more sophisticated maintenance support.

- Special care should be taken in designing freezing facilities to minimize bottlenecks in the processing operation. This requires that the processing capacity of different pieces of equipment and of staff be synchronized so that product can flow through the facility efficiently and without costly delays.

- Several interviewees noted their difficulty in finding freezing equipment that was properly scaled to the rest of their operation, observing that they could typically run the rest of their operation faster than their freezer could freeze the product.

- Processing ventures should also ensure that they have the infrastructure in place to properly hold fresh produce before processing, and to store and deliver finished product. Partnerships with entities that already have this infrastructure in place can help keep capital outlays in check.

- For farmers, freezing partners can be an attractive market for "seconds" and a stable source of demand. For freezing ventures, using seconds can be a very effective way of purchasing raw product economically.

G. CO-PACK RELATIONSHIPS

In this final section of the report, we explore strategies that rely on existing processors to freeze product on behalf of an interested buyer or producer group. Often called "co-pack" approaches, such relationships enable an interested party to pay a processing partner to freeze produce for them, often under a fee-for-service payment structure.

In one example below, the co-pack relationship was initiated by a cooperative of grocery retailers seeking frozen produce grown on farms in the Northeast. In another, a large Midwestern school district and its food service management company sought out a co-packer to process regionally grown produce for their school meal program. Co-pack relationships can also be initiated by a group of farmers interested in reaching the frozen market.

We also draw insights from the experience of Sno Pac Foods, a regional freezing company based in Minnesota.

Neighboring Food Co-op Association

The Neighboring Food Co-op Association (NFCA)[61] is a cooperative of 30 grocery co-ops and start-up initiatives in Vermont, New Hampshire, Massachusetts, Connecticut and Rhode Island. A central goal of NFCA is to facilitate the sourcing of local and regional products for their member co-ops. In 2011, the NFCA focused their efforts on identifying produce that could be sourced locally and sold at food co-ops in the region. A priority product was frozen fruits and vegetables, which at that time, had no regional sources at the needed scale.

Neighboring Food Cooperative Association products

During their initial pilot phase, the NFCA developed a small line of frozen products including blueberries, broccoli, green beans, and sweet corn, and worked with its members to determine anticipated product volumes. The association then worked with local producer cooperatives to source these products. They also recruited an apple orchard with a large storage facility to aggregate the product, move it to the co-packer and deliver it to the end-customer. NFCA used an experienced co-packer in New York to process and freeze the raw product.

NFCA began their pilot in mid-summer 2011 and found the first season to be highly successful, despite the fact that Hurricane Irene took a serious toll on local agricultural production. They processed and sold 12,000 pounds of produce, selling primarily to retail locations in ten ounce packages.

NFCA reports that the product was well-received by consumers and was competitive with existing product. Despite the fact that a national organic brand put their frozen produce on deep discount at the same time that NFCA introduced their product at the co-ops, the NFCA produce was still in high demand.

In 2012, NFCA is expanding their product line and the period of availability, and transitioning most of the line to organic product sourced in collaboration with a local farmer co-op. (For more information, see www.nfca.coop/farmtofreezer.)

Chicago Public Schools and Harvest Food Group

With approximately 400,000 students, the Chicago Public Schools[62] are the third largest school district in the United States. In order to improve the quality of fruits and vegetables served to their students and expand procurement from farms in the region, the district and its food service management company, Chartwells-Thompson Hospitality, have launched an innovative co-pack relationship for frozen, regionally-grown fruits and vegetables.

Their co-pack partner, Harvest Food Group,[63] is headquartered near Chicago and is a leading, national processor for many well-known brands of frozen food. Under their co-pack arrangement, Harvest Food Group purchases fresh produce from family farms within 250 miles of Chicago (in Michigan, Wisconsin and Illinois) and flash freezes the produce within 48 hours of harvest.

During the 2011-2012 school year, the district's frozen local offerings included approximately 350,000 pounds of these products including a cranberry/apple blend served at breakfast, corn, zucchini, squash, garden blend, mixed vegetable blend, and peas-and-matchstick carrots, along with several other products. Frozen local vegetables represented approximately 25 percent of the produce they served throughout the school year.

Recent changes to the federal school meal program have resulted in adjustments to CPS' frozen local program for the 2012-2013 school year. CPS will purchase fewer varieties of frozen local vegetables and instead focus on those that students regularly select. As a result of this change in strategy, CPS anticipates an eight percent increase in student vegetable consumption.

Sno Pac Foods[64]

Located in the bluff country of Southeast Minnesota, Sno Pac Foods is a fourth-generation family-owned processor of frozen fruits and vegetables. Sno Pac's products include organic green peas, beans, sweet corn, strawberries, cranberries, potatoes and edamame, among others. Sno Pac's products are primarily sold in the retail marketplace, but are also available in bulk sizes appropriate to food service contexts.

In many cases, the cost of Sno Pac's organic products are competitive with the frozen (non-organic) vegetables that some Minnesota districts are currently procuring. Depending on districts' volume needs and location, Sno Pac product may offer an attractive alternative for districts looking to expand their use of locally grown products beyond the local harvest season.

Sno Pac Organic Green Peas

Their fruits and vegetables are sourced from approximately 50 farmers who grow for Sno Pac under contract and from the family that owns Sno Pac's processing operation. The company processes product that is grown on roughly 4,000 acres of land, much of which is located within 75 miles of the freezing plant. Sno Pac sources from more distant locations for crops like potatoes, broccoli and carrots that they are not able to obtain locally at the volumes needed.

Typically, nearby farmers will prepare their fields in the spring and then Sno Pac will plant the crop and harvest it, often bringing in specialized equipment that would be costly for individual farmers to own. Planting schedules are carefully designed to ensure a smooth flow of product through the processing plant at the time of harvest. The plant typically operates at full capacity from mid-June through November, with other processing activities occurring before and after that peak season.

At the peak of the harvest season, Sno Pac processes 100,000 to 150,000 pounds per day, or roughly 8,000 pounds per hour. Crops are typically delivered to the plant by the 40,000-pound semi-truck load. As one of very few moderately sized processors still operating in the region, Sno Pac has been approached many times by farmers who were interested in having their crop frozen through a co-pack relationship. However, for a wide variety of logistical reasons highlighted below, this has not proven feasible.

Lessons learned

Benefits and caveats with co-pack relationships

- In the cases identified where co-pack relationships are in operation, it seems to work very well for the parties that initiated them. Benefits include flexibility in the crops to be processed and the form/pack sizes in which they will be cut and packaged, high quality products, workable pricing, and minimal capital investment.

- The timing and specs for co-packed product can be established well in advance, enabling K-12 schools to weave frozen locally grown foods into their menus many months before the food is actually served.

- In situations where the co-packer is responsible for establishing purchasing relationships with growers, it is essential to set clear expectations about the size, location, growing practices and labor practices of participating farms and how farmers will be compensated (for instance, so the buyer can determine if sourcing practices for their Farm to School freezing program meet their definition of "local" and if the farmers are being compensated fairly).

- Particularly if the co-packer is sourcing from their own pre-existing network of farmers, they may consider their payment practices and even the identity of the growers to be confidential. This lack of transparency can make it difficult for buyers to know what farms their food is coming from, to educate K-12 students about the farms involved, and to ensure that the co-pack relationship is meeting objectives like positively affecting the local economy and farm community.

- Those initiating co-pack relationships should also ensure that they have the infrastructure and partnerships in place to store, transport and market that product after it has been frozen.

- Strong communications and planning that involves all members of the supply chain are key to success.

Image courtesy of Erin McKee VanSlooten

Finding an appropriate co-pack partner

- The availability of potential co-pack partners varies greatly across the country. For instance, in the Upper Midwest, intense consolidation in the produce freezing industry in recent decades has sharply reduced the number of independent, mid-size processing companies in operation. While the authors' search was not exhaustive, we found that the number of potential co-pack partners freezing on a larger-than-commercial-kitchen scale in Minnesota was very limited.

- Produce distributors with the capacity to cut and freeze produce may be an option if sourcing protocols and volumes can be synced effectively with suppliers.

- Prospects for finding viable co-pack partners may be stronger in regions such as the Northeast and Southeast U.S. where there the produce processing industry has a long history and some small and mid-size processing capacity is still in place.

- Plant operators have a strong incentive to keep their plant operating as close to capacity as possible, for as many months of the year as possible. They will typically strive to contract with growers so that produce is delivered in volumes and on a schedule that maximizes utilization of their plant. This can make it challenging to find a processor that has excess capacity available and is interested in handling additional product on a co-pack basis, particularly at the peak of the harvest season. Plants operating at (or beyond) capacity may have little incentive to engage in co-pack activities, particularly if they involve small quantities.

- Processors may have more latitude to co-pack early- or late-season crops that are harvested when the main freezing crops are not in season, or crops that can be held and processed at less busy times.

Rae Rusnak, L & R Poultry and Produce

Linking farm supply with processing partners

While requirements will vary, farmers and farm collaboratives interested in having their product frozen by a co-pack partner should keep the following parameters in mind:

- The choice of seed varieties can have a significant impact on the quality of the final product. Varieties that make good choices for the fresh market may not be the best choice for a commercial line of frozen products.

- Consistency in production methods, harvesting techniques and post-harvest handling among participating farms is also key to producing a consistent frozen product.

- Significant quantities may be required, depending on the co-pack partner. For instance, a processor like Sno Pac, which is considered relatively small by industry standards, requires a minimum drop of 40,000 pounds.

- The co-packer may require that the grower/aggregator has the trace-ability systems in place to allow the product to be traced back to the farm or farm field of origin. They may also require that farms have third-party certification for their on-farm food safety and food handling practices, documentation of when the product was harvested by whom, and the like.

- A co-pack partner may also require that agreed quantities of product be delivered within very specific windows of time so that it is synchronized with other product flows through their facility. This, in turn, will require growers/aggregators to carefully coordinate planting, harvesting and delivery schedules with their co-pack partner and participating growers.

Winona, Minn. Area Public Schools food service staff celebrating Farm to School Month

APPENDIX A: LIST OF INTERVIEWEES

Name	Title	Organization	Location
Philip Ackerman-Leist	Associate Professor of Environmental Studies; Director of the Farm and Food Project	Green Mountain College	Poultney, Vt.
Brenda Anderson	Foodservice Director	Pine River-Backus School District #25	Pine River, Minn.
Mary Anderson	Culinary Express Supervisor	Wayzata Public Schools	Wayzata, Minn.
Melissa Anderson	Foodservice Director	Ricori-Holdingford School District #848	Holdingford, Minn.
Lindy Bannister	Former General Manager	Wedge Cooperative / Coop Partners Warehouse	Minneapolis, Minn.
Bob Bloomer	Former Regional Vice President	Chartwells Thompson Hospitality for Chicago Public Schools	Chicago, Ill.
Jeanine Bowman	Foodservice Director	Benson School District #511 and Morris School District #738	Benson and Morris, Minn.
Dr. A. J. Bussan	Professor	University of Wisconsin-Madison, Dept of Horticulture	Madison, Wis.
Carol Coren	Principal	Cornerstone Ventures	Southampton, Pa.
Margaret Christie	Special Projects Director	Community Involved in Sustaining Agriculture (CISA)	Amherst, Mass.
Erbin Crowell	Executive Director	Neighboring Food Co-op Association	Shelburne Falls, Mass.
Atina Diffley	Consultant and organic farming advocate	Organic FarmingWorks	Farmington, Minn.
Vince Ferraro	Project Manager	Advanced Food Equipment, LLC	Ridgeway, Pa.
Chuck Fleming	Retired	North Dakota Department of Agriculture	Bismarck, N.D.
Jill Fitzsimmons	Former Extended Season Farm to Institution Project Manager	Franklin County Community Development Corporation	Greenfield, Mass.
Pete Gengler	CEO	Sno Pac Foods	Caledonia, Minn.
Nick George	President	Midwest Food Processors Association	Madison, Wis.
Julia Govis	Illinois State Lead, National Farm to School Network	Urban and Small-scale Organic Agriculture Research Institute (University of Chicago)	Chicago, Ill.
Jim Groskopf	Purchasing Analyst	St. Paul Public Schools	St. Paul, Minn.
Linda Grover	Former Director	Winona County Economic Development Agency	Winona, Minn.
Chris Hallweaver	General Manager	Northern Girl	Caribou, Maine
Lyn Halvorson	School Nutrition Director	Winona Area Public Schools	Winona, Minn.
Rufus Haucke	Founder, CEO	Just Local Foods	Viroqua, Wis.
Andrew Hayner	Farm Manager	White Earth Land Recovery Project	White Earth, Minn.
Sarah Heusner	Farm 2 School Coordinator	Burlington School District	Burlington, Vt.
Peggy Hill	Foodservice Manager	Dawson-Boyd School District #777	Dawson, Minn.
Monique Hooker	Chef	Collaborator with the Viroqua Area School District	Viroqua, Wis.
Steve Jenkins	Director of the Food Innovation and Entrepreneurship Program	Salus Center, St. Louis University	St. Louis, Mo.
Joelle Johnson	Former Local Initiatives and Procurement Coordinator	D.C. Central Kitchen	Washington, DC
Haile Johnston	Co-founder and Director	Common Market Philadelphia	Philadelphia, Pa.
Stephan Kendall	Procurement Manager	D.C. Central Kitchen	Washington, DC
Garland Mason	VISTA Local-Link Coordinator	Green Mountain College	Poultney, Vt.
Mildred Mattfeldt-Beman	Chair, Department of Nutrition and Dietetics	Salus Center, St. Louis University	St. Louis, Mo.
Laurie Millbrandt	Foodservice Director, Taher Foods	Redwood School District #2897	Redwood, Minn.

Name	Title	Organization	Location
Terry Nennich	Extension Professor	University of MN, Extension Services Tech Unit Northwest	Bagley, Minn.
Sue Noble	Executive Director	Vernon Economic Development Association	Westby, Wis.
Duane Pfleiger	Vice President	Bix Produce	St. Paul, Minn.
Greg Reynolds	Organic famer	Riverbend Farm	Delano, Minn.
Jim Riddle	Organic Outreach Coordinator	University of MN	Winona, Minn.
Rae Rusnak	Farmer	L & R Poultry and Produce	Kenyon, Minn.
Paul Sand	Former Global Food Manager	Minnesota Dept of Agriculture, Ag Marketing Services Division	St. Paul, Minn.
Jean Saunders	Director of Marketing	Chartwells Thompson Hospitality for Chicago Public Schools	Chicago, Ill.
Greta Sikorski	Bookkeeper	Featherstone Farms	Rushford, Minn.
Nancy Smith	Part-owner and Marketing Director/ Rural Development Specialist	Farm to Family Naturally	St. Louis, Mo.
Steven Spencer	Proprietor	LocalFolks Foods	Indianapolis, IN
Sara Tedeschi	Wisconsin Farm to School Program Outreach Specialist	University of Wisconsin, Center for Integrated Agricultural Systems	Madison, Wis.
Rick Terrien	Executive Director	Iowa County Area Economic Develop-ment Corp	Dodgeville, Wis.
Mark and Laurie Timm	Producer	Fairview Farm	Altura, Minn.
Jan Tusick	Program Manager	Mission Mountain Market	Ronan, Mont.
John Vanek	COO	Harvest Food Group	Chicago, Ill.
Heather Wahl	Area Manager, Lunch Time Solutions	Adrian School District #2396	Adrian, Minn.
John Waite	Executive Director	Franklin County Community Develop-ment Corporation	Greenfield, Mass.
Janelle Weaver	Head Cook	Pine Point School District #769	Ponsford, Minn.
Jessica Weber	Foodservice Director	Independence (Iowa) Schools	Independence, IA
Annake Witkop	Produce Program Manager	CROPP Cooperative / Organic Valley	La Farge, Wis.
Marilyn Volden	Foodservice Director	Viroqua Area School District	Viroqua, Wis.
Bobby Young	Former Farm to School Coordinator	Burlington School District	Burlington, Vt.
Marc Zammit	Vice President, Sustainability & Culinary Initiatives	Compass Group USA	Palo Alto, Calif.

APPENDIX B: FARM TO SCHOOL FOODS USED BY MINNESOTA SCHOOL DISTRICTS

In calendar year 2011, the following Farm to School (F2S) foods were used by 10 or more school districts in Minnesota. As shown below, the vast majority of these F2S foods were characterized by participating school food service directors as either "very" or "somewhat" successful.

Food Item	Number of districts using item in 2011	Number of districts using item in 2009	Very successful	Somewhat successful	Not successful
Apples	117	67	81%	17%	0%
Cucumbers	81		78%	12%	0%
Tomatoes	77	17	77%	17%	0%
Watermelon	70	15	74%	23%	1%
Potatoes	64	25	72%	17%	2%
Squash, Winter	60	17	55%	30%	8%
Peppers	57	22	74%	14%	2%
Carrots	57	15	74%	11%	5%
Cantaloupe	55	14	76%	18%	4%
Sweet Corn	51	17	79%	10%	4%
Onions	48	12	79%	15%	0%
Cabbage	47	11	62%	34%	5%
Wild Rice	36		75%	22%	0%
Green Beans	31		61%	32%	3%
Zucchini	30		60%	27%	3%
Radishes	29		55%	41%	0%
Salad Greens	29		79%	7%	7%
Broccoli	26		62%	35%	4%
Beets	23		17%	65%	13%
Pumpkins	22		59%	23%	5%
Spinach	20		75%	15%	0%
Honey	20		85%	15%	0%
Herbs	14		86%	7%	0%
Turnips, Parsnips and/ or Rutabagas	14		43%	43%	14%
Bison	13		77%	23%	0%
Cauliflower	12		75%	33%	0%
Grains	12		75%	25%	0%

Note: Percentages for individual foods will not sum to 100 percent where respondents indicated that they used a given item but did not rate the success level.

Source: Farm to School in Minnesota: Fourth Annual Survey of School Food Service Leaders," Institute for Agriculture and Trade Policy (March 2012): 5.

APPENDIX C: FREEZING FARM TO SCHOOL PRODUCE: INITIAL LESSONS FROM MINNESOTA SCHOOL DISTRICTS

Overview

As Farm to School (F2S) gains momentum across the state, schools are looking for ways to "extend the Farm to School season" and make maximum use of food provided by nearby farmers.

In March 2011, IATP used our annual Farm to School survey process to identify K-12 food service directors who had frozen Farm to School foods for use in school meals. While there had not been a deliberate effort to encourage schools to explore freezing up to that point, we found that seven Minnesota school districts had engaged in freezing fruits or vegetables in their own kitchens. One district, Pine Point in Northern Minnesota, purchased product that was grown locally and frozen by a nearby commercial kitchen.

IATP interviewed each of the participating food service leaders to learn about their motivation for freezing local produce, the foods and methods used, the outcomes of their effort and their advice for other school food service staff.

The districts Adrian (#511), Benson (#777), Dawson-Boyd (#848), Holdingford (#738), Morris (#769), Pine Point (#25), Pine River-Backus (#2174) and Redwood (#2897) are all located in rural areas, do some scratch cooking and have a student enrollment under 1,200. Below are some of the lessons that emerged from their experience.

Motivation

None of the districts that froze local produce on-site bought the produce with the intention of freezing it. Rather, most schools happened to find themselves with an unexpectedly large supply of perishable produce on hand. In some cases, farmers who were selling to the schools delivered greater quantities than anticipated—for instance, when large cabbage heads yielded more product than expected. In other cases, school gardens had produce ready to harvest or vegetables were donated in advance of a hard freeze in the Fall. Food service leaders stressed their desire to make maximum use of locally grown produce and to avoid wasting high quality produce.

In the case of the Pine Point schools, they were able to purchase locally grown, frozen produce that was prepared by Native Harvest, a commercial kitchen operation that is part of the White Earth Land Recovery Project. The district receives a weekly order sheet of the frozen products that Pine Point has available and plans their menus around those items. In 2010, Pine Point used corn on the cob, blueberries, strawberries, snow peas, cauliflower, rhubarb, beets, and carrots that were grown locally near the White Earth Reservation and frozen by Native Harvest.

Foods and processing methods

All the schools that froze produce did so in their school kitchens. Twelve different kinds of produce were frozen. The most common were winter squash (used by five districts) and zucchini (used by four of the eight districts). The Farm to School foods used and related prep methods are sketched out below:

- Beans (yellow and green): cleaned, snapped, blanched, frozen
- Broccoli: soaked in saltwater, trimmed, blanched, coldwater bath, drained, frozen flat on sheet pans and used in stir fry and as a side dish
- Cabbage: shredded and made into freezer slaw. Also shredded, cooked and frozen for a hot dish recipe.
- Celery: chopped, blanched, cold water bath, drained, bagged and frozen
- Eggplant: sliced and roasted, drained, frozen on flat pan and added to spaghetti sauce
- Green Peppers: chopped and frozen used in sloppy joes or chili. Also sliced thin and frozen for fajitas
- Onions: chopped and frozen, used in sloppy joes or chili
- Pumpkin: cooked and frozen, used in baking and in a pumpkin dip
- Tomatoes: chopped or blended and frozen for soups, sloppy joes and chili
- Winter Squash: cooked, mashed and frozen. Also sliced into rings, baked and frozen
- Zucchini: chunked and frozen for soup. Also grated and frozen for baking. And sliced, roasted, drained and frozen on flat pans and used in spaghetti sauce.

In nearly all cases, individual foods were frozen, rather than combined into multi-ingredient items and then frozen. Most commonly, schools froze the produce either in small plastic

bags or in rigid plastic container ranging in size from 5 pound containers to 4-gallon bins. These pack sizes seemed to correspond well with the quantities that were needed later to menu these items. The product was then held in school freezers at 0 to -10 degrees. Schools found many uses for their frozen items and generally used up their supply of frozen locally grown produce within a few months. A few schools were able to freeze enough cabbage, squash, onions or green peppers to menu throughout the school year. For each product above, the weight frozen varied from a few dozen pounds to several hundred.

LABOR: Schools that extended the season by freezing local product had staff or a food service manager who already felt familiar with "putting up" vegetables and they found their staff was generally enthusiastic.

The food service director was generally very involved in organizing the freezing effort and, in at least two cases, it was the food service director who actually did the prep and freezing.

Most froze product in August before the school year started, bringing in extra staff or using summer school staff. In other cases, prep and freezing occurred during the fall on days when the activity could be slotted into the normal work day.

FOOD COST: All of the districts felt that the cost of the product was within their budgets. Many also noted the benefit of supporting local farmers, collaborating with their school gardens and preserving high quality fresh foods for later use.

NEEDS IDENTIFIED: Participants indicate they would appreciate having:

- more recipes for multi-ingredient frozen foods
- learning opportunities about methods to more efficiently organize processing activities and storage

LOOKING AHEAD: All of the eight interviewees said that their freezing effort went well. And while freezing activity in 2010 largely occurred without prior planning, all of these districts planned to continue it the following year. Three of the districts intend to expand their freezing efforts, while five plan to do about the same as in 2010. In the future, some schools hope to try additional types of fall vegetables while others will add spring products like rhubarb. Several schools plan to work more closely with their school gardens by planning menuing and freezing activities around what is planted.

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