

**Feasibility study for an elderberry processing hub in the Upper Midwestern US:
Results of a USDA Value-Added Producer Planning Grant**

Midwest Elderberry Cooperative (MEC)
UMN Forever Green Commercialization Team
February 27, 2022



Introduction

Christopher Patton, MEC President

Midwest Elderberry Cooperative (MEC) was established in 2012 and has 30 members in the USA. Over the last ten years our members have proven the viability of small scale elderberry production for direct sale to consumers, chefs, craft food and beverage makers from jams and syrups to wines and brews. Many growers make their own value added products, too.

MEC survived these past ten years mostly due to brokering the sales of bulk elderberries, dried elderberries, freeze dried elderberries, IQF blue elderberries from WA, dried elderflowers, and bulk elderberry juice to buyers for members and other elderberry farmer partners. MEC's online presence has been critical to this success.

Over the years by direct contact or through regional and national trade shows, larger food and beverage companies have expressed strong interest in obtaining US grown native elderberry ingredients; however, they require larger quantities and dependable supply guarantees beyond MEC's current capacity to offer in good faith. Our primary challenges are to increase the volume of elderberries that can be harvested and reduce the costs of growing and processing them into desired ingredient formats that work for food and beverage manufacturers so as to provide volumes desired at competitive prices and that deliver acceptable revenues to grower members.

Our immediate goal is to scale up our existing ingredients, as well as add other desired ingredient formats for fruits like puree, to fairly large commercial scale in MN around regional, rural hubs. Bulk frozen elderberry is the basis for all of our ingredients. Our answer to Q1 describes our ingredients and their status of production and sale.

Farmers will not scale up production, and MEC cannot fund infrastructure development without being able to enter into large volume advance contracts for harvest from buyers. To satisfy buyers' requirements and to compete against European imports at \$3.30-3.60/lb. for certified organic elderberries, MEC needs to provide quality control and independent measures of nutrient values in order to deliver what buyers want with confidence. MEC does not have the expertise or labs to do this.

Picking, destemming and processing cymes of small elderberries is currently a very labor intensive process. We need to reduce the labor inputs significantly in order to lower ingredient prices to be competitive with imports, despite the superior taste and other qualities exhibited by our native elderberries. MEC requires help in process development and equipment utilization to midrange scale of operations, suitable for elderberry and other small fruits, well above a typical commercial kitchen but below the massive fruit processing facilities typical of more common fruits like apples, raspberries or grapes. We need experienced, skilled assistance to make this goal reality.

Meeting the competition of imported elder ingredients

Although facilitating the sales of elder flower and berry ingredients for its members and other farmers at their desired prices, MEC as a grower cooperative is focused on delivering the highest price to growers that can be supported in commercial volume. Most American food and beverage

companies use imported European elder ingredients: IQF berries, dried berries, dried flowers, concentrate and powder. All ingredient feasibility calculations meet current published pricing of these ingredients.

Currently American elderberry producers are demanding prices too high (\$4.00-6.00/lb) to attract volume purchases of 10,000 lb. or more. Up to now there has not been sufficient supply to meet all consumer direct or small business demand for native berries and so that pricing has produced sufficient sales volume to meet production through 2020. Fall 2021 harvest is not sold out as of February 2022 and may not at those prices.

IQF European elderberries are available on the east coast for \$3.00-3.60/lb. with relatively modest freight costs from eastern warehouses. Pricing for other elderberry ingredients comes back to that same price range, which also seems reasonable with bulk frozen Mexican blackberries selling for \$2.49-2.59/lb. in Texas.

Feasibility analysis of elderberry ingredients currently marketed through MEC require berry prices of \$3.00-3.50/lb. to break even with currently available copacker and grower processing equipment, which works well for growers who also make their own products or ingredients for resale. However, it means that MEC must pay growers less than that for berries to cover MEC's overhead expenses as an intermediary. Estimated margin required is from fifty cents to \$1/lb.

Commercial volume producers and distribution shares

As recently as 2018, MEC coop members discussed pricing to the coop at \$2.00-2.50/lb. (sustainably grown-certified organic) so that Class C Distribution Rights shares were then and remain valued at \$2.00 representing one pound of berries committed to annual delivery by the farmer and commitment to purchase by the coop. Other than delivery rights commitments, MEC is an open cooperative not requiring growers to sell their entire harvest to MEC. MEC buys from and sells to non-members at negotiated prices, which best describes MEC's operations so far.

Distribution Rights / Class C shareholders participate in MEC's profit and losses proportional to their shares owned vs. all outstanding shares. This potential participation in MEC's profits and losses across all activities provides further upside or downside to a commercial scale elderberry farmer holding substantial C shares rather than attempting to market their own harvest. The existence of C Share commitments will enable MEC to enter into contracts in advance for harvest and/or specific ingredients so that food and beverage manufacturers can depend on the supply needed to justify the development of products using native elderberry ingredients.

Background: Domestic elderberry production well-established as niche market

Since about 2000, native elder (*Sambucus nigra ssp. canadensis*) has become a popular woody perennial crop for dozens of small to medium scale farms, especially in the Midwest. With early and consistent support from the University of Missouri, and the pioneering work of Terry Durham of River Hills Elderberry Producers, LLC (Missouri), several cultivars selected from the wild were trialed and proven to be successful commercial crops on a modest scale.

A key contributor to this current level of success, Terry Durham developed a fairly efficient, batch process mechanical destemmer, which made the harvesting and packing of elderberries considerably more efficient so that he developed a modest retail product line using native elderberries as their overwhelmingly primary ingredient.

Since then many growers have imitated this success story on smaller scale by selling directly to local consumers and craft food or beverage producers as well as often making their own value added products on farm or in community kitchens. The current success of this scale of elderberry and flower production has been proven in the marketplace.

Commercial feasibility on a regional/national scale

In 2011 Christopher Patton began to work with Terry Durham in both growing elder and wholesaling Terry's River Hills Harvest (RHH) brand retail products to stores outside of Missouri. To determine the feasibility of if and how to scale up elderberry farming and efficiently produce elder berry and flower ingredients in sufficient scale to meet larger company's needs and deliver profits to farmers, Mr. Patton founded the Midwest Elderberry Cooperative (MEC) in 2012.

Forming a volunteer steering committee/interim board, they applied to USDA/SARE to do an initial feasibility study at the then existing potential market with Cooperative Development Services, which confirmed in advance the success experienced over the last ten years. Most of these farms follow organic, sustainable and regenerative practices (certified or not) for whom elder's environmental benefits are very desirable.

Due to his years of experience working in Pillsbury's Engineering Department and later in its International Research & Development Division, Patton understood what larger companies required in price, quality and ingredient format for larger scale food and beverage product development and market success. While continuing to support its members and other farms who are growing or seek to grow elder to diversify their smaller scale operations of providing food and/or value added products locally, MEC has steadily increased its attention towards the feasibility of larger scale commercial elder berry and flower operations from 20 acres of managed fields on up.

Urgency for feasibility study

MEC has received inquiries from an increasing number of farmers with larger land holdings who want to grow elder on sufficient scale to significantly diversify their traditional field crops like corn and soybeans. Their desire is to increase environmental stewardship with a profitable crop, in significant volume comparable to their other crops, that they wholesale *in toto* without marketing hassle or making their own products.

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Market landscape analysis, by ingredient

Dried Elderflowers

Since 2018, the price of imported, dried European elderflowers has gone up 30%. Fresh, frozen and dried elderflowers are most often used to make an elderflower syrup. Commercial sourcing markets it in a 65 BRIX format. Elderflower syrup is used to make wine, beers, ciders, kombucha and liqueurs. Properly dried or frozen flowers keep for a year. Dried elderflowers are also used to make various herbal infusions (teas) and/or mixed with other herbals like hops directly without being first transformed into a syrup.

For farmers focused on berry production, elderflowers are best considered as a part on general field maintenance for pest control, mower access. MEC recommends harvesting flowers from ground level up to about a yard above as well as on leaning canes that should be pruned regardless for a healthy orchard with open space between rows and to reduce pest habitat.

Dried elderflowers can be sold directly or to MEC for \$30/lb., and the grower gets some return on what otherwise would be a field hygiene expense. Picked flowers should be dried immediately on the stem at 90-110°F to 14-15% dryness (small cyme stems snap cleanly) and then sifted to remove most of the stems. Should not take more than 48 hr. or there is too much humidity in the dryer, which can lead to discoloration making the elderflowers unmarketable. Estimated production cost to the farmer of \$25/lb.

As always, if you can sell your fresh flowers directly (suggested \$15-20/lb.) or freeze them for later wine making, then do so. Berry destemmers typically work to remove fresh flowers from the cyme. If done fresh, they can be frozen immediately to make syrup from them later.

Sacred Blossom Farm, Gilmanton, WI, has converted a shed into an herb dryer that can hold 600lb. of fresh flowers at a time. It has internal drying racks of fairly open netting and is heated by solar power backed up by propane.

Sharing Our Roots Farm, Northfield, MN, purchased a used shipping container and added a raised, perforated grain bin floor, internal fan and dehumidifier draining to the outside for \$6200. This system worked well as a closed system without introduction of heated air/humidity from outside the container, which was first tried.

Elderflower Syrup

Elderflower syrup is used by existing brewery, distillery, bottling resources to make a bottled 65 BRIX Elderflower Syrup. Decentralized collection of fresh flowers, quality checked, weighed and noted per growers for later MEC payment, placed in hot sugar water in portable food grade bins that can be collected centrally and picked up for delivery to FDA grade bottler who can press the flowers out and concentrate the simple syrup to 65 BRIX bottles/gallons for sale to commercial buyers.

Five pounds of properly processed elderflower petals can produce 10 cases of 6 x750ml bottles /cs, of elderflower liqueur.

Dried Elderberries

Since 2018 the price of imported, thermally dried elderberries from Europe has gone up 72%, which makes the production of thermally dried native berries more feasible in 2022. MEC will pay \$24/lb. for thermally dried organic elderberries / \$20/lb. for sustainably grown, leaving \$9/lb. for marketing expenses, overhead and profit from retail sales. Berry value to grower is \$3.08 sustainable, \$3.84 certified organic after \$35/pail processing cost.

Dried elderberries are most often used to make an elderberry syrup, usually mixed with honey and a selection of herbs. Properly dried berries keep for a year. Dried elderberries are also used to make various herbal infusions (teas) and/or mixed with other herbals directly without being first transformed into a syrup. Properly dried, packed and stored, they have a 12 month shelf life.

The production of thermally dried elderberries from bulk frozen elderberries yields from 1.5-1.7 gal of juice from each 4 gal/25lb. pail of bulk frozen berries. The juice should be strained to remove impurities but retain berry solids and frozen promptly in food grade jugs - 2 or 5 gal. With appropriate infrastructure, the production of bulk juice as a by-product of thermally drying elderberries delivers a higher total return per pound of harvested berries than producing the juice by pressing directly with a pomace by-product.

Data used in this analysis was collected from multiple growers over multiple years and balanced against a series of drying trials conducted in the fall of 2018 by Riley Gordon, Abel Tekeste, and Ben Swanson of Minnesota's Agricultural Utilization Research Institute (AURI) using a 1200W 10 Tray Stainless Steel Digital Food Jerky Fruit Dehydrator with added Weston Dehydrator Netting Sheets. A UMN student engineering lab used computer modeling to test a rotating screen dryer, which was found to be more efficient.

Due to a number of practical reasons, 4 gal. pails of block frozen elderberries are used for this process. They need to be brought to room temperature (70°F), which takes 48 hours. The juice must be drained 10-15 min. from the thawed pails before the berries are spread out on the drying trays. Each 25 lb. pail yields 14.5 lb. of juice and 10.5 lb. of moist berries. The berries were dried at 125-135°F to 12-14% dryness, which can take 7-11 hours depending on the dryer - 10 hr. for AURI.

For quality control trays usually need to be shuffled at least once per cycle due to the uneven distribution of heat in the repurposed dryers used by growers. AURI found 14% moisture level to be

stable for storage as the water activity was below 75. The dried berries should be packed fairly promptly to avoid reabsorption of moisture. Use of nitrogen in sealing the packs would improve quality and extend shelf life. The whole process is best conducted in an enclosed preparation area with controlled heat and humidity. This improves drier efficiency, reducing the time required, as well as reducing the risks of dried berries reabsorbing moisture from the air during handling.

Freeze Dried Elderberries

Freeze dried elderberries are being produced with small scale food freeze dryers on flat trays available online. Wholesale price is \$90/lb. with a retail of \$115/lb. At these prices volume is limited. For the right price, substantial demand exists for both freeze dried berries and powder made from them or freeze dried juice. The question is at what price and can larger scale equipment operate more efficiently.

At \$90/lb. producers are receiving \$5.63/lb. for frozen berries less the cost of processing. The cost to freeze dry per pound is undetermined at this point. A lower price of \$3.00/lb. also offers the potential of lowering the freeze dried wholesale and retail prices significantly, which would likely open them up to higher volume sales.

Bulk Frozen Juice

On October 15, 2021 co-packer Arise Nutrition (Wisconsin Rapids, WI) pressed 5,000 lb. of member Kaeb Organics certified organic elderberries for MEC. The Kaeb's donated \$1/lb [\$5,000 value) off their normal berry price of \$5/lb. MEC bought several thousand lb. of berries at \$5/lb. that were resold to East Coast buyers. To reduce risk, MEC pre-sold 360 gal. packed 45 gal in eight 55 gal drums to member Carmel Berry Company at a reduced price of \$44/gal to compensate for their risk and frozen freight costs to deliver the two pallets to CA, where they are located.

Elderberry Juice Trial: Highlight of results

2021 Trial Production

BRIX 10, 9% solids, pH 4.8 (4.92 normally?)

Frozen Juice: 444 gallons: packed 55 gal. drums, 5 and 1 gal. jugs

Frozen Pomace: 825 lb. (30 lb. bags)

(A run of 15,000 lb. would yield an extra 10gal of juice / 5,000 lb.)

2021 Trial Expenses

5,000 lb. of org. berries @ \$4/lb. = \$20,000 + \$500 delivery

Arise pressing cost = \$2,000

ULINE 5gal boxes: \$85.21

Transaction fees: \$94.95

Warehouse fees: (not yet invoiced)

Total cost: \$22,680 [Freight excluded]

Trial Sales as of 1/20/222: (20 gal juice & 200 lb. pomace unsold)
 360 gal @ \$44/gal = \$15,840
 12 gal @ \$45/gal = \$540
 25 gal @ \$45/gal = \$1,125
 15 gal @ \$50/gal = \$750
 400 lb. @ \$.50/lb. = \$200
 Total Revenues: \$18,455
 Net Loss from Trial: (\$4,225) [Freight excluded]

Bulk frozen juice is used as a primary ingredient in beers, wines, kombucha, ice cream, yogurts and syrups. It has unrealized potential for use in a variety of fruit drinks, waters, and ginger ale.

Imported EU not-from-concentrate certified organic elderberry juice (pasteurized) from a potential buyer currently importing 25,000 lb. of juice/year or about 3,000 gal. 2022 East Coast price is \$3.50/lb. of juice x 8.55 lb./gal. = \$29.93/gal. Breakeven berry value at that price is \$2.66/lb.

To create margin from the input side, MEC should pay \$2.00/lb. for sustainably grown berries and \$2.50/lb. for certified organic berries to use this toll processor. These are the prices originally discussed with MEC members and paid by River Hills Harvest (Terry Durham) for harvested clean native berries in 2014-2018 when commercial production was beginning. Current prices range from \$4-\$6/lb. in volume, and up to \$10/lb. for small quantities sold directly to consumers as demanded this year by many existing elderberry farmers. This indicates that the current market is too high and expectations need to be lowered.

Market experience over the last few years indicates that we should be able to sell 55 gal drums of bulk frozen native elderberry juice in modest pallet plus quantities for \$36/gal sustainably grown and \$38/gal for certified organic juice. Larger volumes would require discounting towards the \$30/gal. import price. If MEC can document higher nutritive values and otherwise measure superior flavor or other desirable attributes imparting competitive advantage. Smaller volumes (2 or 5 gal jugs) can be sold for \$45/gal., which could meaningfully improve annual margins for this ingredient product.

Elderberry Puree

Manufacturers typically want 55 gal. drums of frozen fruit puree. At trade shows buyers expressed strong interest in a puree. A pure elderberry puree can likely attract premium pricing as its color and flavor are strong, so it can easily be mixed with a pear or apple puree to extend volumes required by the process formula. Pricing would likely fall in line with what the other ingredients delivered in relation to the imported European berry and juice prices.

Elderberry puree should be a focus of further study. Member Regenerative Agriculture Alliance is interested in producing an elderberry puree at their Albert Lea, MN facility.

Bulk Frozen Elderberries

Bulk frozen elderberries are the benchmark ingredient for native elderberry production. All ingredient analyses have focused on using bulk frozen elderberries harvested according to current

protocols established by River Hills Harvest (Terry Durham) with the approval of the Federal Drug Administration for safe use in food and beverage products. MEC instructs growers to follow this protocol for any berries intended for sale through the coop.

As mentioned elsewhere, current pricing of \$4.00-\$6.00/lb. is too high to sustain high volume sales. Three to four years ago high volume interest was strong for prices of \$3.00-3.50/lb. Imported IQF European elderberries sell for \$3.00-3.60/lb. on the US East Coast.

Individual Quick Frozen Elderberries - Blue (cerulea) Elderberries

Tim Wilson of Spring Green Organics, LLC located in Dryden, WA has developed a mid-sized, automated system for sorting, cleaning and freeze the native west coast blue (*S. cerulea*) elderberries. Tim has over 30 years experience in fruit processing engineering design and management. He is sharing his expertise with MEC. His working berry processing system demonstrates potential for continuous flow berry handling at relatively high volumes suitable for commercial scale operations.

Partner profiles

Savannah Institute Online Grower Guide

Keefe Keeley

David Bruce was brought on at Savanna Institute to lead a Specialty Crop Block Grant focused on expanding the opportunity for family farmers to adopt elderberry by writing a grower guide, organizing grower education field days, and networking to identify and expand the elderberry market. David's role, while still focused on elderberries and their commercialization, evolved to encompass assembling and building a team of two Community Agroforesters and two Technical Service Providers that Savanna institute refers to as the Agroforestry Adoption Team.

The Agroforestry Adoption Team at Savanna Institute works to educate farmers interested in the possibilities of agroforestry crops including elderberries to both understand cultivation and the potential markets, but also how to access NRCS cost share programs in order to assist with preparation and establishment. Part of this work also encompasses helping to model enterprise budgets of how a crop such as elderberries compares in terms of establishment, maintenance, cost of production, yields and profitability.

The work that Savanna Institute has done in this regard is helping to further the awareness and adoption of elderberries throughout the Midwest Elderberry Cooperative network. By expanding the depth of expertise available to farmers looking to adopt agroforestry and perennial cropping systems including elderberries, more infrastructure will be created, more farmers are educated, and more networks are woven.

Additionally, through our work on other agroforestry and perennial crops we have continued to identify barriers to adoption of elderberry for farmers, as well as investments needed to scale up

the market for elderberry and other perennial crops. We have focused on the pioneering efforts needed in order to develop production clusters and corresponding processing hubs that can aggregate the production of smaller operations in order to access both further, value added processing, but also third party processors that can bring scale and efficiencies to product processing, marketing and distribution.

Partner profile: Commercial grower Fountain Ark Farms, LLC

Author: Brian Weber, Jon Jobes Partners

Fountain Ark Farms was established in January 2021 to grow high quality, nutrient-dense elderberries. We strongly believe in the market potential of elderberries and the many health and medicinal benefits they provide. The vast majority of elderberries are imported from overseas, so we hope Fountain Ark Farms can become one of the largest domestic elderberry producers over the next decade.

Our current farm has 20 tillable acres that will all be used for elderberries. We currently have 2,500 cuttings (2.5 acres) and will add an additional 3,500 cuttings in 2022 (5-6 total acres). Our plan is to have our full 20 acres planted by 2024.

Along with the market potential of elderberries, we believe in the economic potential to achieve our dream of building a generational business that provides numerous jobs and business partnerships. We believe we should produce 4,000 pounds/acre, and can wholesale them for a minimum of \$3/lb (\$12,000 gross income/acre). Aside from the income from the actual berries, the exponential compound growth of cuttings is powerful (a single cutting produces 3 additional cuttings over two years). By planting more now and being one of the first to do so, we will have significant opportunity to grow our market share of the elderberry cuttings market, and at little additional expense to do so. If we're able to hit our revenue numbers and have addressed the concerns below, we will be looking for additional land to fuel growth.

There are currently no harvesters/processing facilities that are ready for large-scale production and no wholesale contracts in place. Fountain Ark Farms will need to build or partner with someone like the Midwest Elderberry Co-op (MEC) to develop a harvester and processing hub. Our plan is to sell our elderberries to the Midwest Elderberry Co-op (at \$3/pound), so we're putting confidence and faith that the MEC is a long-term and viable operation that has built numerous partnerships to sell large amounts of berries. We will also need reliable wholesale contracts to grow at a scale that can be supported by actual sales. If these two challenges can be addressed over the next 1-2 years, it gives us a lot of confidence to grow at a pace we'd like to.

UMN grower survey, interviews, and processing hub feasibility study

Introduction and context

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MEC survived these past ten years mostly due to brokering the sales of bulk elderberries, dried elderberries, freeze dried elderberries, IQF blue elderberries from WA, dried elderflowers, and bulk elderberry juice to buyers for members and other elderberry farmer partners. MEC's online presence has been critical to this success.

Over the years by direct contact or through regional and national trade shows, larger food and beverage companies have expressed strong interest in obtaining US-grown native elderberry ingredients; however, they require larger quantities and dependable supply guarantees beyond MEC's current capacity to offer in good faith. MEC's primary challenges are to increase the volume of elderberries that can be harvested and processed into desired ingredient formats that work with existing food and beverage processes so as to provide volumes desired at competitive prices, which deliver acceptable revenues to grower members.

MEC's immediate goal is to scale up existing ingredients, as well as add other desired ingredient formats for fruits like puree, to fairly large commercial scale in MN around regional, rural hubs. Bulk frozen elderberry is the basis for all of offered ingredients at this time and the foreseeable future, though as the section above notes there is strong demand and potential for other ingredients.

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Picking, destemming and otherwise processing cymes of small elderberries is currently a very labor intensive process. MEC sees a priority of reducing labor inputs significantly in order to lower ingredient prices to be competitive with imports, as the premium for superior taste and other qualities exhibited by our native elderberries will have limits. MEC requires expert help in process development and equipment utilization for a mid-range scale of operations, suitable for elderberry and other small fruits, well above a typical commercial kitchen but below the much larger fruit processing facilities typical of more common fruits like apples, raspberries or grapes. In sum, in partnership elderberry stakeholders with development of one or more efficient, mid-scale elderberry processing hubs. A grower survey, interviews, and processing hub model were undertaken in partnership with the UMN Forever Green Commercialization Team to explore current and projected supply, satisfaction with coop structure and member experience, and evaluate hub feasibility.

Survey and interview methods

An electronic survey assessing grower location, current and projected production, processing, marketing, attitudes, and co-op feedback was developed by the UMN Forever Green Commercialization Team and MEC leadership. The survey was sent to a national list of elderberry growers and industry contacts compiled and provided by Patton (N= 164). The list was informed of the survey prior to distribution. The survey was developed and distributed via UMN Qualtrics in mid-October (2021), and a reminder was sent out one week later, with the timeline extended to the end of October. The survey received 59 responses, or a response rate of 36%.

Interviews were conducted in late November, 2021 and early December, 2021. Subjects self-selected on the electronic survey by agreeing to be contacted by UMN Forever Green staff. Notices were sent to all self-selected candidates to schedule an Zoom interview via Outlook calendar. Candidates were given a two-week window to schedule an interview. Six candidates scheduled interviews. All six interviews were conducted and completed.

Survey sample: Insights into larger population, gaps, informing hub assumptions

Consistent with MEC's membership and network, the majority of respondents were located in the Midwest, with several responses also coming in from the Eastern seaboard, Florida, and the West Coast. The practicalities of elderberry harvest, transport, and processing would make long-distance coordination infeasible in terms of costs and maintaining product quality. While the precise geographic footprint of a processing hub is contingent on many factors, it is clear that collaboration in a relatively tight geographic area will be needed to achieve volume and other efficiencies.

Several of the significant elderberry operations established in the Upper Midwest are not included in the survey, perhaps due to insufficient survey promotion or less interest in an offsite processing hub given more established onsite processing. Therefore, the survey respondents should be considered as a *sample* of a larger *population* of growers. Nevertheless, this sample can reasonably provide quantitative and qualitative insights into regional elderberry production trajectories, grower characteristics, needs, and ground important aspects of a processing hub model.

Situating increasing Upper Midwest production in global elderberry demand

Publicly-available information from Techavio.com on the global elderberry market indicated a 2019 market size of \$334.5M, based on 25 of the largest global vendors. The elderberry market has been growing at 4.5% CAGR. The market is expected to nearly double between 2019 and 2024 (82% projected growth). The market, however, remains relatively fragmented, or decentralized. The global elderberry market is broken into the following regional shared:

- Asia-Pacific: 39.34%
- North America: 24.12%
- South America: 20.15%
- Middle East and Africa: 9.3%
- Europe: 7.09%

Four countries (Germany, France, India, China) contribute 23-25% of total market share.

Significant demand in North America—nearly a quarter of global demand—but relatively little North American production presents a major market development opportunity.

Trends in regional elderberry production: Current and near-term

Plantings and acres, 2005-2021

Since 2005, elderberry plantings and acres have been on the rise. Figure 1 shows that aside from several larger plantings in 2013 and 2016, from 2005 to 2017, elderberry plantings among respondents were limited to only a few plantings and acres total per year. In 2018, plantings and acres began to grow more consistently, both peaking in 2021.

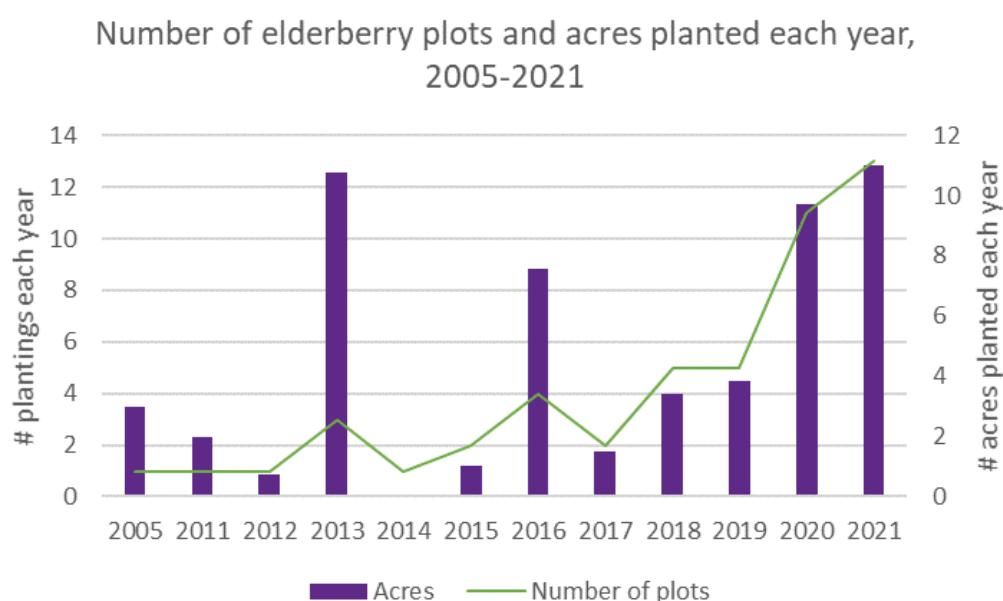


Figure 1: Number of elderberry plots and acres planted by year, 2005-2021

Acres of elderberry, total land, average planting size

As of 2021, survey respondents had planted a total of 81.3 acres of elderberry. These growers manage just over 3,500 acres total, suggesting that elderberry accounts for only 2.3% of total acreage. Respondents manage an average of 73 acres of land each and 1.8 acres of elderberry, the latter of which is skewed upward by a small set of larger plantings. For most growers, elderberry is a small part of an overall, often diversified agricultural and land management operation including row crops, livestock, forestry, agroforestry, and uncultivated woodland and pasture.

Production system

Over a third of growers report organic management practices but only 9% report certified organic. Transitional accounts for nearly half (43%) of all respondents. The remaining 10% is accounted for by conventional acreage (8%) and sustainable (2%). This suggests that the vast majority of

elderberry producers identify with a system other than ‘conventional,’ but almost three-quarters of all producers are in the broad categories of organic management, transitional, or sustainable. Using initial elderberry establishment years to transition acres to organic appears to be a common strategy

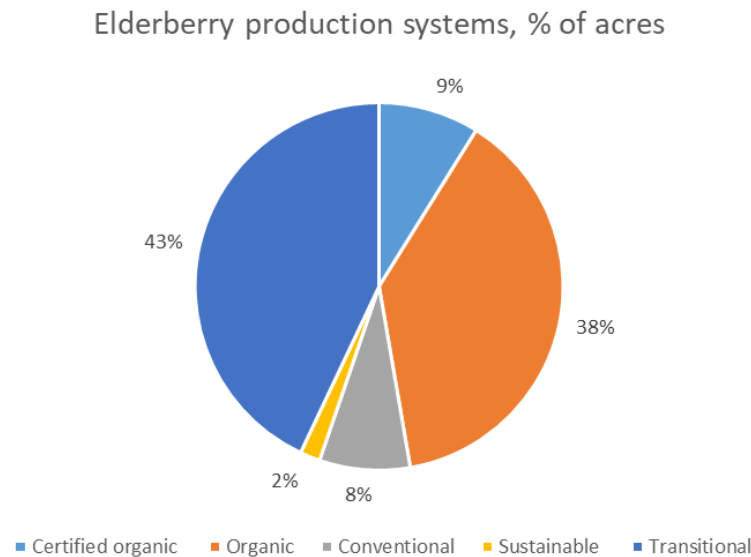
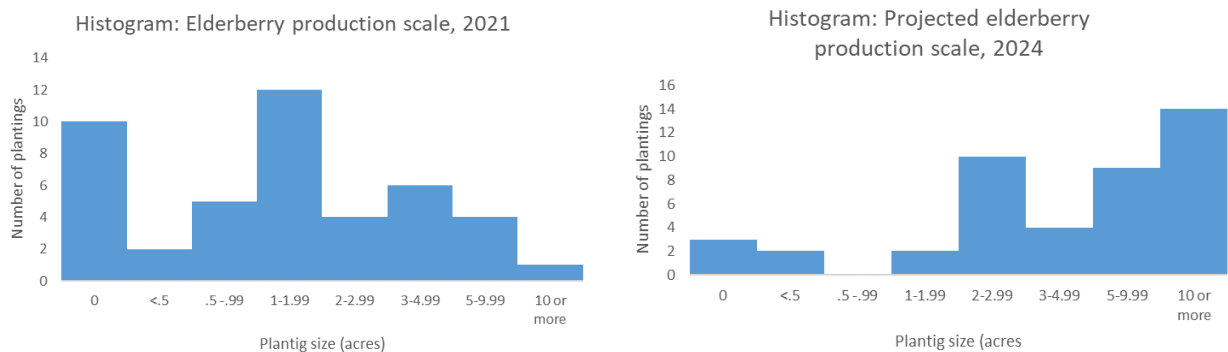


Figure 2: Elderberry production systems

Projected increase in elderberry acres, 2022-2024

Over the coming two years, respondents’ indicate intention to significantly expand their elderberry production. **These 59 growers alone indicate their total elderberry production will expand nearly five-fold by 2024, from the current 81 acres to 382 acres.** The distribution of production scale will shift with this expansion as well. For example, as of 2021 two-thirds of respondents are growing two-acres or less of elderberry. Many have yet to plant but intend to in 2022. By 2024, about 85% of respondents expect to be managing two acres or more of elderberry and almost a third of respondents expect to be managing 10 acres or more. The two histograms below display this projected shift.

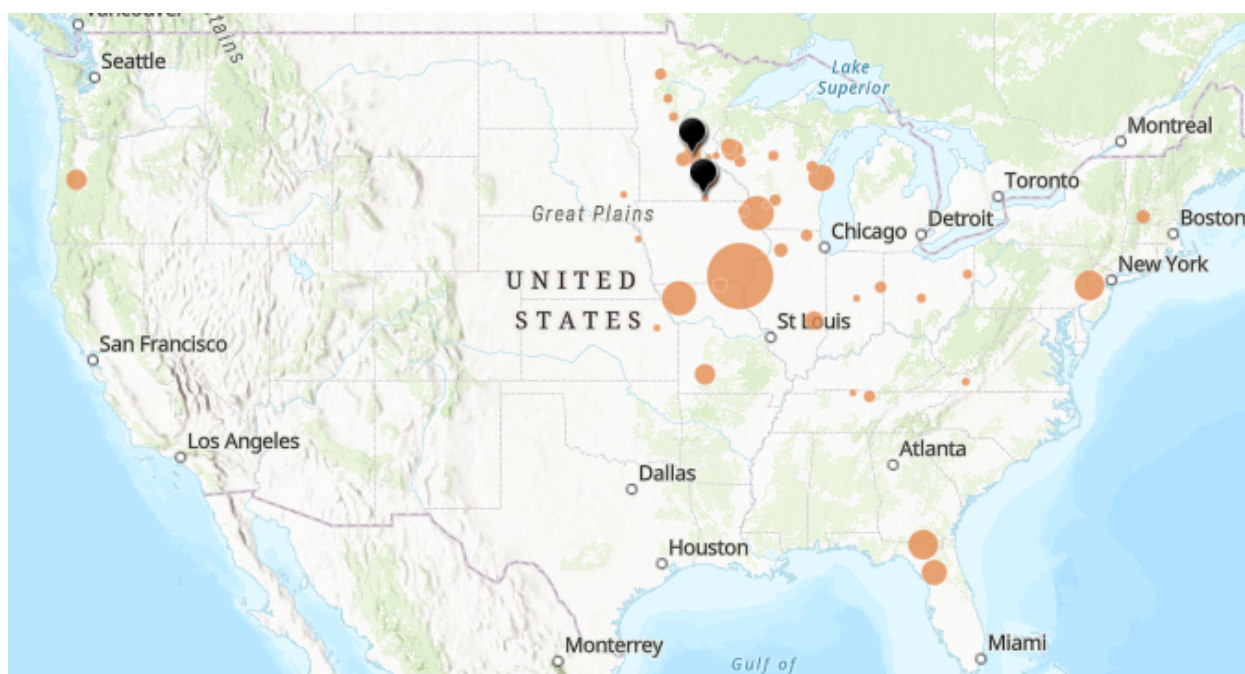


Figures 3 and 4: Histograms showing current and projected planting size increase

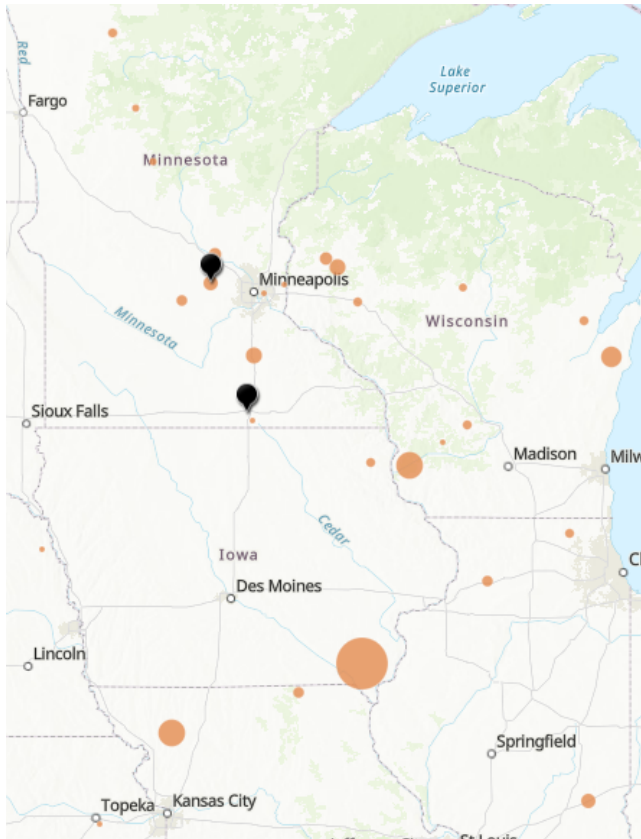
One interpretation could be that growers that could currently be considered primarily homestead and hobby production, often about an acre or less, are planning expansion to significantly larger commercial production. The above figures suggest that elderberry production is expanding among respondents in both regional production acreage and scale.

Visualizing respondent locations and scale, current & projected 2024 regional elderberry production

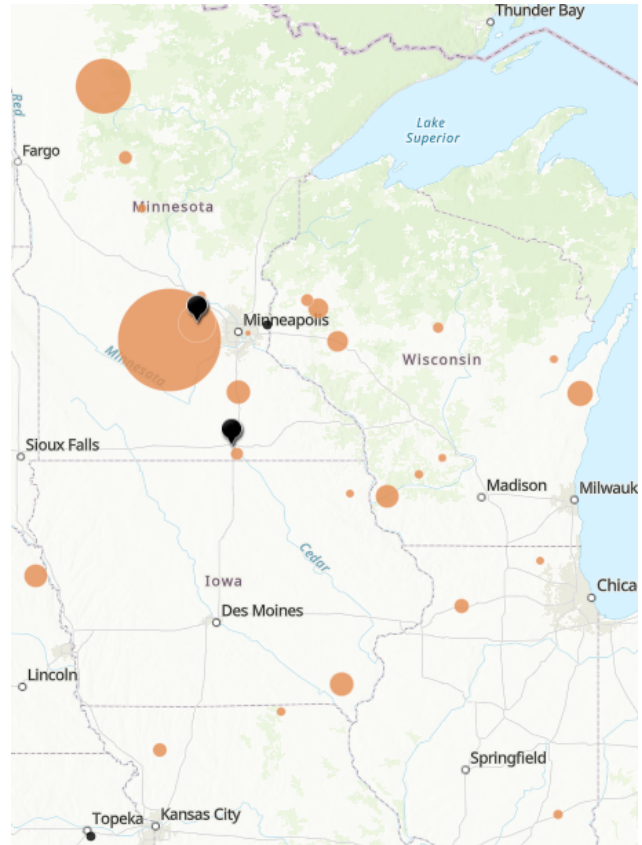
The maps below are based on zip code location provided by survey respondents. The first shows the location of all survey respondents. The remaining hone-in on an area in the Upper Midwest where most respondents are located and where several potential processing hub locations have been identified. The second two maps show a side-by-side of acreage at the time of the survey (2021) compared to projected acreage by 2024, with the size of marker indicating relative planting size (not to scale). The maps clearly indicate the acreage expansion discussed above. The final map shows a 120-mile radius around two initially proposed processing hubs, one in Montrose, MN and one in Albert Lea, MN, as well as an Upper Midwest potential hub catchment area for which a centrally-located hub could reasonably access several production hubs Northwest of the Twin Cities, in Southern MN, Northern IA, and Western WI.



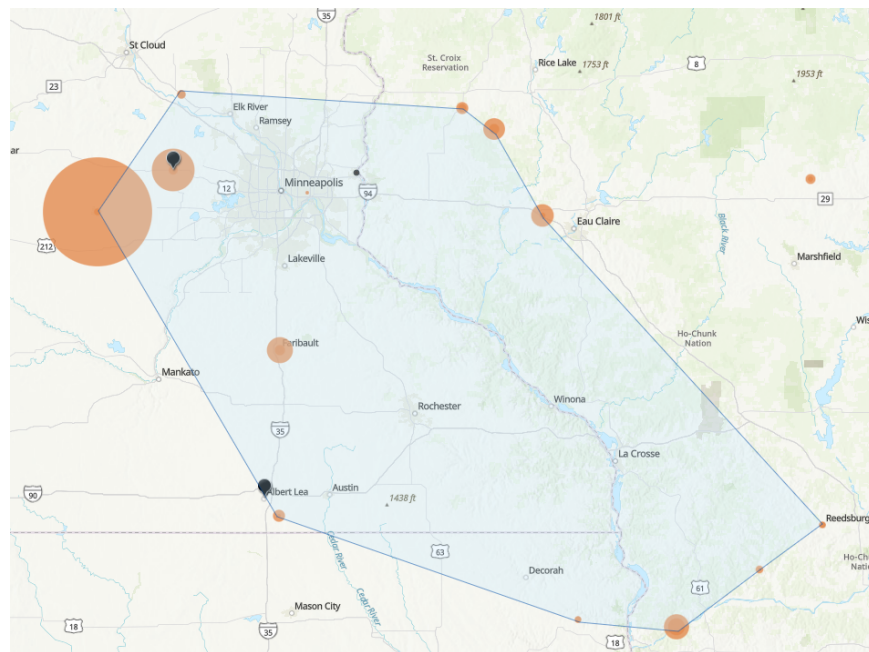
Map 1: Elderberry grower survey respondent locations, 2021 production (not-to-scale)



2021 Upper regional production



Projected 2024 regional production



Cluster of projected 2024 elderberry production in SE/S MN, Western WI, Northern IA

Note: black markers indicate two proposed processing hub locations by regional partners

Differentiating hobby/homestead and commercial growers

Survey responses and interviews suggested that many current elderberry growers could be classified as what could be called hobby, homestead, retirement, or lifestyle growers that often managed about an acre or less. Many of these growers hope their elderberry enterprise to be profitable, but it is not a primary source of income. Equal or greater motivations include physical activity, health promotion through products, land stewardship, and community connectedness.

This is somewhat in contrast to a smaller but growing number of producers that might be called commercial growers, which manage two to five or more acres of production and are targeting significant volumes, post-production management, processing, and marketing. Interviews suggest a role for MEC and a prospective processing hub for both hobby and commercial growers. For example, many hobby growers make and market value-added products whereas others seek to move all or part of their harvest through MEC to minimize marketing costs. Larger commercial growers have often by necessity put more effort into on-farm processing and storage, but may also be looking to minimize additional infrastructure, labor, and seek wholesale markets for their larger harvests.

This differentiation between hobby/homestead versus commercial production is not a value judgment on the importance of either cohort of growers, more a recognition of grower characteristics that inform their likely goals, production set-up, and marketing approaches.

Equipment on-farm

Survey responses suggest relatively limited equipment on-farm for elderberry production. Specifically, 20 respondents do not own any equipment. Among those that do own equipment, eight own a cover crop drill, six own a dual-axle trailer, four own a water wheel planter, one owns a roller crimper, one owns a hydra weeder. Ten (10) own an assortment of other equipment. Several growers produce elderberry among various row crops and so have a wider range of equipment onsite including tractors, plows, brush hogs, gators, tillers, sprayers, etc, but this is limited to a few growers. Several other pieces of equipment include woodchippers and mulch layers, irrigation, fencing, loaders, etc. but again may of these are not common.

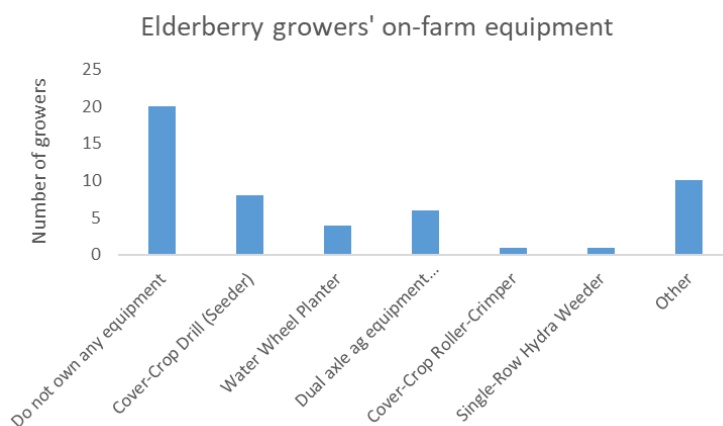


Figure 5: Elderberry growers' on-farm equipment

Yields

Since many of respondents' plantings have gone in since 2019, robust insight into observed production yields in mature fields is difficult. Estimated grower yields range in mature plantings ranged from near zero to over 3,000 lbs/ac. This tracks grower feedback in interviews of highly variable production success, and a desire for more support in effective production techniques. Within the dozen or so pre-2019 plantings, there is no clear correlation or statistically significant relationship between planting size and yield. Notably, reported yields were significantly below commonly-cited yields in the agronomic literature of 3,000-4,000 lbs/ac or more. Most of the reported yields were under 1,000 lbs/ac. Supporting grower production success will be an important component of producing the volume that will be needed to achieve scale and efficiencies in processing.

Processing

The grower survey asked several questions about processing. A quarter (25%) of respondents do not process elderberry on-farm and about half do (47%), the remaining quarter did not respond. About half that process on-farm (46%) process their berries indoors, and about half process their berries in-field (50%). Several indicate off-farm processing but indicated that 'off-farm' meant home. One stated their 'County Ag Center' but no further details were provided.

Most respondents with on-farm processing have stainless steel sinks. About five have destemmers, at least one is a hand destemmer, the others did not specify but mechanical destemming can be assumed for these respondents. One respondent uses a grape destemmer. Two have bladder presses and several call out freezers. It is reasonable to assume a number of others have freezers as well. One respondent reports hand screening. One hobby or home producer's processing response highlights the range in approaches, reporting the processing method: "Table, fork, and bowl."

Highlight: Midwest Elderberry Co-op Structure and Member Experience

Overview of the Midwest Elderberry Co-operative (MEC)

The Midwest Elderberry Cooperative was established in 2012 and as of the writing of this report, has a total membership of 30. The board of directors consists of 5 members and has been led by Christopher Patton since its inception. The vision of the cooperative, as outlined on their website, states:

Through profitable, environmentally and humanly sustainable,-- and often Certified Organic -- elderflower and elderberry production, MEC will contribute to the economic welfare of its growers and ingredient customers -- from local to global food and beverage producers. Ingredient nutritional and taste quality, consumer satisfaction and a naturally healthy environment take precedence over excessive return on invested capital, which must nonetheless be robustly positive for our operations to be sustainable and provide acceptable return to our investor partners."

Of the number of survey respondents (n=43), 13 of the total indicated they were members of MEC, whereas 30 respondents indicated they were not. Of the 6 individuals who were interviewed, 2 of the subjects indicated they were members. Length of membership of all respondents ranged from 1 year of membership to being a founding member (10 years).

Top reasons for joining MEC: Access to information, research and markets

In both the survey responses and individual interviews, both members and non-members indicated that a top benefit of the co-op is access to agronomic and production research, with market access a close follow-up. As stated by one interviewee, "Access to Christopher (Patton) is 'definitely a positive.' Both Patton and Terry Durham were mentioned throughout as key sources of information and that both "pick up the phone." One subject stated that "[MEC] could be THE place to go for the small grower" and most respondents agreeing that information sharing was a key benefit. It was indicated by respondents that Patton and Durham are generous with their time and information and do not reserve their time and resources exclusively for MEC members.

Regarding market access, three of the interviewees view the co-op as a platform that could provide a safety net for surplus inventory. They each stated in their own words that they would not want to be required to sell all of their product to the co-op, but rather, would prefer having it as an option, which fits MEC's structure as an open cooperative. There was also an indication among the interviewees that they were waiting to see how viable the co-op is or will be. One survey respondent who is a new member wrote, "First year, still feeling them out."

When asked how successful MEC has been in meeting their reasons for joining, the response was overwhelmingly positive, with respondents either neutral (n=1) or indicating somewhat successful (n=5) or Very successful (n=6). When asked to explain their answer, the respondents were complimentary of MEC's ability to sell their product or provide information and resources for growing elderberries, "We would not have the confidence to expand without the assistance of the MEC. Mr. Patton's excellent research and great networking skills." Another comment, "MEC has been what I needed to get started growing elderberries."

Assessment and satisfaction with Co-op Structure

When asked about their understanding and familiarity with the MEC structure, many of the respondents, both survey and interview, indicated they had a "fuzzy" understanding of how the co-op was structured. Two of the interviewees had significant co-op experience through other cooperatives, including participation in an electric co-op for several decades. This interviewee stated that they "believe in co-ops and believe they bring value to grower..." another spoke of loyalty, "I don't ever anticipate cutting ties with the coop. How can you take advantage of an entity for the first 10 years of your program, then cut ties?" [Note: MEC has always posted its by-laws and member agreements online along with a brief functional description.]

The grower survey asked about satisfaction with the coop structure. The table below summarizes responses:

MEC structure satisfaction	Number	%
Extremely dissatisfied	3	5%
Somewhat dissatisfied	2	3%
Neither satisfied nor dissatisfied	15	25%
Somewhat satisfied	9	15%
Extremely satisfied	6	10%

Table 1: Grower survey respondents' satisfaction with MEC structure

Responses to this question run the gamut, demonstrating the relatively diverse views of MEC as well as the direction of the elderberry industry. Several statements were as simple and even keel as, “[MEC] baseline helps with hedging strategies,” “appreciate the work and structure to date,” and, “knowledge of trends and expansion opportunities.” Two emphasized the importance that the industry scale production and the spread between grower and buyer price expectations that will be needed for the coop to succeed:

“Emphasis needs to be put on adding grower acres to get production up. MEC does a great job with market awareness about elderberries hopefully creating opportunities in the future, but until producers have more acres/pounds, these sales/contracts won't get executed. More dollars needs to be put in grower processing to give growers confidence there's a way to process these instead of doing large acres by hand.”

“I feel that in order for MEC to truly succeed, growers will need to commit to selling a portion of their harvest through the coop - however the issue lies with the price per pound paid because growers can get \$4-12 per pound of fruit selling to food processors and home consumers.”

MEC management, however, consistently notes that these prices reflect current high harvest and processing costs and are not feasible for accessing broadline buyer markets competing with imported berries. Finally, the few respondents extremely dissatisfied with MEC's structure highlighted what they perceive to be differences in philosophy,

“We are an all hand operation that strives to continually increase soil health and we diversify by planting other crops like garlic and herbs in with the elderberry to prevent monoculture situations. We have very different goals than this coop which seems to be about bigger productions and mechanization.”

Perceptions, philosophies, needs, scale, and goals among elderberry growers vary widely, and MEC may not be a good fit for all growers.

MEC vision, current activities, leadership

Survey respondents were encouraging when asked whether the current vision statement of MEC accurately reflects the current activities and functions of the MEC. Of the 12 responses to this question, all rated the vision statement “somewhat accurate (n=12),” “accurate (n=8)” or “very accurate (n=3).” On the question of the effectiveness of MEC leadership on a scale of 1 - 5 (1=Not

at all effective, 5 = very effective), the co-op received high marks (3.75 - 4.3) on all attributes they were asked, including effectiveness in marketing products, recruiting new members, engaging new customers, stewarding coop resources and planning for expansion.

Summary of member responses

The number of actual members who responded to the questions was small (n=14, 12 survey, 2 interview), but accounts for almost 50% of total MEC membership (30) at the time of the survey. Overall, the response was consistently positive toward the coop. The members recognize that Mr. Patton has been “pounding the pavement” for them and for the success of elderberry production in the U.S. One member wrote, “I found that I can reach out to the President [Patton] and he will email me back. I just hate bothering him because I know he must be busy trying his best to assist [sic] us all. I would love to see a private forum developed on the MEC website where we can share knowledge with one another.”

This later comment echoes a number of comments across all survey responses and interviews about the need for communication, information sharing, and agronomic support. Whether the grower is a member or not, a recognized need in the elderberry community is regular and consistent communication channels for market and production information. Market and production information needs were stated as the top services the coop could offer survey respondents (members and non-members) in the next 3-5 years. They ranked highest “market access ease,” “elderberry promotion and awareness,” and “processing.” One respondent suggested, “Encourage small scale producers; Better website structure; better member communication.”

On the topic of agronomic challenges, several interviewees stated a version of, “I made every mistake under the sun,” and indicated a major need to support grower production planning, site prep, planting, establishment, and management. While several resources and courses are emerging to meet these needs presently, the sense is that MEC can and should be a hub of grower agronomic support, which is intrinsically linked to member and coop success.

Non-member Responses

Of the 39 survey respondents and 4 interviewees who indicated they are not members of the co-op, the top reason was that they had “no product.” Interestingly, the next highest response was, “I plan to join some time.” Interviews with non-members echoed this sentiment, with statements indicating that they “plan on it” or “just not yet” which signal a future intention of joining. Several indicate insufficient berries or a lack of surplus berries, but expect to have volume to sell to MEC in the future.

Elderberry processing hub feasibility model: Context and scenarios

A model was developed based on information collected from growers, publicly-available information, cost benchmarks in other Midwest/US berry processing feasibility studies, and MEC leadership. The model focuses on the capital and variable costs associated with developing and operating a processing hub relative to projected revenue. The model focuses on bulk frozen berries, also known as straight-packed berries, as these are the backbone of current MEC sales. A scenario examining the costs and benefits of individually quick-frozen, or IQF berries, was developed to

inform hub product choices. Subsequent modeling on the costs and returns of freeze-dried berries, juice, pomace, elderflower, and other value-added products could be incorporated into the model but detailed examination of these additional products were beyond the scope of the feasibility study.

Notably, the model is highly inter-linked such that any assumptions can be revisited and adapted such that altered assumptions flow through the model. In other words, the model developed should be considered a useful tool for ongoing planning and feasibility assessment rather than a fixed assessment of an elderberry processing hub's feasibility.

Projected hub supply

This model extrapolates survey findings to project regional berry yields through 2030. While a number of grower respondents were outside MN, the survey also did not capture a number of elderberry growers in the Midwestern elderberry production corridor of MN, WI, and MO. Noting the relative breakdown of hobby producers versus commercial producers, the model assumes:

- **Hobby production:** 75% of regional acres are in hobby production, yielding an average of 500 lbs per acre, and 25% of this production is captured by the hub
- **Commercial production:** 25% of regional acres are in commercial production, yielding significantly more—3,000 lbs/ac—and a hub captures 50% of these growers production

Regional increasing acreage and total berry production was modeled through 2030. An average of 75% compound annual growth rate (CAGR) was calculated based on reported plans through 2024. Following significant growth and increased competition, the model assumes a tapering CAGR of 50% in 2025, 25% in 2026, 10% in 2027, and no growth in 2028-2030. Acreage is assumed to have no yield in its first year, 10% of a mature stand's yield in year 2, and full yield at year three.

While production is set to increase roughly five fold in the coming few years, the delayed maturation of these new plantings along with additional assumed plantings project a total potential hub capture of just over 1M lbs of berries by 2030. The table and figure below show this scaling supply, which makes significant upswings once projected expanded plantings occur over the coming years. The assumptions used to inform this hub supply can be revisited at any time.

Year	Pre-existing acres	New acres	Y1 acres	Y2 acres	Mature	Lbs berries, hobby	Lbs berries, commercial	Total lbs berries
2022	81	61	0	0	81	30,488	60,975	91,463
2023	143	108	61	0	81	30,488	60,975	91,463
2024	250	189	108	61	81	32,787	65,573	98,360
2025	439	219	189	108	143	57,512	115,023	172,535
2026	658	165	219	189	250	100,882	201,764	302,646
2027	823	82	165	219	439	172,778	345,555	518,333
2028	905	0	82	165	658	252,996	505,992	758,987
2029	905	0	0	82	823	311,617	623,234	934,850
2030	905	0	0	0	905	339,385	678,769	1,018,154

Table 2: Elderberry processing hub feasibility model, projected supply through 2030

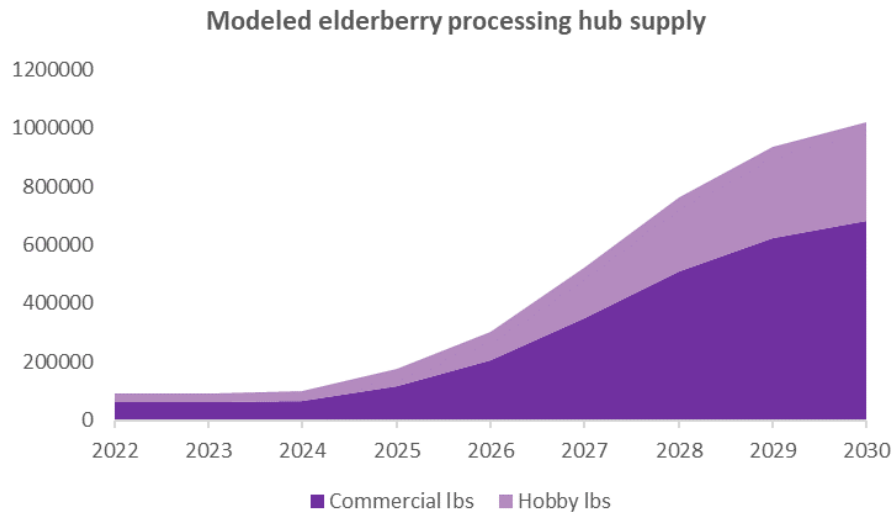


Figure 6: Projected processing hub supply, 2022-2030

Assumptions: Capital costs

Numerous assumptions are required to develop a processing hub financial model. These assumptions were sourced from MEC leadership, publicly-available information, and benchmarks from recent berry processing studies such as aronia and IQF blackberry. These assumptions are listed briefly below:

- **Lbs of berries per cu ft stored:** 18.75, determined by standard use of 25 lbs per 5 gallon, fitting 4 pails across by 4 pails deep by 4 pails tall on a 4 ft by 4ft pallet
- **Cubic ft of storage needed:** Assessed for each year by dividing total hub volume by above figure. This figure starts at 1,667 cu ft in 2022 and scaled to almost 20,000 cu ft by 2030. While inventory fluctuations may not be required for a full year's harvest, a relatively short harvest season plus inventory carryover warrant conservative (high) assumptions for storage needs. Total storage needs were split into a two-phase build out of 9,300 cu ft in 2022 and 2027.
- **Cost of commercial freezer space:** \$11.04/cu ft, from a recent aronia processing study. This results in total cold storage build costs of \$102,451
- **Facility size (sq ft):** Calculated from same aronia study that 0.00378 sq ft are needed per lb of berries processed, at 2030 volume this results in a 1,604 sq. ft. facility. This is a relatively small footprint that should be considered a minimum space requirement. Depending on additional value-added processing, additional space may be needed for a dehydrator line, juicing equipment, holding tanks, etc.
- **Building and electrical:** Publicly-available, state-specific building cost estimation tools predict per sq ft costs of \$56 for building and \$50 for electrical, resulting in just under \$90,000 and \$80,000 each, respectively
- **Equipment:** The included equipment is based on a typical set-up for berry processing facilities. Savings could be seen where elements of this equipment are not needed.

The issue of elderberry destemming equipment could be a short report in itself, as this remains a bottleneck and active area of innovation. The assumed cost of \$20,000 is based on an assumption of operating either a) two currently-available lateral shaker-table de-stemmers such as Terry's Elderberry Destemmer (T.E.D.) or rotary de-stemmers such as recently-patented rotary destemmers from Buehler's organics, or b) Purchasing a single larger used rotary-style grape de-stemmer with additional investment in retrofitting, or c) a novel and custom-built elderberry destemming unit, several of which are in design presently.

All equipment costs are listed in the table below for year one (2022) for the simple straight-pack scenario. In the IQF scenario, the main additional cost is a roughly \$90,000 IQF unit. In years 2-8, other than ongoing maintenance the few of these costs that escalate each year are the need for ever more 5-gallon buckets and pallets. The costs of food-grade poly buckets is surprisingly high, so cost-savings here could be a significant contribution to hub feasibility. A 10% contingency cost on new capital costs is included per year.

Capital costs		
Lbs of berries per cubic foot stored	23	
Number of cubic feet cold storage needed		1667
Phased storage build- two phases (sq ft)		9280
Freezer storage per cubic feet (\$)	\$11.04	
Total cold storage cost (\$)		\$102,451.74
New facility electrical cost install per sq ft (\$)	\$49.87	
New facility electrical install cost (\$)		\$79,971.15
New facility price per sq ft (\$)	\$56	
New facility sq ft needed		1604
Cost of new facility		\$89,801.18
Equipment		
Mechanical destemmer cost (\$)		\$20,000
Two stainless steel inspection conveyors		\$7,600
Spray washing conveyor (six nozzle)		\$4,800
Shaker table		\$1,900
Bagging/boxing station		\$10,000
Whole package metal detector		\$3,500
Push-through lug washer		\$3,000
Pallets needed (#)		9
Plastic pallet (\$ per pallet)	\$30	
Plastic pallets total cost (\$)		\$265.88
5-gal buckets needed (#)		1524
5-gal bucket (\$ per bucket)	\$5.45	
5-gal buckets total cost (\$)		\$8,308
Refrigerated truck		\$35,000
Total capital costs		\$346,597.79
Contingency cost (10%)		\$34,659.78
Final total capital costs		\$381,257.57

Table 3: Capital costs of new elderberry processing hub in year one

Assumptions: Variable costs

Variable cost assumptions include berry purchase price, processing rate, energy prices and usage, labor, and taxes. These assumptions include:

- **Berry purchase price from growers:** \$2.50 per lb is used throughout the models. This figure is, of course, highly impactful on hub costs and subsequent profitability
- **Processing rate:** 500 lbs/hr.
- **Energy price:** A Minnesota average of \$0.1148 per kWh
- **Refrigerator power use per cu ft:** 0.43 kwh per day, or 15.625 kWh per year
- **Maintenance:** An average of 2% of initial plus new capital costs is included per year
- **Labor:** Labor costs were initially examined assuming two employees processing as many hours per year as needed given berry volume and processing rate, operating at 80% full efficiency, at \$20 per hour. Subsequently, leading elderberry growers provided estimated labor costs of \$.50 per lb of berries processed. This observed figure was used, though notably it resulted in significantly higher labor costs, about five times higher. No economies of scale in labor costs were assumed, which could account for savings as volume scales.

The table below summarizes variable costs in the simple straight-pack scenario in year one (2022), though the model includes annual variable costs through 2030.

Variable costs	Assumptions	
Berry costs		
Berry price	\$2.50	
Berries purchased (lbs)		38109
Total berry costs		\$95,273
Equipment costs		
Processing rate (lbs/hr)	500	
Processing days (12 hr runs, full efficiency)		6
Processing days (12 hr runs, 80% efficiency)		8
Maintenance costs (2%)		\$8,119
Energy price (\$/kWh)	\$0.1148	
Refrigerator power use per year per cu ft (kWh)	15.625	
Refrigerator power use per year total (kWh)		176763
Total refrigerator power cost per year		\$20,292.4
Labor		
Labor cost per hour	\$20	
Total labor hours (2 employees onsite, full efficiency)		152
Total labor hours (2 employees onsite, 80% efficiency)		191
Total labor cost (\$, full efficiency)		\$3,048.75
Total labor cost (\$, 80% efficiency)		\$3,810.94
Labor costs - \$/lb in above scenario		\$0.10
Labor costs- \$/lb average (from current producers)	\$0.50	
Labor costs- total		\$19,054.69
Payroll taxes	18%	
Total payroll taxes (\$)		\$3,429.84
Total variable costs		\$138,050.34

Table 4: Elderberry processing hub variable costs in year one

Assumptions: Revenue

Similar to berry purchase price from growers, bulk frozen berry sales price will be an important factor in hub profitability. In the base scenario, a bulk frozen berry price of \$3.50 per lb is used, which is near the upper end of the target pricing targeted by MEC leadership detailed previously in this report. This price is likely to fluctuate over time depending on supply and demand, which can be somewhat volatile in the early years of scaling new productions and markets.

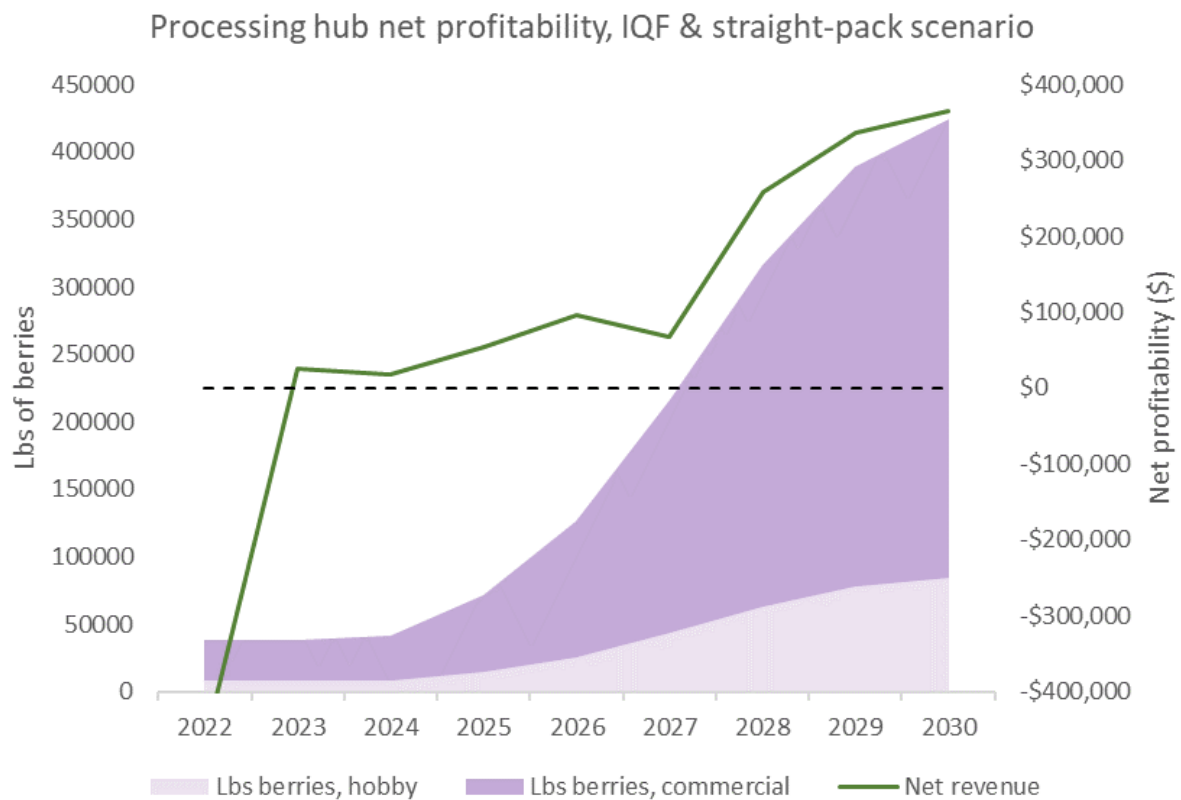
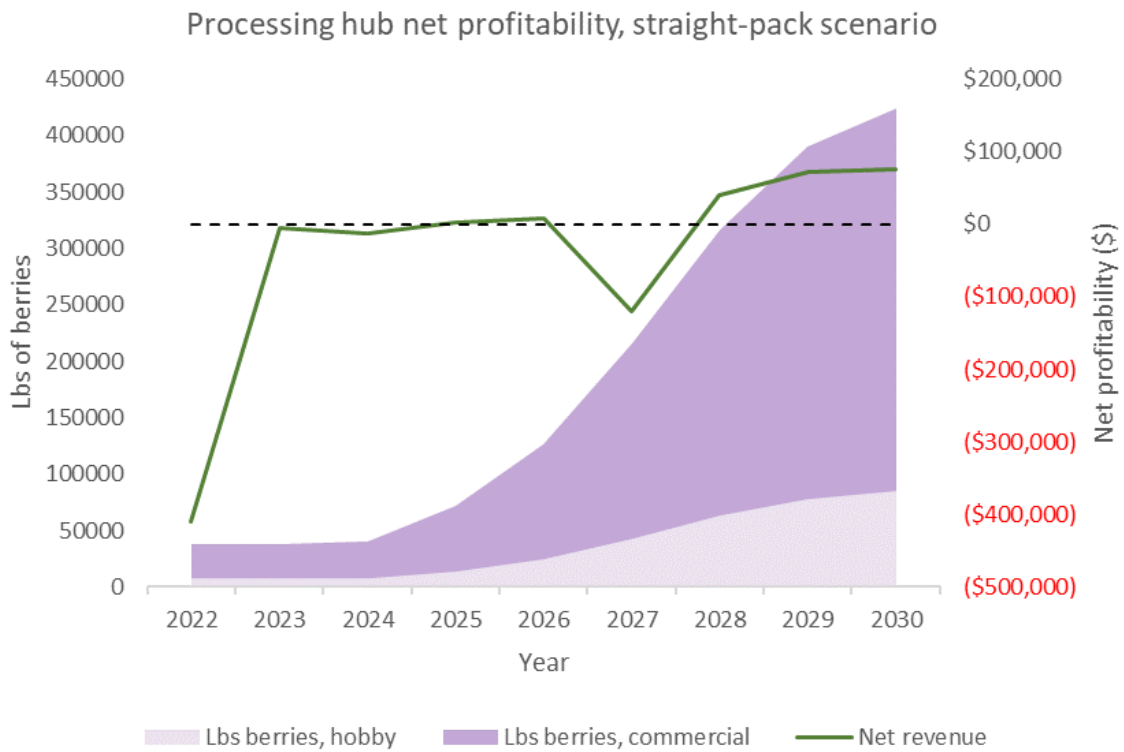
In the IQF scenario, first prices for straight-pack versus IQF berries were spot-checked in publicly-available price lists from major US berry wholesalers for several types of berries (black raspberries, red raspberries, and blackberries). This process found a premium for IQF relative to straight-pack berries ranging from 4-68%, a wide range. Further engagement with MEC leadership guided the decision to set a 25% premium for IQF berries. The base IQF scenario assumes 75% of all berries sold are IQF, and 25% are straight-packed. Again, these assumptions can be revisited at any time.

Elderberry processing hub: Costs and revenues through 2030, straight-pack vs. IQF and straight-pack scenarios

The following figures demonstrate projected capital and variable costs, gross revenue, and net profitability of an elderberry processing hub under the assumptions detailed above.

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030
Straight-pack									
Total costs	\$ 515,662	\$ 134,404	\$ 153,427	\$ 246,433	\$ 429,862	\$ 843,232	\$ 1,058,862	\$ 1,284,935	\$ 1,401,129
Capital costs	\$ 381,258	\$ -	\$ 10,142	\$ 7,648	\$ 23,559	\$ 142,586	\$ 48,374	\$ 48,023	\$ 56,963
Variable costs	\$ 134,404	\$ 134,404	\$ 143,284	\$ 238,785	\$ 406,303	\$ 700,646	\$ 1,010,489	\$ 1,236,912	\$ 1,344,165
Gross revenue	\$ 133,383	\$ 133,383	\$ 143,441	\$ 251,613	\$ 441,359	\$ 755,902	\$ 1,106,857	\$ 1,363,324	\$ 1,484,808
Net revenue	\$ (382,279)	\$ (1,021)	\$ (9,985)	\$ 5,180	\$ 11,497	\$ (87,329)	\$ 47,995	\$ 78,389	\$ 83,679
IQF and straight pack									
Total costs	\$ 624,475	\$ 132,977	\$ 152,000	\$ 245,006	\$ 428,435	\$ 830,718	\$ 1,056,009	\$ 1,282,081	\$ 1,398,275
Capital costs	\$ 491,498	\$ -	\$ 10,142	\$ 7,648	\$ 23,559	\$ 132,926	\$ 48,374	\$ 48,023	\$ 56,963
Variable costs	\$ 132,977	\$ 132,977	\$ 141,858	\$ 237,358	\$ 404,876	\$ 697,792	\$ 1,007,635	\$ 1,234,058	\$ 1,341,312
Gross revenue	\$ 158,392	\$ 158,392	\$ 170,337	\$ 298,791	\$ 524,114	\$ 897,634	\$ 1,314,392	\$ 1,618,947	\$ 1,763,209
Net revenue	\$ (466,083)	\$ 25,415	\$ 18,337	\$ 53,784	\$ 95,679	\$ 66,916	\$ 258,384	\$ 336,865	\$ 364,934

Table 5: Costs and revenues of two elderberry processing hub scenarios



Figures 5 and 6: Projected hub volume and net profitability in two scenarios, 2022-2030

Notably, under these assumptions a hub that focuses exclusively on straight-packed berries hovers at break-even for several years, and goes into the red again for the Phase II cold-storage build out. It only sees modest net revenue in the latter years of the 2020's. **Overall, a straight-pack scenario is unlikely to generate the revenue needed to carry or service debt, be insulated from market shocks and volatilities, conduct robust market development, or deliver profit to investors and owners.**

However, an IQF and straight-pack scenario shows net revenue staying in the black in year two and onward, including through facilities expansion. The IQF's higher capital costs are quickly recovered, and pay-off quickly in the processing hub's early years. Net profitability takes off more substantially in the second half of the decade as berry volume scales and the margins on value-added IQF berries accumulate. **In short, the processing hub model that combines IQF and straight-packed berries is significantly more profitable and viable in its early years compared to a straight pack-only scenario.** The figure below compares net profitability of these two scenarios directly.

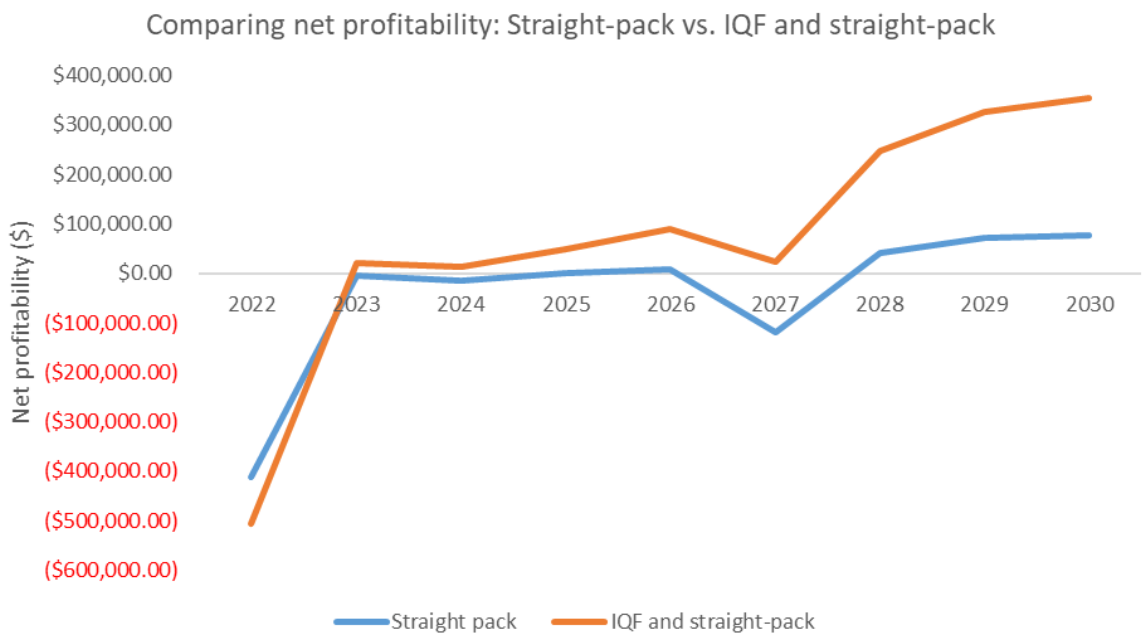


Figure 7: Comparing net revenue of straight-pack vs. IQF and straight-pack scenario

Preferred processing hub services

Beyond hub profitability, a processing hub either owned by or working in close partnership with MEC can offer important additional services. The survey requested growers to rank priority hub services. Results are summarized below. Priority hub services include a location less than two hours from their farm, cleaning and destemming, juicing, packing, dehydration, and storage.

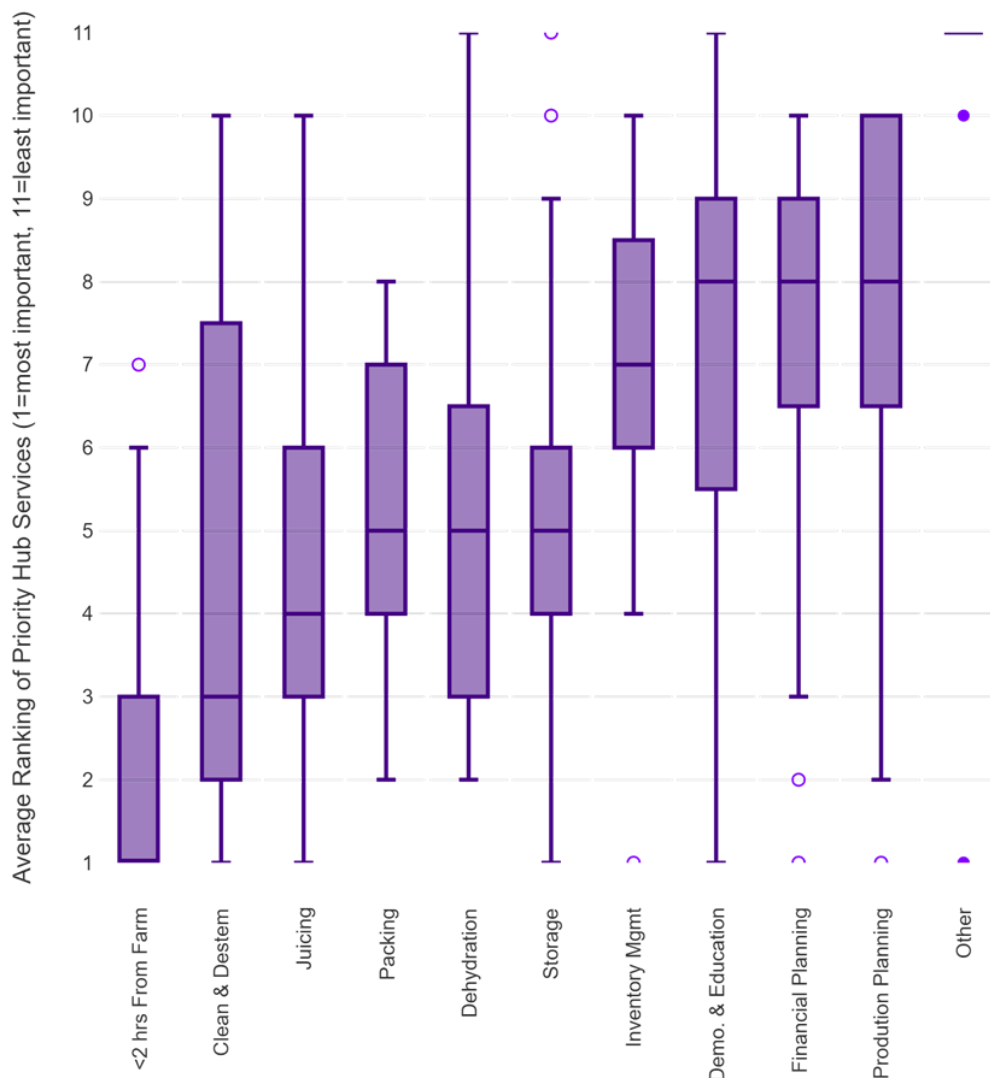


Figure 8: Priority processing hub services, ranked by grower survey respondents

Gaps of hub processing feasibility model, discussion

Prior to inferring conclusions from the model presented, a number of weaknesses warrant discussion. First, the profitability of hub operations in both scenarios are highly sensitive to berry purchase and sale prices, which remain somewhat unknown and volatile given limited robust market information and reliable supply. MEC leadership notes that direct-to-consumer berries and value-added products on a limited scale often see much higher prices and, conversely, target sale prices will still exceed imported berry prices. So whether the purchase and sale prices assumed in this model will be accepted by growers and buyers is an open question. Several critical areas that remain unexplored in the model include:

- **Transportation:** The hub model assumes acquisition of a refrigerated truck, but the staffing, frequency, and costs associated with any transportation routes are not currently included. Undoubtedly, this will increase variable costs for the hub.
- **Management:** Hub costs and revenues are treated as discrete from other areas of MEC's business, such as coop management, marketing, and order fulfillment
- **Regulatory, permitting:** Also not accounted for at this stage are permitting, food safety plan development, and other regulatory costs, which will add some up-front and ongoing expenses.

Allowing for these caveats, the study confirms several tenets of food processing enterprises: Value-added ingredients and products require more up-front investment but deliver important returns to the enterprise than greatly increase enterprise viability and profitability. **This modeling exercise suggests that IQF berries that see a premium in the market could be a valuable addition to an elderberry processing hub, and that such a hub could be profitable as early as year 2.** More importantly, this thought exercise has generated useful tools for ongoing planning by MEC and regional elderberry stakeholders to advance regional value-chain development that will be necessary to account for significant planned growth in regional production.

Project Conclusion: Challenges & Next Steps

Native elderberry's superior taste and greater nutrient diversity do not necessarily command a large premium at commercial scale (i.e. orders of 5 or more tons). The results of this study are fairly consistent across the board when it comes to defining the market challenges faced by commercial scale elderberry farmers and for the coop.

- Since imported IQF European elderberries are priced from \$3.00-3.60/lb. on the East Coast, Midwest berry prices delivered being turned into ingredients must range from \$2.50-3.50/lb. depending on the ingredient.
- MEC needs to pay \$2.00-2.50/lb. for delivered berries to provide for operations expenses and investment in infrastructure.
- MEC needs 25 cents/lb. from the production of 250 acres (4,000lb./acre) to provide \$250,000/yr. to pay for a few permanent staff, full and part-time, and office overhead.

MEC's goal remains to maximize grower income, so how that be achieved? We need to both reduce the cost of production and/or raise the sales price of the ingredient products. Reduction of labor costs for harvest, destemming, cleaning and packing is the obvious first target, which relates to better infrastructure and berry handling technology on larger farm operations and/or regional hubs. Nutritional quality documentation should provide support for a slight premium in native elderberry ingredient pricing.

MEC was recently awarded a Specialty Crop Grant for 2022-2024 from the Minnesota Dept. of Agriculture to make further progress on the goal of developing decentralized commercial hubs that deliver attractive returns to farmers for growing native elderberry. Estimated minimum infrastructure investment of \$500,000 per hub utilizing existing technologies, up to \$1.5 million for a larger hub producing more than one ingredient product format. Here are some of the areas to address:

1. **Ochlopecies** - A woody perennial, native elderberry presents itself in many different forms, which helps it to adapt to a variety of soil and climate conditions across a wide swath of North America. To select for more favorable traits, commercial growers propagate with hard and soft wood cuttings. Small scale farmers can be more flexible in how they grow and use elder flowers and berries. Some in the Northeast let elder grow around their farm as these plants would naturally in the wild, which is on approach to agroforestry.

Yields from established plants vary from 3,000-6,000lb./acre. Successful commercial scale production requires the upper end of that with cultivars that ripen evenly, are disease and pest resistant, while producing larger berries that release from the cyme stems completely without little stubs of stem. Cultivars that bear on first year growth are required for any extensive orchard. Nutrient distribution and density also varies by cultivar.

2. **Soil Health and Investment** - Members have roughly estimated that it costs \$.75-1.00/lb. annually to grow elderberries in an established orchard. This figure needs to be verified and its components identified in order to improve efficiency, lowering input costs, without sacrificing plant health and berry nutrition. Soil types vary as do farmer resources when it comes to sourcing the mulch and compost/manure required annually. These two factors significantly impact annual cost of inputs. Being perennials, it is also likely that over time native elder will improve soil health naturally, which should positively impact yield and quality.
3. **Harvest & Packing** - Estimated cost is \$.50-1.00/lb. to pick, destem, wash and pack the berries using existing mechanical assistance. The rate of focused processing runs from 300-500lb./hr. depending on the equipment and labor available. On most farms the grower is actively involved in the labor. Better, continuous flow equipment that can destem, wash and pack 2,000lb./hr. with the same labor inputs would make larger elderberry orchards feasible for family operations and deliver more revenue per acre at the market determined berry prices noted above.
4. **Regional Aggregation & Processing** - Each decentralized hub will cost at least \$500,000 depending on site particulars and ingredients made. Adequate frozen storage must be included in the facility. Picked berries could be transported in refrigerated trucks, following a staggered schedule to smooth intake, for up to two hours from the field to a hub with increased flow through processing capacity.
5. **Quality Parameters & Nutrient Verification** - Besides the standards of fully ripe dark color, BRIX and pH, annual benchmarking of that year's nutrient content provides competitive advantage to native berry sales. The current MDA Specialty Crop Grant provides funds for AURI to establish protocols that measure 8 critical nutrients desired by buyers as well as a process for determined best time to harvest.
6. **Contracts for Harvest** - Required in advance for growing elderberries on a commercial scale. This requires planning due to the perennial nature of elder so as to coordinate desired supply in volume with acres planted and account for the always variable weather patterns.

7. **MEC Sustainability as an Organization** - As noted above, MEC needs at least 250 acres of production dedicated to Class C Distribution Rights shares to support a modest staff and office overhead into the future. Furthermore, MEC's board directors and growers need training in cooperative culture so as to keep the balance between sharing in elderberry production and marketing and individual freedom of operation for each farm. Lastly, an updated platform for communication and information sharing from MEC and between growers should be developed, preferably by MEC leadership, to build out expertise and reduce the reliance on one or two individuals. The MEC website is a comprehensive source of information, but investment in updating the site and creating ways for growers to communicate with each through a central platform to accelerate connections and information sharing will reduce risk and foster network development and collaboration between members and growers. Survey respondents mentioned numerous times in different forms that they wish they knew the information they know now when they started. A few growers who were interviewed were very interested in learning about where other growers are located and finding ways to connect. The interview subjects also shared that they want newer growers to learn from their mistakes and reduce the risk and hardship of starting out in elderberry production. Many are ready and willing to share their knowledge and continue to be committed and engaged in developing an Upper Midwest Elderberry industry.

APPENDIX: Midwest Elderberry Coop 2021 Frozen Juice Trial

Arise Nutrition, LLC - Report to USDA

On October 15, 2021 Arise Nutrition (Wisconsin Rapids, WI) pressed 5,000 lb. of Kaeb Organics certified organic elderberries for MEC. (The Kaeb's donated \$1/lb. [\$5,000 value] off their normal berry price of \$5/lb. MEC bought several thousand lb. of berries at \$5/lb. that were resold to other buyers this year.) To reduce risk, MEC pre-sold 360 gal. packed 45 gal in eight 55 gal drums to member Carmel Berry Company at a reduced price of \$44/gal. to compensate for their risk and frozen freight costs to deliver the two pallets to CA, where they are located.

The Pressing

Colin Cureton of Forever Green Initiative attended the pressing on MEC's behalf. His report states:

- Berries were left to thaw on pallets, they got up to between 40-50 degrees before press. We thought they'd get to room temperature but stacking on top and near one another preserved cold temps longer. We ran two buckets, taking weight pre and post. We found **83% juice recovery**.
- A cold-press screw-press method was used, which is less efficient labor-wise but higher recovery-rate and best preserves product quality. The trial ran for the most part at the desired 28-30 PSI of pressure. At times pressure slipped down to 20 PSI, at times it ran up toward 40 PSI. The desired PSI is on the far low end of the pressure settings, so getting the press to hold steady at the desired rate required monitoring. Juice drained into a container that was pumped over to a larger drum that cools and circulates the juice. Pomace was bagged and boxed, headed to the onsite freezer for storage.

2021 Trial Production

BRIX 10, 9% solids, pH 4.8 (4.92 normally?)

Frozen Juice: 444 gallons: packed 55 gal. drums, 5 and 1 gal. jugs

Frozen Pomace: 825 lb. (30 lb. bags)

(A run of 15,000 lb. would yield an extra 10gal of juice / 5,000 lb.)

2021 Trial Expenses

5,000 lb. of org. berries @ \$4/lb. = \$20,000 + \$500 delivery

Arise pressing cost = \$2,000

ULINE 5gal boxes: \$85.21

Transaction fees: \$94.95

Warehouse fees: ? (not yet invoiced)

Total cost: \$22,680 [Freight excluded]

Trial Sales as of 1/20/22:

360 gal @ \$44/gal = \$15,840

12 gal @ \$45/gal = \$540

25 gal @ \$45/gal = \$1,125
15 gal @ \$50/gal = \$750
400 lb. @ \$.50/lb. = \$200
Total Revenues: \$18,455
Net Loss from Trial: (\$4,225) [Freight excluded]

Trial Conclusion

In comparing the juice recovery rates between what two members reported, the 83% recovery rate using Arise Nutrition's services is 20.6-29% more efficient. **The trial verified the feasibility of utilizing their services to source Wisconsin regional elderberries for juice production, at the right bulk commercial price.**

Breakeven Calculation @ \$30/gal is \$2.66/lb. for certified organic elderberries

Imported EU Not From Concentrate certified organic Elderberry Juice (pasteurized)

From a potential buyer currently importing 25,000 lb. of juice/year or about 3,000 gal.

2022 East Coast price is \$3.50/lb. of juice x 8.55 lb./gal. = \$29.93/gal.

[Note: Source could be wild collected elderberries. Not verified.]

Arise Pressing: 15,000 lb. yields 1,332 gal x \$30 = \$39,960/15,000lb. = **\$2.66/lb. Delivered**

Arise toll cost = \$6,000 less 2475 lb. pomace @ \$.50/lb. = \$1,237.50 offset

Net processing cost is \$4762.50/15,000 = \$.32/lb. + \$2.66 = \$2.98/lb.

[@15,000 lb., Bernie Lager III: 30 gal gain (444 gal/5,000 lb.) or 1,332 gal.]

Competitive Market Development

Delivered certified organic berries at \$2.66/lb. is breakeven at a \$30/gal. price. There is no margin for error, overhead or profit for the cooperative at this price structure. Berry prices must go down to match current imported prices. If higher quality for domestic production can be established (nutritional value, taste, other factors), then a modestly higher price could be achieved for higher volume sales of domestic frozen juice.

To create margin from the input side, MEC should pay \$2.00/lb. for sustainably grown berries and \$2.50/lb. for certified organic berries to use this toll processor. These are the prices originally discussed with MEC members and paid by River Hills Harvest (Terry Durham) for harvested clean native berries in 2014-2018 when commercial production was beginning. Current prices range from \$4-\$6/lb. in volume, and up to \$10/lb. for small quantities sold directly to consumers, demanded by many existing elderberry farmers. **This indicates that the current market is too high and expectations need to be lowered.**

Our goal remains to maximize grower income, so how can that be achieved? We need to both reduce the cost of production and raise the sales price of the ingredient products. Reduction of

labor costs for harvest, destemming, cleaning and packing is the obvious first target, which relates to better infrastructure and berry handling technology lasted on larger farm operations and/or regional hubs.

We need to also see **if the pomace could be sold for more money**, which would only be possible if it functions well as an unmodified ingredient for someone's formula - blended into chicken feed?

Market experience over the last few years indicates that **we should be able to sell 55 gal drums of bulk frozen native elderberry juice in modest pallet plus quantities for \$36/gal sustainably grown and \$38/gal for certified organic juice. Larger volumes would require discounting towards the \$30/gal. import price.** If MEC can document higher nutritive values and otherwise measure superior flavor or other desirable attributes imparting competitive advantage. **Smaller volumes (2 or 5 gal jugs) can be sold for \$45/gal., which could meaningfully improve annual margins for this ingredient product.**

Projected Margins @ \$36/\$38 /gal. = Berries: \$2.25/\$2.50 /lb.

Proposed Juice Press of 15,000 w/Arise Nutrition

15,000 lb. berries @ \$2.25/lb. delivered = **\$33,750** sustainably grown

15,000 lb. berries @ \$2.50/lb. delivered = **\$37,500** certified organic

Arise toll cost = \$6,000 less 2475 lb. pomace @ \$.50/lb. = \$1,237.50 offset or **\$4,762.50**

Sustainably grown: 1,332 gal x \$36 = \$47,952 - \$38,512.50 costs = **\$9,439.50 gross** (19.7%)

Certified organic: 1,332 gal x \$38 = \$50,616 - \$42,262.50 = **\$8,353.50 gross** (16.5%)

Implementation

MEC's beginning hypothesis of sourcing berries in WI for Arise, delivered by growers directly to the Arise freezer, works well and eliminates the need for extensive freezer infrastructure for them. Bernie would also like to see the bulk frozen elderberries packed differently, probably 40lb. cardboard boxes to make it easier to open, thaw, heat and press, which is possible with advanced sale to MEC dedicated to bulk frozen juice production.

A realistic goal to implement that program is 2-3 years from now with delivered berry prices of \$2.25/lb. sustainably grown and \$2.50/lb. for certified organic native elderberries to develop sustainable commercial market volumes for bulk frozen juice. Annual nutrient monitoring and other quality control required. **The margins for MEC are minimal but could contribute to administrative overhead costs significantly and thus support the addition of paid staff.**