

Costs of Local and Regional Retail Frozen Produce

Produce Freezing Costs at the WMFPC

Processing costs for frozen blueberries and spinach were estimated through observation at the freezing trials conducted at the Western Massachusetts Food Processing Center at the Franklin County Community Development Corp. in Greenfield, Massachusetts (WMFPC). Trials for freezing blueberries were conducted on the following dates: August 16 and 23 of 2019 and July 14, 2020. Trials for freezing spinach were conducted on January 3, 2020.

The primary focus in estimating costs of freezing during each trial was on the number of workers, time, and equipment needed for each of the tasks required to receive, process and pack the raw product. Imputed capital (building and equipment) and utilities costs were added, as well as the materials and supplies needed specific to the product produced (raw produce input, bags, labels, boxes, etc.). For both blueberries and spinach, the focus was on determining the costs of processing for retail-pack sales. In addition to the costs of processing at the WMFPC, estimates are developed that reflect the costs of a for-profit firm investing in the capital (building and equipment) available at the WMFPC.

A general discussion of the methods used to estimate costs associated with capital (building and equipment), materials, utilities, and labor are discussed in the sections that follow. The estimated costs per pound for blueberries and spinach are then presented. Costs differ for the two products in the equipment used and the labor costs associated with preparation, cleaning and packaging. Finally, the fixed, variable and total costs per pound for each of the two products are summarized and discussed.

This document may be used in conjunction with the Retail Frozen Produce Costs and Returns Calculator. Farmers and food entrepreneurs who are considering whether the market for retail frozen produce is a good fit for their business can manipulate the calculator by changing the WMFPC-specific configurations to estimate their own facility costs.

Capital Costs

The costs of capital items are generally determined as the sum of depreciation, interest, repairs and maintenance, taxes, and insurance (DIRTI).

Equipment

- **Depreciation** for the building and equipment used in processing blueberries and spinach was determined following a straight-line approach. For each capital item, the current value, useful life, and salvage value were used in estimating daily depreciation costs. Current values were taken from WMFPC records. Salvage values were determined by reviewing prices of various used items offered for sale online. Useful lives were based on experience at the WMFPC.

- **Interest** is either the interest paid on a loan or an opportunity cost for a capital item that was purchased outright (no loan). Interest rates on a small business loans were used for all capital items. The Small Business Association ([SBA](#)) lists several different rates, a number of those start with the prime rate, currently at 3.25% ([Wall Street Journal](#)). Larger loans, up to \$5.5 million, use Treasury Bill rates as the base. Most of the capital items used in freezing blueberries and spinach (equipment) have useful lives that suggest SBA 7(a) loan levels (see Table 1). Given the value of equipment at the WMFPC, an interest rate of 6% (prime rate plus 2.75%), the SBA 7(a) loan rate for loans over \$50,000 and over 7 years in duration, was used. Thus, a single loan for all equipment was assumed. If capital items were assumed to be purchased separately (spinner, tables, etc.), a rate as high as 8% could be used (prime rate plus 4.75%), the rate on loans for under 7 years and less than \$25,000. The rates in Table 1 are all recommendations by the SBA. Rates actually paid by borrowers will vary as each borrower negotiates with their chosen lender.
- **Repairs and maintenance** were determined from WMFPC records on monthly expenditures for repairs and maintenance of all building and equipment. We estimated an aggregate daily value for repairs and maintenance assuming 20 business days per month.

Building

- **Property Taxes** are not charged to a non-profit like the FCCDC/WMFPC. For-profit ventures, however, would be subject to property taxes. For example, taxes are charged by the Town of Greenfield (Massachusetts) against commercial and industrial buildings at the current tax rate (\$22.36 per \$1,000 of valuation in 2019). The Town of Greenfield charges a single tax rate for both residential and commercial real estate. Taxes are not charged against equipment.
- **Insurance** costs were determined based on the monthly payments by the WMFPC. An aggregate daily cost of insurance was estimated based on those monthly payments and assuming 20 business days per month. It was not possible to determine insurance payments on individual capital items.

Table 1. Small Business Association Loan Rates by Loan Type

Type of SBA Loan	Loan Amount	Repayment Term	SBA Loan Rate
SBA 7(a) Loan	Under \$25,000	Over 7 years	Prime rate + 4.75%
SBA 7(a) Loan	Between \$25,000 and \$50,000	Over 7 years	Prime rate + 3.75%
SBA 7(a) Loan	Over \$50,000	Over 7 years	Prime rate + 2.75%
SBA 7(a) Loan	Under \$25,000	Under 7 years	Prime rate + 4.25%
SBA 7(a) Loan	Between \$25,000 and \$50,000	Under 7 years	Prime rate + 3.25%
SBA 7(a) Loan	Over \$50,000	Under 7 years	Prime rate + 2.25%
SBA Express Loan	Up to \$350,000	Up to 7 years	Prime rate + 4.5% to 6.5%
SBA 504/CDC Loan (CDC portion)	Up to \$5.5 million	10 years	5-year Treasury rate + 2% to 4.322% in fees
SBA 504/CDC Loan (CDC portion)	Up to \$5.5 million	20 or 25 years	10-year Treasury rate + 2% to 4.322% in fees

SBA Microloan	Less than or equal to \$10,000	Up to 6 years	Cost of funds + 8.50%
SBA Microloan	Over \$10,000	Up to 6 years	Cost of funds + 7.75%

Source: <https://www.fundera.com/business-loans/guides/sba-loan-rates>

Various money rates can be found in the Wall Street Journal: <https://www.wsj.com/market-data/bonds/moneyrates>

The capital costs of freezing blueberries and spinach are estimated for one day of using the WMFPC based on rent charged for the WMFPC by the Franklin County Community Development Corporation. That rental value is to cover the cost of using the WMFPC and it is assumed that a full day of the building is required for freezing either blueberries or spinach. Interest reflects an opportunity cost for the assessed value of the WMFPC. Repairs and maintenance are those expenses reported for the WMFPC. Taxes are not charged as the WMFPC does not pay taxes. Insurance expenses are those reported for the WMFPC. Additional depreciation and opportunity costs are added for the equipment used for processing (freezing) the blueberries and spinach. Repairs and maintenance costs are assumed covered by the expenditures reported for the WMFPC. Daily costs of capital are calculated from annual costs using an average of 20 business days per month. Building costs for the WMFPC, including rent, maintenance and repairs, and insurance are \$184.83 per day (Table 2).

Table 2. Building costs at the WMFPC.

WMFPC Building	Value/Cost	Period	Daily Cost	Days per month
Rent to the Venture Center	\$1,666.67	Monthly	\$83.33	20
Facility maintenance/repair ¹	\$1,446.68	Monthly	\$72.33	20
Insurance ¹	\$583.33	Monthly	\$29.17	20
WMFPC Building Total	\$3,696.68	Monthly	\$184.83	20

¹ Based on WMFPC records.

A second set of capital cost estimates are developed assuming a *for-profit* firm secured a loan for the value of the WMFPC building and equipment. All five DIRT components discussed above are included in this estimate for the building and equipment used in freezing blueberries and spinach. Again, daily costs of capital are calculated assuming 20 business days per month.

An IQF (Individual Quick-Frozen) machine and liquid nitrogen are used in freezing the products. The IQF is a capital item as is the liquid nitrogen tank. At the WMFPC, the liquid nitrogen tank is rented from a company and that rental value is assumed to represent the appropriate DIRT costs associated with ownership. The rental costs for the liquid nitrogen tank may over-estimate the costs because the firm renting the tank likely includes some profit within the monthly rental rate.

DIRTI Capital Costs for Freezing at the WMFPC

The assessed value of the WMFPC is \$759,402 and a salvage value for the building is assumed to be \$200,000. (This may be conservative as no real estate appreciation is assumed.) Straight-line depreciation is determined based on a 30-year life. Interest is determined based on an annual interest

rate of 6 percent and the current assessed value of the building of \$759,402. Repairs and maintenance are based on WMFPC records and are identical to the costs assumed above in Table 2. While the WMFPC is a non-profit and not taxed, it is assumed a for-profit firm has purchased a building identical to the WMFPC. Thus, taxes are calculated based on the assessed value and the local property tax rate. Insurance is based on WMFPC records and is also identical to the value used above. The total costs for the building are allocated based on an average of 20 business days per month. The building is used throughout the year, so the daily rate is not based on only the number of days used for freezing fresh produce. Total daily costs to a private for-profit firm to own and use a building of equal assessed value are \$439.80 (Table 3).

Importantly, these two cost estimates represent the costs of using the WMFPC and its equipment (or an identical privately own facility) to freeze blueberries for one full day. These costs will be the same regardless of the amount of blueberries frozen. It is assumed that retail bags will be the final product and equipment is included for freezing blueberries and sealing them in plastic bags. Processing for wholesale would not require the “Check Weight Filler” or the “Band Sealer” equipment included above – a reduction in costs by more than \$20 per day. The label printer for printing bag labels would also not be required reducing the equipment costs slightly.

Table 3. Estimated freezing costs for a firm owning a facility like the WMFPC.

WMFPC Building	Value/Cost	Period	Daily Cost	Days per month	Salvage Value
WMFPC Value	\$ 759,402				\$200,000
Depreciation (straight-line, 30 years)	\$1,553.89	Monthly	\$77.69	20	
Interest ¹	\$3,797.01	Monthly	\$189.85	20	
Facility maintenance/repair ²	\$1,446.68	Monthly	\$72.33	20	
Taxes ³	\$1,415.02	Monthly	\$70.75	20	
Insurance ⁴	\$583.33	Monthly	\$29.17	20	
FPC Building Total	\$8,795.93	Monthly	\$439.80	20	

¹ Interest on the building is based on a 30 year mortgage at an interest rate of 6%.

² Building maintenance and repairs based on WMFPC records.

³ Taxes based on the WMFPC assessed value and the Greenfield, MA, 2019 tax rate of \$22.36 per \$1,000.

⁴ Insurance based on WMFPC records.

Utilities

Utility costs are based on data from the WMFPC on expenditures for utilities such as water, electricity, natural gas, water/sewer, laundry service, pest control and other necessary monthly expenditures. Rental costs for the liquid nitrogen tank are also included in utilities. While the tank could be a capital investment, the WMFPC chose a rental contract with the firm that provides liquid nitrogen. These inputs are necessary expenses for the WMFPC and are combined as a part of the fixed costs of processing. Daily costs for these utilities are calculated from the monthly expenditures for utilities and are based on 20 business days per month.

These costs are paid monthly and while they may vary based on the amount of produce frozen (e.g., water, sewer, electricity) the amounts of these utilities are not easily measured based on amount or type of product frozen. Thus, these expenses are based on WMFPC records and are used to estimate costs for one day using the facility to freeze blueberries. These are necessary overhead expenses, many

are unavoidable (e.g. Liquid nitrogen tank rental) due to contracts, implying they should be included in the fixed costs of freezing.

Table 4 shows the daily costs of utilities for freezing blueberries including rental of the liquid nitrogen tank rental, water/sewer, electricity, natural gas, and other necessary monthly expenses. Daily costs are based on 20 business days per month. Total utility costs are \$376.31 per day for freezing blueberries at the WMFPC. Energy (gas and electricity) represent over 46 percent of utility expenses for freezing. Rental of the liquid nitrogen tank adds an additional 15 percent of a day’s utility expenses. We use the same daily cost estimates for spinach.

Table 4. Estimated daily utility costs for freezing at the WMFPC.

Utilities	Cost per month	Days per month	Daily cost
Liquid nitrogen tank - Rental	\$1,134.00	20	\$56.70
Water/sewer	\$500.00	20	\$25.00
Electric	\$2,583.33	20	\$129.17
Gas (heat and hot water)	\$916.67	20	\$45.83
Trash removal	\$750.00	20	\$37.50
Cleaning supplies	\$583.33	20	\$29.17
Other supplies	\$422.24	20	\$21.11
Laundry service	\$416.67	20	\$20.83
Pest control	\$220.00	20	\$11.00
Utilities total	\$7,526.24		\$376.31

Processing Costs

Supplies - Materials and Ingredients

This category of costs are variable and depend upon the amount of product that is processed. These costs include the raw vegetable or fruit to be processed and supplies or materials needed to freeze the raw product, including food safety supplies like hair nets, masks, and gloves and packaging supplies like bags, boxes and labels. Liquid nitrogen used to freeze the product can be measured after each day of processing and can be easily assigned to the product. Liquid nitrogen used per pound of product processed is calculated and included in the supplies for processing. We estimated that the liquid nitrogen costs are approximately \$0.132 per pound of processed product based on tank measurements before and after freezing products. This estimate reflects liquid nitrogen “start-up” costs of cooling the IQF; greater amounts of product frozen during a run will reduce the cost per pound.

Labor

Labor costs are straightforward – they are the aggregate of payments to staff that worked to freeze the blueberries and spinach. The time worked for each individual multiplied by their wage is aggregated. Additional labor costs are charged for management and administration.

The WMFPC processing methods may differ from other processing methods. To allow other individuals or firms to compare their costs of freezing, time spent on each task in the WMFPC process was collected by observation for each worker. The time-tracking tools used during observation are shown in Figures 1

and 2. The time-tracking tools show the same basic processes with a few additional steps for spinach processing, as spinach requires the additional steps of blanching, cooling, and forming into patties. Initial trials with spinach showed that placing the blanched and cooled spinach on the IQF belt resulted in low yields, less than 50 percent, and much longer cleaning time for the IQF after processing. The decision was made to create spinach patties that were placed on the IQF belt increasing yield by 25 percent (to 75 percent) and reducing cleaning time for the IQF following freezing.

Figure 1. Time-Tracking Tool for Labor Required to Freeze Blueberries

Task	Staff Person	Start	End	Total Time (minutes)	Notes
Receive product					
Weigh product					
Pre-production set up/sanitation					
Box set up					
Bag labeling					
Wash/rinse/sanitize					
Spin					
IQF Input					
Bag, seal, box					
Clean-up (general)					
Final cleanup					
Other					
Total					

Figure 2. Time-Tracking Tool for Labor Required to Freeze Spinach

Task	Staff Person	Start	End	Total Time (minutes)	Notes
Receive product					
Weigh product					
Pre-production set up/sanitation					
Box set up					
Bag labeling					
Wash/rinse/sanitize					
Clean spinach in sanitizing solution					
Blanch, spin, cool					
Patty-making					
IQF Input					
Bag, seal, box					
Clean-up					
Final Clean-up					

Cost Estimates for Blueberries

Capital Costs

Estimated capital costs for one day of freezing blueberries at the WMFPC are shown in Table 5. Equipment costs are based on depreciation, opportunity costs (assuming an investment of the asset values shown), and repairs and maintenance. Taxes and insurance are not charged on specific equipment items. Annual depreciation costs are converted to a daily value using the estimated number of days equipment is used in a typical year. The IQF and associated equipment are used 52 days in a typical year.

Opportunity costs are calculated using an annual interest rate of 6 percent. We allocate the annual opportunity costs assuming 20 business days per month. Monthly repairs and maintenance based on WMFPC records are also allocated assuming 20 business days per month. Total equipment costs for a day of freezing blueberries at the WMFPC are estimated to be \$177.27.

Table 5. Estimated daily capital costs for freezing blueberries at the WMFPC.						
Equipment	Value/ Cost	Number Used	Daily Depreciation (straight-line)	Salvage Value	Asset Life (years)	Days per year
IQF	\$20,000.00	1	\$9.62	\$10,000	20	52
IQF dual pack table & scales	\$5,870.00	1	\$16.13	\$0	7	52
Check weight filler	\$9,457.00	1	\$19.07	\$4,500	5	52
Electric pallet jack	\$2,200.00	1	\$3.85	\$1,200	5	52
Band sealer	\$1,602.00	1	\$4.24	\$500	5	52
Prep table	\$700.00	3	\$2.69	\$0	15	52
Utility cart	\$129.00	2	\$0.65	\$0	2	52
Brute	\$35.00	6	\$2.48	\$0	2	52
Spinner centrifuge	\$2,330.07	1	\$3.19	\$1,500	5	52
Basket for spinner	\$260.37	1	\$2.50	\$0	2	52
Dunk tank	\$5,300.00	1	\$3.59	\$2,500	15	52
Baskets for dunk tank	\$310.00	4	\$4.77	\$0	5	52
Label printer 1	\$400.00	1	\$2.40	\$150	2	52
Label printer 2	\$150.00	1	\$0.38	\$50	5	52
Total Equipment and Depreciation¹	\$51,377.44		\$76.93			
Total Equipment Interest/Opp. Cost²	\$256.89	Monthly	\$12.84			
Equipment Maintenance/repair³	\$1,750.00	Monthly	\$87.50			
Equipment total			\$177.27			
WMFPC Building	Value/Cost	Period	Daily Cost	Days per month		
Rent to the Venture Center	\$1,666.67	Monthly	\$83.33	20		
Facility maintenance/repair ³	\$1,446.68	Monthly	\$72.33	20		
Insurance ³	\$583.33	Monthly	\$29.17	20		

WMFPC Building Total	\$3,696.68	Monthly	\$184.83	20
Total WMFPC Daily Capital Costs			\$362.10	
¹ Weighted sum of all equipment values and straight-line depreciation where weights are the number of items. ² Opportunity costs based on a 6% rate of return. ³ Maintenance and repair and Insurance are based on WMFPC records.				

The equipment must be housed somewhere and those costs must be included. The WMFPC pays monthly rent to the Venture Center. Rather than depreciation and interest costs, the rent paid (\$1,666.67 per month) is included. Insurance costs are also added as well as repairs and maintenance to the building based on the WMFPC records. As a non-profit, the WMFPC does not pay taxes. As shown in Table 2, total WMFPC building costs are \$3,696.68 per month, or \$184.83 per day. Adding building costs and equipment costs, the total costs charged by the WMFPC for a day of freezing fresh produce is \$362.10. This represents the costs to the WMFPC for one day of freezing blueberries at their facility.

Supplies – Materials and Ingredients

The costs of supplies and ingredients depend upon the type and amount of blueberries that is frozen and are truly variable costs. Supplies and ingredient costs, including the raw blueberries, are calculated from the quantity used and per unit costs of supplies used. In addition to the raw fruit, inputs such as bags, boxes, hair nets, labels, sanitizing products, and other materials required to freeze the raw fruit are included. Liquid nitrogen is included in material cost; the tank used to store the liquid nitrogen is included under capital costs. To determine the amount and costs of liquid nitrogen, tank measurements were used to calculate the volume. The price per gallon of liquid nitrogen was used to estimate the costs and a cost per pound of blueberries frozen was determined. The cost of liquid nitrogen per pound of blueberries frozen can be used to estimate liquid nitrogen costs for alternative levels of production. Greater amounts of blueberries produced would result in lower per pound costs because of the liquid nitrogen required to cool the IQF before starting to process blueberries.

For the trial used in these estimates, 508 pounds of blueberries were frozen and packaged in 12-ounce plastic retail bags. Bags were packed in boxes (12 bags per box) for storage. Liquid nitrogen cost was 13.2 cents per pound frozen. The costs of supplies and ingredients are shown in Table 6. The cost of the raw blueberries dominates these costs representing over 93 percent of total supplies and ingredient costs.

Table 6. Supplies and ingredients for freezing blueberries at the WMFPC.¹

Supplies	Prices	Units	Number	Cost
Bags	\$0.06	Ea.	672	\$40.32
Boxes for bags	\$0.47	Ea.	56	\$26.32
Labels	\$0.01	Ea.	728	\$7.28
Hairnets	\$0.03	Ea.	8	\$0.24
Beard Nets	\$0.02	Ea.	5	\$0.10
Gloves	\$0.12	Ea.	16	\$1.92
Heavy duty edge protectors	\$3.40	Ea.	4	\$13.60
Supplies total				\$89.78
Ingredients				
Blueberries	\$2.30		508.4	\$1,169.32

Liquid Nitrogen	\$0.132	\$/processed lb.	508.4	\$67.11
Sanidate	\$7.06			\$7.06
Ingredients Total				\$1,243.49
Supplies and Ingredients Total				\$1,333.27

¹ These estimates are for freezing 508 pounds of blueberries.

Labor

The labor required differs depending upon the process followed to freeze the raw product and the amount of raw product delivered for freezing. Labor inputs for each part of the WMFPC process for freezing blueberries are shown in Table 7. The labor costs shown below are for packaging a total of 508 pounds of blueberries in 12-ounce plastic retail bags. The costs cover all labor required, from receipt of the raw product to final clean-up at the end of the day. Developing a cost per pound of final product (or a cost per 12-ounce bag) depends also on the yield, the final product weight divided by the raw product weight. The yield for freezing blueberries was very high at 99 percent.

Data on labor input by task were gathered by observation. A team of observers was used recorded start and end times for each task by individual. To ensure coverage, team member assignments overlapped so that each of the worker's times were recorded by at least two team members. The amount of time individuals spent working on each task was determined; starting and stopping times were recorded and the difference calculated. Times on task were then aggregated to determine total labor required to process the raw blueberries. While individuals earned different wages due to experience, an average wage rate of \$17.23/hour was used in calculating the labor costs for each task and the total labor costs. Fringe benefits assumed to be 40 percent of wages are included bringing total labor costs to \$611.09 for the day (freezing 508 pounds of blueberries).

The greatest amount of labor for freezing blueberries was for packaging into the plastic retail bags. The task required weighing the frozen product into the bags, sealing the bags, and packing them into boxes. For blueberries, a "Vibratory filler" machine was used to speed the process. The time required for packaging also affected the IQF time because the blueberries could not be left sitting very long before packaging. The packaged blueberries were immediately boxed and placed in a freezer. Total time and costs for the IQF and packaging portions of the process represented about 45 percent of all labor. General clean-up throughout the process and the final clean-up represented about 19 percent of all labor input.

Table 7. Labor input and costs for freezing blueberries at the WMFPC.

Task	Number of Employees	Labor (Hours)	Labor Cost (\$) ¹	Percent of Labor
Receive and Weight product	1	0.17	\$ 2.87	0.66
Pre-production set up/sanitation	4	4.08	\$ 70.36	16.12
Box set up	2	1.08	\$ 18.67	4.28
Bag labeling	2	1.83	\$ 31.59	7.24
Wash/rinse/sanitize (dunk tank)	2	1.33	\$ 22.97	5.26
Spin	1	0.67	\$ 11.49	2.63
IQF Input	1	2.83	\$ 48.82	11.18

Bag, seal, box	3	8.50	\$ 146.46	33.55
Clean-up (general)	4	1.17	\$ 20.10	4.61
Final cleanup	4	3.67	\$ 63.18	14.47
Total for all tasks	5	25.42	\$ 436.39	
Fringe Benefits (40% of wage)			\$ 174.60	
Total Labor Costs	5	27.58	\$ 611.09	

¹ An average wage rate of \$17.23/hour was assumed.

Additional administrative labor costs are also added (Table 8). These costs represent administrative and management costs for the FCCDC and WMFPC and fringe benefits for those staff. This labor provides a wide range of services, like business development (contacts and contracts with buyers and sellers), financial management, and directing the WMFPC operations. These are costs specific to the WMFPC. While a for-profit firm would also have administrative costs, they may be very different and there may be cost savings in freezing blueberries. Combining the administrative labor costs (\$537.60) and production labor costs (\$611.09) at the WMFPC results in a total labor bill of \$1,148.69 for processing 508 pounds of blueberries in one day at the WMFPC.

Table 8. Administrative daily labor costs for the WMFPC.

Position	Wage (\$/hour)	Hours	Labor Cost (\$)
Administrative Support	\$40.00	1	\$ 40.00
Bookkeeper	\$40.00	0.5	\$ 20.00
Executive Director	\$40.00	2	\$ 80.00
Operations Director/Floor Manager	\$31.00	4	\$ 124.00
Food Business Coordinator	\$30.00	4	\$ 120.00
			\$ 384.00
Fringe Benefits (40% of wages)			\$ 153.60
Total Administrative Labor Costs			\$ 537.60

Summary – Blueberry Freezing Costs

Table 9 combines the freezing costs for fresh blueberries. The costs are for one day of processing the fresh blueberries into 12-ounce plastic bags (retail-pack) and one day's use of the WMFPC. Capital costs include all equipment, utilities, supplies, and labor used to receive the product, prepare for freezing, freezing, packaging and cold storage of the bags in boxes. Also included are labor for clean-up and administration of the WMFPC. The greatest cost of frozen blueberries are the supplies and ingredients, and this cost is primarily the fresh blueberries. The price paid for fresh blueberries for this research trial was \$2.30 per pound; substantial cost savings could be obtained with lower prices, perhaps for a grower using the WMFPC to freeze their blueberries. Production labor adds about \$1.20 per pound to the costs of freezing blueberries and administrative labor adds \$1.06 per pound. Total costs per pound are estimated to be \$6.32 at the WMFPC and costs per 12-ounce retail bag are estimated to be \$4.79.

These costs reflect charges by the WMFPC for the building that are paid to the Franklin County Community Development Corporation. Costs would differ if a for-profit firm were to charge the full costs of depreciation, interest, and taxes. The daily costs for a building of equal assessed value to the

WMFPC would increase to \$439.80 per day (see Table 3) from the \$184.83 shown in Tables 2 and 8. The freezing costs for blueberries would increase to \$6.84 per pound and \$5.17 per 12-ounce bag of blueberries.

Table 8. Summary of blueberry freezing costs.¹

Cost category	Total Costs per Day	Cost per Pound	Cost per Bag
Equipment	\$ 177.27	\$ 0.35	\$ 0.26
Buildings	\$ 184.83	\$ 0.36	\$ 0.28
Utilities	\$ 376.31	\$ 0.74	\$ 0.56
Administrative Labor	\$ 537.60	\$ 1.06	\$ 0.80
Supplies and Ingredients	\$ 1,333.27	\$ 2.62	\$ 1.98
Production Labor	\$ 611.09	\$ 1.20	\$ 0.91
Total Costs	\$ 3,220.38	\$ 6.33	\$ 4.79

¹ Freezing 508.4 pounds of blueberries, packaged in 12-ounce plastic bags, and one day's use of the WMFPC.

DRAFT

Cost Estimates for Spinach

Capital Costs

Capital costs for freezing spinach at the WMFPC are very similar to the capital costs for freezing blueberries. There is one important difference; the nature of the vegetable makes it impossible to use the WMFPC “Vibratory Filler” machinery to fill retail bags with the spinach. Spinach also requires blanching to prior to chilling using the dunk tank and freezing. Equipment costs for freezing spinach are shown in Table 9. The daily cost for equipment needed to freeze spinach is less than the costs for

Table 9. Estimated daily capital costs for freezing blueberries at the WMFPC.

Equipment	Value/Cost	Number Used	Daily Depreciation (straight-line)	Salvage Value	Asset Life (years)	Days per year
IQF	\$20,000.00	1	\$9.62	\$10,000	20	52
IQF dual pack table & scales	\$5,870.00	1	\$16.13	\$0	7	52
Electric pallet jack	\$2,200.00	1	\$3.85	\$1,200	5	52
Band sealer	\$1,602.00	1	\$4.24	\$500	5	52
Prep table	\$700.00	3	\$2.69	\$0	15	52
Utility cart	\$129.00	2	\$0.65	\$0	2	52
Brute	\$35.00	6	\$2.48	\$0	2	52
Spinner centrifuge	\$2,330.07	1	\$3.19	\$1,500	5	52
Basket for spinner	\$260.37	1	\$2.50	\$0	2	52
Dunk tank	\$5,300.00	1	\$3.59	\$2,500	15	52
Baskets for dunk tank	\$310.00	4	\$4.77	\$0	5	52
Label printer 1	\$400.00	1	\$2.40	\$150	2	52
Label printer 2	\$150.00	1	\$0.38	\$50	5	52
Total Equipment and Depreciation¹	\$41,920.44		\$57.86			
Total Equipment Interest/Opp. Cost²	\$209.60	Monthly	\$10.48			
Equipment Maintenance/repair³	\$1,750.00	Monthly	\$87.50			
Equipment total			\$155.84			
WMFPC Building	Value/Cost	Period	Daily Cost	Days per month		
Rent to the Venture Center	\$1,666.67	Monthly	\$ 83.33	20		
Facility maintenance/repair ³	\$1,446.68	Monthly	\$ 72.33	20		
Insurance ³	\$583.33	Monthly	\$ 29.17	20		
WMFPC Building Total	\$3,696.68	Monthly	\$184.83	20		
Total WMFPC Daily Capital Costs			\$340.67			

¹ Weighted sum of all equipment values and straight-line depreciation where weights are the number of items.

² Opportunity costs based on a 6% rate of return.

³ Maintenance and repair and Insurance are based on WMFPC records.

blueberries because the check-weight filler was not used. But, the need to hand pack the retail bags of spinach results in higher labor costs as will be shown below.

Building costs for the WMFPC based on rent paid are the same as the costs for blueberries; they are presented in Table 9 for convenience. The building costs faced by a for-profit firm are also identical to the costs for blueberries (see Table 3). Daily building costs for a for-profit firm were estimated to be \$439.80 based on depreciation, interests, repairs, taxes and insurance costs. These costs are again used as the daily building costs incurred by a for-profit firm freezing spinach in a building equivalent in assessed value to the WMFPC.

Supplies – Materials and Ingredients

The supply costs for freezing spinach at the WMFP Care shown in Table 10. Supplies include the raw ingredient, fresh spinach, and the materials needed to freeze and package the spinach. Bags (16-ounce plastic bags) and boxes are required for packaging and cold storage. In this research trial, 500 pounds of spinach was processed. The yield was 75%, thus 375 one-pound bags were required for the frozen product. Liquid nitrogen used is included as it varies with the amount of spinach frozen. For this trial, the total liquid nitrogen costs of \$66.00 are based on the estimated cost per pound frozen of 13.2 cents. The largest item in this category of costs is the raw product, fresh spinach. The spinach that was processed in this trial cost \$3.40 per pound for a total of \$1,700 for the 500 pounds processed. This category of costs is dominated by the cost of the raw product, fresh spinach, as was true for blueberries.

Labor

Labor costs for freezing spinach are shown in Table 11. The same process used in determining labor costs for freezing blueberries was followed to determine labor costs for freezing spinach. These labor costs are for the processing (freezing and packaging) of 500 pounds of raw spinach. The spinach was blanched, chilled, spun, then formed into patties (about the size of a hockey puck). The spinach patties

Table 10. Costs of materials/supplies and ingredients for freezing spinach.

Materials/Supplies	Price (\$ each)	Number	Cost
Bags	\$ 0.06	375	\$ 22.50
Boxes for bags	\$ 0.47	32	\$ 15.04
Labels	\$ 0.01	407	\$ 4.07
Hairnets	\$ 0.03	8	\$ 0.24
Beard Nets	\$ 0.02	5	\$ 0.10
Gloves	\$ 0.12	16	\$ 1.92
Heavy duty edge protectors	\$ 3.40	4	\$ 13.60
Materials/supplies total			\$ 57.47
Ingredients	Price	Amount	Cost
Fresh Spinach	\$ 3.40 / lb.	500 pounds	\$1,700.00
Liquid Nitrogen	\$ 0.132	\$/lb. frozen	\$ 66.00
Sanitizing liquid	\$ 2.28	Total	\$ 2.28
Ingredients Total			\$1,768.28
Total materials/supplies and ingredients			\$1,825.75

were then frozen and hand packaged in retail bags (16 ounces each). The tasks of patty-making and packaging (bag, seal, box) represent 43 percent of the labor input. The patty-making, a time-consuming process, was in response to poor yields (less than 50 percent) when trying to freeze loose spinach and the time required to clean the IQF after freezing. Small bits of loose spinach were embedded in the IQF belt requiring a lot of tedious labor to clean the belt. The patties created much less mess in the IQF and also led to smooth and rapid IQF input. Freezing the patties resulted in substantial improvements in both yield and cleaning time, but did add labor for forming the patties. Patty making and packaging represent 43 percent of total labor. Clean-up throughout the process and final clean-up represented about 20 percent of labor, not substantially different from the clean-up for freezing blueberries but total labor for spinach is higher.

The same administrative labor cost apply to freezing spinach. Administrative labor was discussed above and presented in Table 7. Administrative labor adds \$537.60 to the spinach freezing costs for use of the WMFPC for one day. Combining administrative and production labor brings the total labor bill to \$1,603.39 for one day of freezing spinach at the WMFPC.

Table 11. Labor input and cost for freezing spinach.

Task	Number of Employees	Total Labor (hours)	Labor Cost (\$) ¹	Percentage of Labor
Receive product	1	0.25	\$ 4.31	0.6%
Weigh product	3	2.00	\$ 34.46	4.5%
Pre-production set up/sanitation	4	2.67	\$ 45.95	6.0%
Box set up	1	0.12	\$ 2.01	0.3%
Bag labeling	1	0.50	\$ 8.62	1.1%
Wash/rinse/sanitize brutes	3	0.83	\$ 14.36	1.9%
Clean spinach in Sandidate	5	3.83	\$ 66.05	8.7%
Blanch, spin, cool	2	3.83	\$ 66.05	8.7%
Patty-making	5	10.48	\$ 180.63	23.7%
IQF Input	1	2.50	\$ 43.08	5.7%
Bag, seal, box	4	8.50	\$ 146.46	19.2%
Clean-up	3	3.67	\$ 63.18	8.3%
Final clean-up	5	5.00	\$ 86.15	11.3%
			\$ 761.28	
Fringe Benefits (40% of wages)			\$ 304.51	
Total Production Labor Costs	7	44.18	\$ 1,065.79	

¹ A wage rate of \$17.23/hour is assumed.

Summary – Spinach Freezing Costs

Table 12 presents a summary of the costs of processing (freezing) 500 pounds of raw spinach at the WMFPC for one day. The yield for freezing spinach was 75 percent; the costs per pound represent the costs for 375 pounds of final product, frozen spinach in 16-ounce plastic bags for retail sale. The final cost per pound (or bag) was \$11.06 and these are only the processing costs. Retail sales at any outlet would imply an additional markup. Notable is the very high expense for supplies and ingredients at \$4.87 per pound. This is primarily the cost of the fresh spinach – at \$3.40 per pound and a yield of 75

percent, the effect of cost of the spinach is \$4.53 per pound of final product. Supplies and ingredients represent 44 percent of the costs of the final product. Making patties was deemed necessary due to the amount of loss in freezing that reduced the yield to 50 percent in a prior trial. But, making patties was also time consuming, one reason for the high cost of production labor of \$2.84 per pound. Cost for the other inputs (equipment, building and utilities) were higher than blueberries due to the yield differences. For freezing fresh spinach, lower fresh prices and yield control while reducing production labor input will be necessary for a viable product.

The WMFPC is a non-profit institution. If a for-profit firm were to invest in the same facility, the costs would be greater due to depreciation, interest, and taxes on the facility. Rather than building costs of \$184.83 per day, the for-profit firm daily building costs are estimated to be \$439.80 per day. The building cost per pound of final product increases from \$0.49 per pound to \$1.17 per pound. Total freezing costs for the final 375 bags (16-ounce bags) of frozen spinach rise to \$11.74.

Table 12. Summary of Spinach freezing costs.¹

Cost category	Total Costs per Day	Cost per Pound²
Equipment	\$ 155.84	\$ 0.42
Buildings	\$ 184.83	\$ 0.49
Utilities	\$ 376.31	\$ 1.00
Administrative Labor	\$ 537.60	\$ 1.43
Supplies and Ingredients	\$ 1,825.75	\$ 4.87
Production Labor	\$ 1,065.79	\$ 2.84
Total Costs	\$ 4,146.13	\$ 11.06

¹ Freezing 500 pounds of fresh spinach in 16 ounce plastic bags, and one day's use of the WMFPC.

² The yield was 75% - 500 pounds of fresh spinach yielded 375 bags (16 ounces) of frozen spinach.