The University of Georgia

Center for Agribusiness and Economic Development

College of Agricultural and Environmental Sciences

The Feasibility of Operating an Individual Quick Freeze Vegetable Processing Facility in Decatur County, Georgia

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Purpose

This study examines the economic feasibility of operating an Individual Quick Freeze (IQF) line in Decatur County, Georgia. This freeze line will assist vegetable producers in retaining some of the farm-to-retail price spread and create a market for their #2 (cull) vegetables. The fresh market can become more competitive during certain times of the year and fewer vegetables produced in the area will be marketable. In order for producers to send higher quality vegetables to market, they have to be discriminating about what is selected during harvest. This process leaves a great deal of profit potential in the field to rot. An alternative market would allow the producer to be discriminating and retain some of the value of the remaining vegetables in the field. This will greatly benefit bottom line profitability for the vegetable producer. An IQF line would assist in solving this quality problem. Producers could receive a premium by being highly selective and still market the culls. Producers may be able to expand acreage and/or cultivation practices to fully satisfy the fresh market, while also satisfying the frozen market.

This study examines the relevant economic issues surrounding IQF vegetables including bell peppers, carrots, English peas, lima beans, snap beans, southern peas, sweet corn, yellow squash, and zucchini. The economic analysis includes the cost of operating an IQF line along with the current market prices for various vegetables.

Individual Quick Freeze Vegetable Market

According to a Food Institute Report (2000), the frozen vegetable market is a $1.599 billion industry with mixed vegetables accounting for one third of the segment ($520 million). The frozen vegetable industry has struggled of late (1999-2000) with negative growth in sales and volume. However, these numbers may not truly reflect the industry, as meal-starter frozen vegetables are included in frozen vegetable data. If meal-starter vegetable products are excluded, the frozen vegetable market grew in the year 2000.

The United States Department of Agriculture's cold storage report indicates a storage decline on most vegetables. A major reason for this is the surge in fresh produce consumption. There has been a 26% increase in per capita fresh produce consumption since 1973. Vegetables are being packaged and sold at a quicker pace, requiring less

long-term storage. One can estimate from this study that either demand is stronger than in the past or supplies are lower. Either scenario is positive for starting a quick-freeze operation.

With the recent decline in cold storage, the amount stored is significantly higher in the spring with gradual reductions occurring by fall. This appears to emulate the production season of many of the frozen crops.

There are four primary markets for frozen vegetables: retail, food service, processed foods, and home meal replacement. The retail market generally purchases vegetables from brokers or contracts with independently owned and operated farms. Getting into this retail market takes consistency in quantity and quality. This may be one of the more difficult markets for the Decatur County group to enter without the use of a broker. Kroger, Publix, and other large supermarkets need to be assured of quality, quantity, and on-time delivery. These big firms cannot operate efficiently if weather, disease, or insects affect delivery of merchandise. An IQF plant relying on production from a relatively small area runs a higher risk of encountering such problems. Being centrally located in Decatur, or even the surrounding area, may place risk on these big firms. Brokers exist throughout the food chain with numerous contacts to alleviate the spread of these risks.

The food service market (hotels, hospitals, schools, and prisons) purchases large quantities of vegetables from assorted buyers. The state of Georgia is currently pushing a project to purchase more of the foods consumed in the schools and jails from Georgia producers. This may be a more feasible opportunity for the Decatur County group.

A third market of significance is the use of vegetables as an ingredient in processed foods. This is especially true of onions, peppers, and other vegetables used in relishes, sauces, and dressings. Numerous brokers have commented on the need for frozen bell peppers.

A fourth market for IQF vegetables is in the increasingly popular “Home Meal Replacement” category. As the number of dual income households rises, Americans find less time to prepare traditional home-cooked meals. Takeout meals are on the rise. Increasingly chefs and restauranteurs are preparing complete carry-home meals for consumers.

Frozen vegetable supermarket sales have increased steadily over the past six years. A major factor has been the increase in frozen French fries sold to Japan. The food service industry is expected to increase frozen foods used for a number of reasons: labor costs, year-around availability, consistency, reduced prep-time, portion control, high quality, ease of storage, price stability, and low cost. Technological changes have increased frozen food quality to the point that consumers now have a hard time distinguishing products in prepared (microwavable) meals made with frozen produce and products made with fresh produce.

Table 1. Supermarket Sales of Selected Frozen Vegetables in the United States, 2000.

Vegetable	Volume (Millions)	Dollars (Millions)	Estimated Price/Lb.	Estimated Price Removing Margins
Mixed	251.4	$ 384.00	$ 1.53	$ 0.76
Corn	115.9	$ 145.90	$ 1.26	$ 0.63
Peas	107.4	$ 142.80	$ 1.33	$ 0.66
Beans	97.9	$ 135.90	$ 1.39	$ 0.69
Broccoli	92.7	$ 126.60	$ 1.37	$ 0.68
Spinach	55.8	$ 76.20	$ 1.37	$ 0.68
Carrots	16.5	$ 21.00	$ 1.27	$ 0.64
Squash/Zucchini	6.1	$ 7.10	$ 1.16	$ 0.58
Onions	4.9	$ 7.10	$ 1.45	$ 0.72

From the chart above, The American Frozen Food Institute indicates the volume (pounds sold) and price received for each of the vegetable crops. The researcher divided the dollars/volume to figure the estimated price per pound. To remove the margins, the researcher assumed the retailer mark-up on the wholesale price was 20% and the wholesaler mark-up on the farm or processor price was 20%. A discount formula was used to estimate what price the processor or farmer owning the processing equipment would get for frozen products.

According to the American Frozen Food Institute (2000), almost all frozen vegetables have increased in consumption over the past five years. Mixed vegetables have increased dramatically, but encompass a wide array of vegetables. Anything from peas and carrots to Mexicali corn and even certain seasoned potato tots are in the mixed vegetable group.

Table 2. Frozen Vegetable Volume From 1994-1998.

Vegetable	**1994**	**1995**	**1996**	**1997**	**1998**
Butterbeans	7,491	7,664	4,577	5,170	7,298
Baby Lima Beans	95,695	101,295	85,053	97,598	101,757
Carrots		418,816	397,967	409,044	388,094
Corn-on-Cob		414,662	383,840	464,942	435,271
Black-eye Peas	33,427	29,352	22,901	25,363	27,684
Green and Red Peppers	42,787	54,155	44,858	40,746	42,599
Miscellaneous Vegetables	38,575	41,004	36,715	46,363	42,849

General wholesalers and distributors are not the target market for IQF frozen produce. After contacting over 10 wholesalers and distributors operating in Georgia, it was determined that brokers or wholesalers servicing the ingredient or individual markets are more likely to be interested in IQF produce. Additional research into these groups is needed to gain an understanding of the market.

One reason for targeting the food service sector rather than the retail market is the reduced expense in marketing. The time and money needed to establish a brand name for frozen vegetables in the retail market is cost prohibitive. The food service or wholesale market will purchase frozen vegetables without brand name recognition.

Frozen vegetable consumption data compiled by the Economic Research Service, USDA, indicates per capita consumption rose at a rate of 48% between 1970 and 2000. In the last five years, consumption has been flat. However, in 2000, approximately 84.1 pounds of frozen vegetables were consumed per capita. The major vegetables consumed were lima beans, snap beans, broccoli, carrots, sweet corn, green beans, and potatoes. Georgia grows all of these vegetables and has the potential for entering into the frozen market with #2 vegetables.

Production and packing of frozen vegetables has grown annually due to improved technology. Assisting this growth is the American desire for ready-made meals and quick meals. These two factors have contributed to marked changes in the vegetable market. According to The Food Institute, demand for canned vegetables has declined while demand for frozen vegetables has increased.

In general, demand for all vegetables, fresh or frozen, has increased due to reports indicating the benefits of consuming large quantities of fruit and vegetables. The old food pyramid has been redesigned with increased portions of fruit and vegetables and reductions in the meat and dairy categories.

The prices below are based on information supplied by food ingredient brokers and The Food Market Institute on the various frozen vegetables. Prices would be cheaper when sold in bulk bins, bigger bags, and on the east coast. However, it is interesting to note the vegetables seen as traditional southern vegetables have higher prices per pound than other vegetables. Lima beans, yellow squash, zucchini, southern peas, and collards, were all significantly higher per pound and are easily produced in Georgia. One explanation is that the majority of the frozen vegetable market exists around the west coast of the United States and southern vegetables are typically not grown in that region.

Table 3. Frozen Vegetable Trading Prices, April 2001.

Frozen Vegetable	Packaging	$/LB*
Bell Peppers	12/3-lb bags	.45-.50
Carrots, diced	12/3-lb bags	.36-.40
Carrots, sliced	12/3-lb bags	.39-.43
Collards, chopped	12/3-lb bags	0.45
English Peas	12/2.5-lb bags	0.50
Lima Beans	12/2.5-lb bags	.80-.85
Snap Beans	12/2.5-lb bags	.45-.49
Southern Peas	12/2.5-lb bags	0.66
Sweet Corn, cut	12/2.5-lb bags	.44-.49
Sweet Corn, coblet	48/1-lb bags	10.75
Yellow Squash	12/3-lb bags	0.63
Zucchini	12/3-lb bags	0.63
*F.O.B. West Coast		

Vegetable Production Area

Agriculture in Georgia is changing and many farmers have begun to grow more vegetables. Based on conversations with wholesalers at the Atlanta Farmers Market, the vegetable market has grown faster than supply. Many wholesalers discussed the need to import vegetables from out of state. This slight deficit in vegetables from Georgia opens a window for Georgia farmers to increase acreage.

Many of the vegetables used in the frozen market come from fresh market culls. Therefore, increased demand in the fresh market creates increased supply in the frozen market. However, increased frozen market supply does not appear to have created a serious frozen vegetable price change according to data gathered from numerous sources by the Center for Agribusiness and Economic Development.

The proposed quick freeze operation will be located in Decatur County. Decatur County and neighboring Mitchell County are located in a concentrated vegetable area growing bell peppers, carrots, collards, English peas, lima beans, snap beans, southern peas, sweet corn, yellow squash, and zucchini. An estimate of the acreage was obtained for these crops from the 2000 Farm Gate Value Report from the Center for Agribusiness and Economic Development at The University of Georgia.

The following table indicates the total acreage of each of those vegetables. Many vegetable crops will have 30% or more of the total crop not meet fresh market grade.

Table 4. Potential Vegetables for Freezing, Acreage, and Pounds Within Decatur County, Georgia.

Vegetable	Acres	AvgYield	Total Yield	Pounds	Estimated #2	$/Lb
Bell Peppers	2	1000	2000	60,000	18,000	.45-.50
Carrots	275	460	126500	6,072,000	1,821,600	.39-.43
English Peas	800	3.2	2560	76,800	23,040	0.50
Lima Beans	360	105	37800	1,134,000	340,200	.80-.85
Okra	16	300	4800	144,000	43,200	0.63
Snap Beans	2290	215.25	492922.5	14,787,675	4,436,303	.45-.49
Southern Peas	742	150	111300	3,116,400	934,920	0.66
Sweet Corn	11883	362.5	4307587.5	180,918,675	54,275,603	.40-.49
Yellow Squash	325	1800	585000	17,550,000	5,265,000	0.63
Zucchini	100	1100	110000	2,310,000	693,000	0.63

Table 5. Potential Vegetables for Freezing, Acreage, and Pounds Within Mitchell County, Georgia.

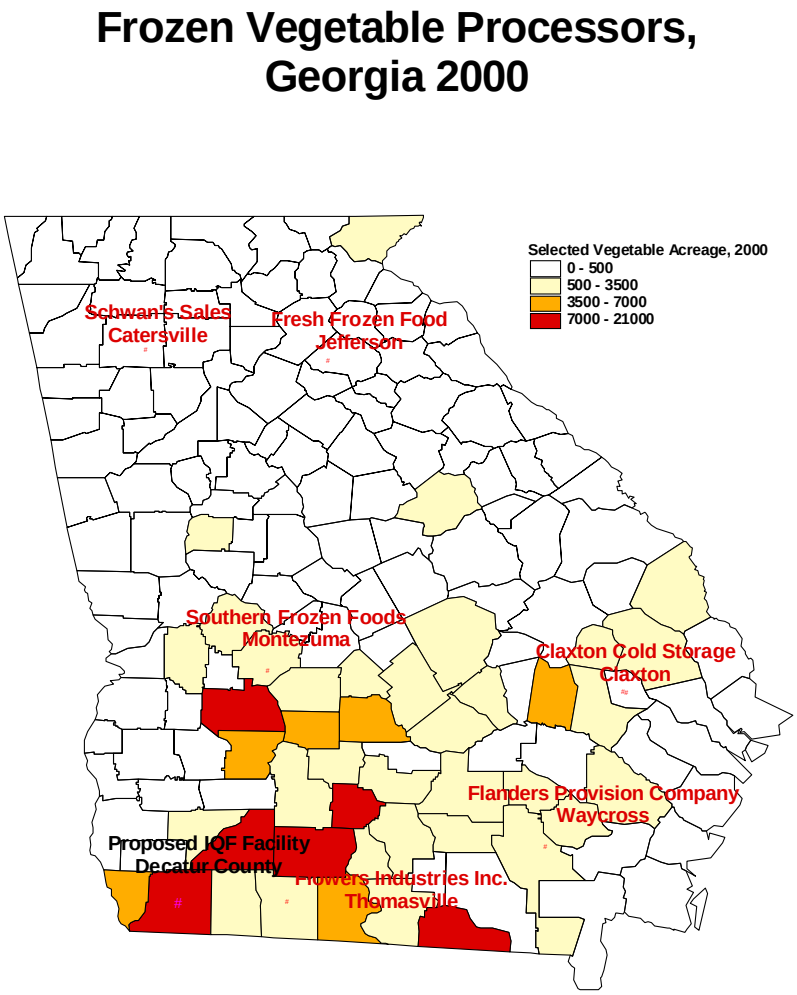
Vegetable	Acres	AvgYield	Total Yield	Pounds	Estimated #2	$/Lb
Bell Peppers	101	600	60,600	1,818,000	545,400	.45-.50
Carrots	500	483	241,250	11,580,000	3,474,000	.39-.43
Collards	425	343	145,563	3,639,063	1,091,719	.39-.43
Okra	29	250	7,250	217,500	65,250	0.63
Snap Beans	750	140	105,000	3,150,000	945,000	.45-.49
Southern Peas	236	130	30,680	859,040	257,712	0.66
Sweet Corn	7,310	300	2,193,000	92,106,000	27,631,800	.40-.49
Yellow Squash	307	813	249,438	7,483,125	2,244,938	0.63
Zucchini	460	828	380,650	7,993,650	2,398,095	0.63

These tables indicate approximately 16,793 acres of vegetables in Decatur County and 10,118 in Mitchell County for a total of 26,911 acres within acceptable distance to the freezing line. The estimated #2's above are 30% of the total pounds of the vegetables produced. Certain crops will have a higher percentage of #2's versus others, but a relatively good estimate is 30%. Estimating a #2 yield of 30% leaves 8,073 acres of vegetables available for processing and freezing.

Alternatives to the vegetables listed above can be controlled atmosphere onions during the off-season and blueberries. The equipment needed is already covered in the capital cost of this operation.

Graph 1 indicates Georgia's 2000 total acreage of the vegetables best suited for the fresh market. The vegetables include bell pepper, carrots, English peas, eggplant, snap/pole beans, yellow squash, collards, southern peas, zucchini, okra, lima beans, and sweet corn. The circle represents a fifty-mile radius around the proposed freezing location.

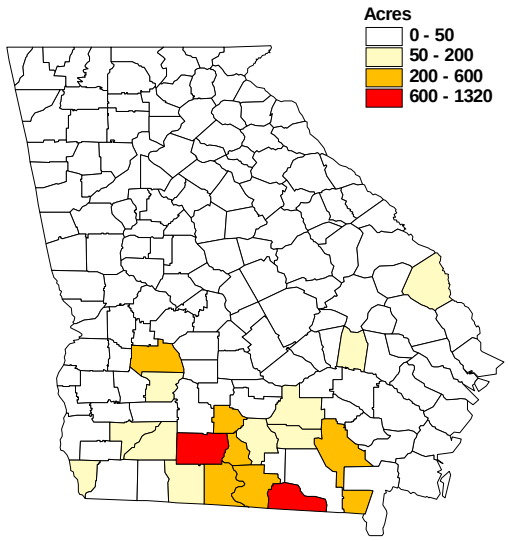
Graph 1. Select Vegetable Acreage for IQF, Georgia 2000.



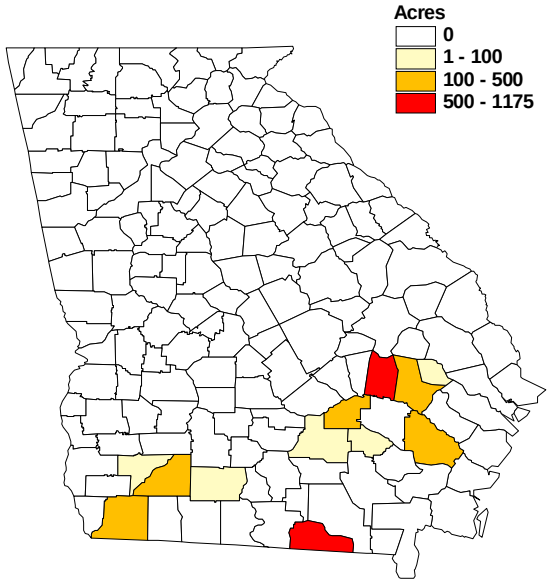
The radius does not indicate that vegetables from other parts of the state will not be considered for freezing. If successful, the plant may draw vegetables from any location until the maximum capacity is obtained.

The following state graphs show the acreage for those vegetables with further processing potential through the IQF line.

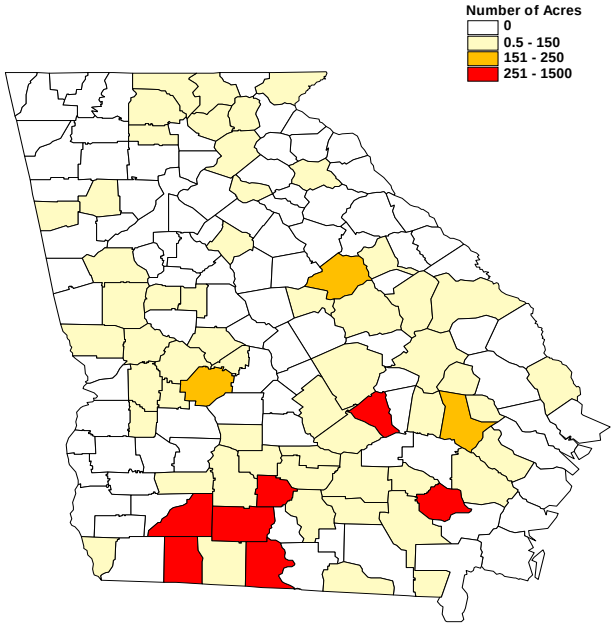
Bell Pepper Acreage by County, Georgia 2000



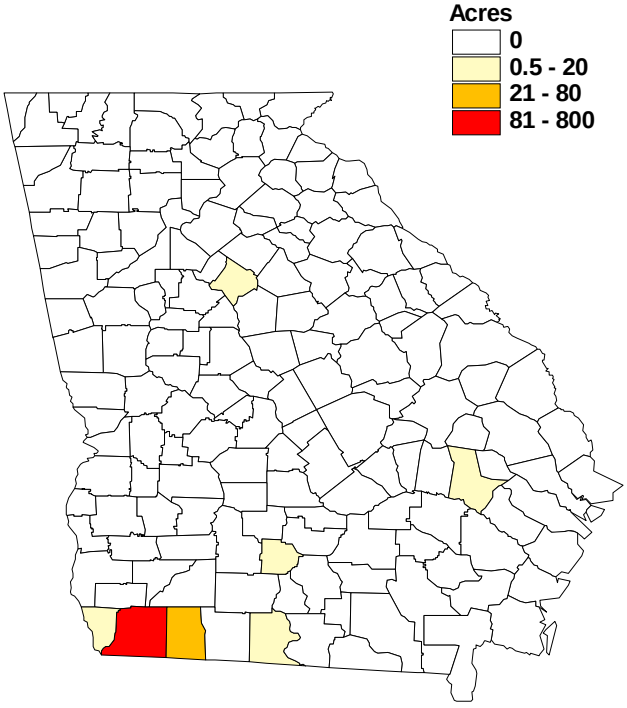
Carrot Acreage by County, Georgia 2000



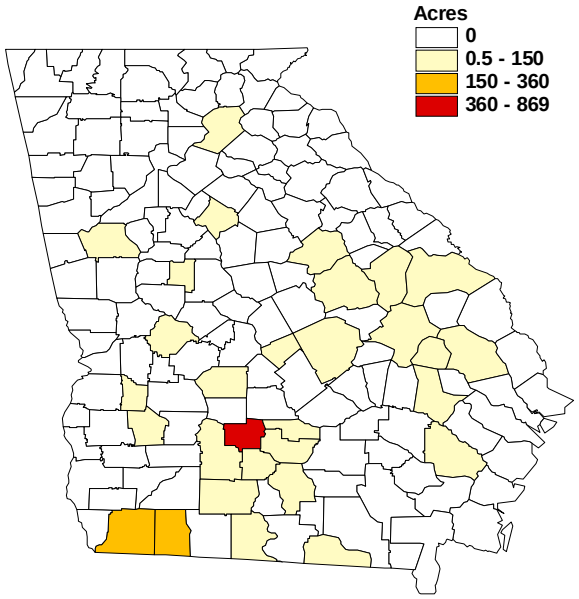
Collard Acreage by County, Georgia 2000



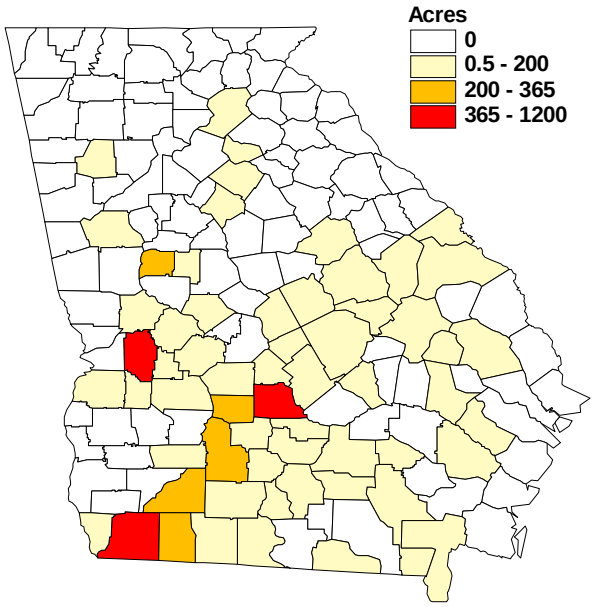
English Pea Acreage by County, Georgia 2000



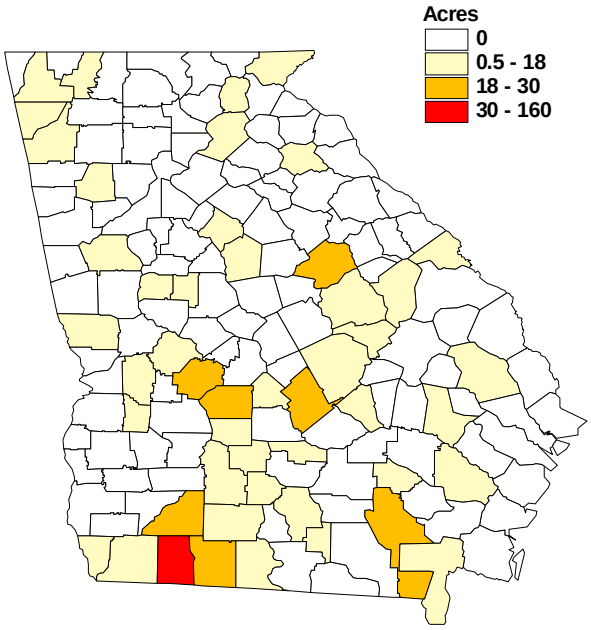
Lima Bean Acreage by County, Georgia 2000



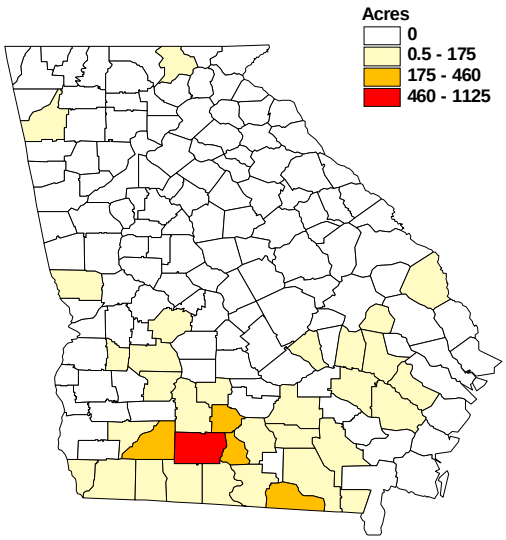
Southern Peas Acreage by County, Georgia 2000



Okra Acreage by County, Georgia 2000



Zucchini Acreage by County, Georgia 2000



Competition

A number of firms exist throughout the state providing quick-freeze processing. The nearest firm to the proposed location is Southern Frozen Foods in Montezuma. This firm has changed hands many times in the past years with little explanation given to the researcher. The table below indicates all the firms listed by SIC currently quick freezing vegetables in Georgia. It is believed that some of these firms may not be in direct competition with the proposed facility, such as Coke and Flowers. Both of these firms do not process and freeze vegetables in large quantities, but do process other food materials which are classified under the same SIC code such as bread, biscuits, and beverages. Fresh Frozen Foods also does not freeze their own merchandise but repacks previously frozen vegetables into consumer-ready bags and containers.

Table 6. Firms with SIC coded relevant to processing vegetables in Georgia.

Coca-Cola Co.	1 Coca Cola Plz., Nw.	Atlanta	GA	30313-2499	404-676-2121
Flanders Provision Co.	1104 Gilmore St.	Waycross	GA	31501-1307	912-283-5191
Flowers Industries Inc.	1919 Flowers Cir.	Thomasville	GA	31757-1137	229-226-9110
Fresh Frozen Food	1814 Washington St.	Jefferson	GA	30549-2668	706-367-9851
Schwan's Sales	5 Dean Dr., Ne.	Cartersville	GA	30121-5170	770-382-2432
Southern Frozen Foods	321 Plant St.	Montezuma	GA	31063-2500	478-472-8101

Sea Pac is another frozen vegetable processor in the state whose SIC did not come up in the program used. This firm takes vegetables and creates items such as frozen corn sticks, sweet potatoes fries, breaded vegetables, and ready to cook items. In addition to the above list, many of the poultry facilities with quick freeze units will provide custom freezing of vegetables. For example, Claxton Cold storage is mainly a poultry freezing and cold storage operation, but will custom freeze vegetables during their slow periods. It has been identified that approximately 6 of these operations exist throughout Georgia, concentrated mainly in North Georgia (see Appendix for list of companies processing vegetables in Georgia).

Table 7. United States Commercially Packed Vegetables in Pounds.

Commercially Packed Vegetables, 1000's Pounds				
Vegetable	**1996**	**1997**	**1998**	**% Change from 96 to 98**
Butterbeans	4,577	5,170	7,298	59%
Baby Lima Beans	85,053	97,598	101,757	20%
Carrots	397,967	409,044	388,094	-2%
Corn-on-Cob	383,840	464,942	435,271	13%
Blackeye Peas	22,901	25,363	27,684	21%
Green and Red Peppers	44,858	40,746	42,599	-5%
Miscellaneous Vegetables	36,715	46,363	42,849	17%

This table indicates the trend of vegetables with potential for further processing at the facility being investigated. One can see a slight downward trend for carrots and

peppers but moderate to strong upward trends for the other vegetables. These numbers represent packaged vegetables throughout the country.

Individual Quick Freeze Feasibility

This section will explore the components necessary for operating a quick freeze line in Vidalia, Georgia. The Baylor Group, (Food Plant Supply Division) provided the quick freeze equipment prices (see Appendix). All prices are for new equipment FOB and do not include sales tax. The equipment was based on a daily maximum rate of 20,000 pounds of vegetable material to be frozen. All components supplied can be used for any vegetable except corn. To freeze corn, a shucker and a segmentor will need to be added. The cost data and other numbers were supplied by various private groups and the following units within the University of Georgia: Department of Food Science, Department of Biological and Agricultural Engineering, and Department of Agricultural and Applied Economics.

Conversations with The Baylor Group indicated the maximum pounds for different vegetables that can be frozen per hour. The contact at this company referred to the specific heat and water content of each vegetable when making the assumptions for pounds frozen per hour. An oscillating conveyor needs to be set up with the quick freeze process to reduce the amount of water remaining on the vegetables after blanching and/or washing. Not all vegetables must be blanched; however, it was recommended, if the equipment was present. An average freezing rate for all vegetables was 2,713 pounds per hour; one of the highest rates was for peas at 3,200 pounds per hour. Corn coblets (5" cobs) averaged 2,240 pounds per hour. Coblets are relatively easy to freeze because only the kernel, and not the cob, is frozen. Cut corn kernels should fall in the same range of pounds per hour as the coblets. The best combination of vegetables the Decatur group produces is carrots and peppers. Since not enough of either of these is available throughout the entire season, beans, peas, and squash were next on the list for freezing capacity and market prices.

Table 8. Required Freeze Time for Various Vegetable Products (The Baylor Group, 2001)

Product	Nominal U.S. Lbs./Hour
3/8" Sliced Carrots	2,656
5" Corn Coblets	2,240
Cut Corn	2,880
Cut Squash	2,800
Diced Potatoes	3,090
Sliced Green Peppers	2,880
Lima Beans	2,760
Melon Balls	2,000
Melon Cubes	2,448
Peas	3,200
Sliced Squash	2,700
Snap Beans	2,900

Capital Cost

The capital cost estimates include all equipment considered necessary to run the IQF operation. All costs are shown in detail in the appendix. These costs include the equipment for preparation, freezing, and storing the vegetables for a limited time period. To reduce labor costs, an automatic stainless steel hopper and oscillating conveyor were added to traditional quick-freeze equipment. These pieces of equipment will reduce labor needs and improve the products in preparation for freezing by removing any excess water on the produce. Also included in the total cost figures were the prices for a metal building to house the operation and a stand-alone freezer. These costs came from a number of sources and can be found in the appendix of this study. The total figure for capital cost were $1,032,279, of which $588,860 (including tax) is used for equipment, $233,500 is used for the building and freezer, and $150,000 is working capital to cover expenses prior to an income-producing period.

Equipment for freezing included in the capital cost:

Model B-200 IQF Tunnel Freezer	$93,323
Refrigeration Skid	$126,162
Product Load Elevator	$10,924
Oscillating De-watering Conveyor	$15,574
Urshell(Dicer & Slicer)	$30,000
Freezer	$116,000
Set Up and Consulting	$3,000

Preparation equipment included in capital cost:

Blancher (including piping)	$60,000
Miscellaneous pieces (tables, dump vats)	$15,000
Fork Lift	$36,000
Segmenter	$67,000
Automatic Shucker	$26,000

Building included in capital cost:

Steel Frame Insulated Building	$70,000
Concrete Floor (Vented and Drains)	$40,000
Refrigeration Unit	$7,500

All equipment was priced new. There is a good second-hand market for many of the pieces mentioned. The prices above do not include the building, concrete floor or working capital.

Direct Labor

Labor cost calculations include both salaried and hourly labor required to run the quick freeze line. The labor figures are automatically adjusted with an increase in pounds processed. The regular hours of operation are 8 hours per day, for 270 days annually. The wages for the unskilled laborers was calculated at $6 per hour per employee (10) for 40 full-time weeks (8 hour days). Skilled labor consists of a fork lift driver and shift supervisor. Their cost is $10 per hour, with the same work hours as the unskilled laborers. The manager/salesperson receives an annual salary of $35,000 with the potential for commissions. This person is responsible for scheduling delivery of the #2's to the freeze line, ordering input supplies, and creating contacts for direct sales. The manager will be the only employee to receive benefits, estimated at $8,750. A part-time bookkeeper, with an estimated salary of $7,500, will be hired to assist the manager. The total labor cost is $212,850. If the operation decides to run a custom vegetable processing line, additional labor figures will need to be calculated.

Direct Costs

The direct cost was derived from quoted prices in the Georgia Farm Gate Report. Converting the yields into pounds generated a consistent and usable form for the analysis. While talking with brokers and re-packers, it was the researcher's understanding that certain frozen vegetables need to be of #1 quality. All frozen corn coblets need uniform color and lines, sliced zucchini and squash need to be free of blemishes and bruises, and bean and pea products need to be uniform in size and color. To meet these requirements, #1's will have to be used in addition to some better quality #2's. The farmers receive the amount shown below per pound of produce delivered to the facility, regardless of the amount of sales.

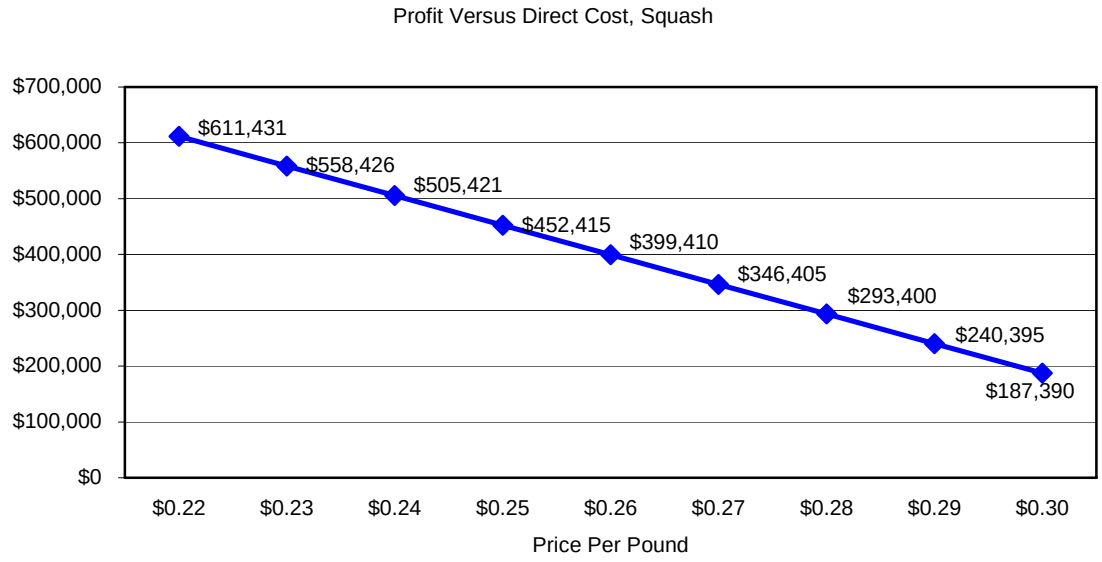
Table 9. Direct Costs Per Pound for Select Frozen Vegetables.

Vegetable	Price Farmer Receives	Farm Price	Units
3/8" Sliced Carrots	$0.14	$7.00	48lb
5" Corn Coblets	$0.14	$5.15	1 carton (42lbs)
Cut Corn	$0.14	$5.15	2 carton (42lbs)
Cut Squash/Zucchini	$0.26	$7.75	3/4 bu crate (30lbs)
Diced Potatoes	$0.00	$5.60	50 lbs
Sliced Green Peppers	$0.23	$7.00	1 1/9 bu (30lbs)
Lima Beans	$0.28	$15.00	1 bu (30lbs)
Melon Balls	$0.00	N/A	N/A
Melon Cubes	$0.00	N/A	N/A
Peas	$0.35	$10.00	1 bu (28lbs)
Sliced Squash/Zucchini	$0.26	$7.75	3/4 bu crate (30lbs)
Snap Beans	$0.40	$12.00	1 bu (30lbs)

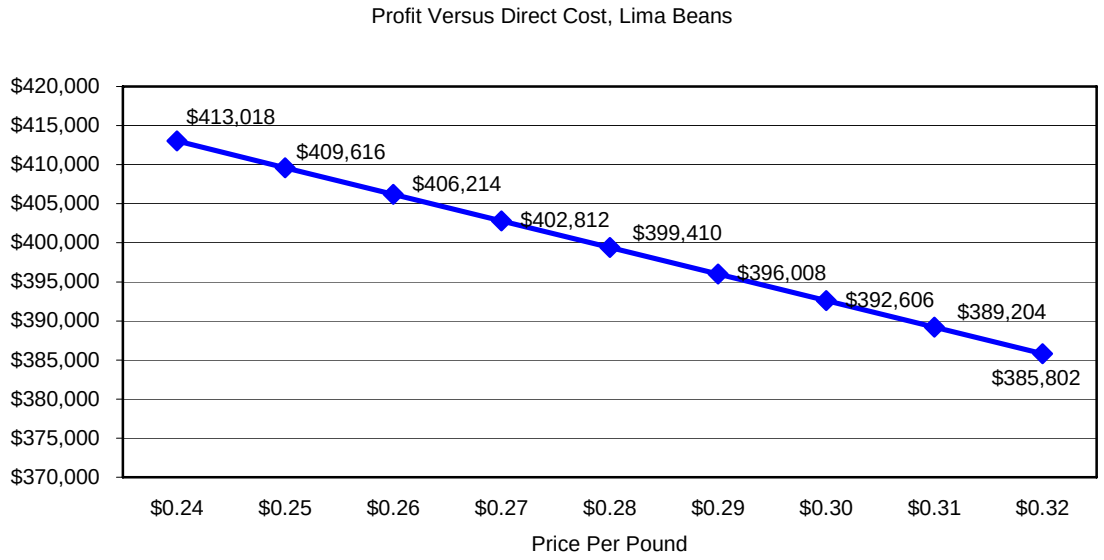
Profit Versus Change in Direct Cost (Farmgate Values)

Graphs 3-5 indicate how a change in the direct cost or prices received by the producers selling the product into the facility affect profitability. Each price was modified in 5% increments of the assumed prices received. The assumed prices came from the Farmgate publication and producers.

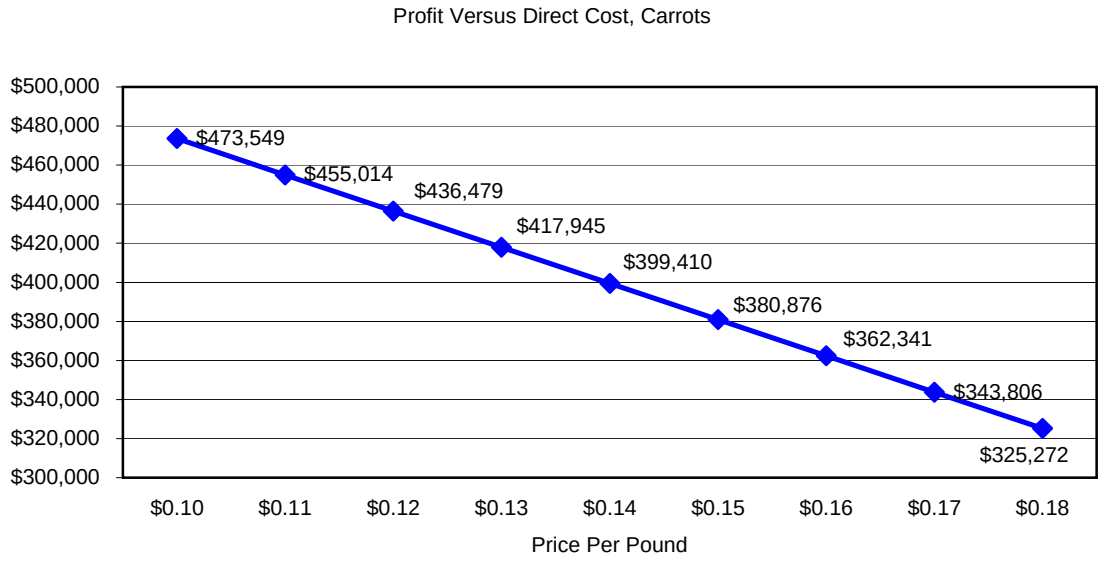
Graph 3. Profit Versus Direct Costs, Squash.



Graph 4. Profit Versus Direct Cost, Lima Beans.



Graph 5. Profit Versus Direct Cost, Carrots.



As seen in the graphs, an increase in raw product prices lowers profit, but it is important to note that the scenario still appears to have a stable profit with little risk.

Variable Costs/Other Direct Costs

Variable costs associated with this project include labor, utilities, insurance, repairs, rental agreements, disposal, and operating costs. Operating costs include: boxes, cleaning supplies, and bags. All of this will change depending on the pounds of product

quick-frozen. The utility cost estimates provided by Georgia Power and The Baylor Group differed slightly per product.

To establish variable cost per pound of product, the maximum capacity per product was determined annually. At full capacity, the variable cost was calculated annually then divided by the maximum pounds. The quotient was the variable price per pound of product. Each vegetable's variable cost differs because of varying heat and water contents and processing times per pound.

Fixed Costs

Fixed costs associated with this packing shed include the interest on investment funds, depreciation on the building, and equipment. The projected fixed costs for this project is $226,954. The depreciation aspect of the fixed cost covers physical deterioration and functional obsolescence. It can also be thought of as covering the principal payment of a debenture if a loan is needed. The other aspects of the fixed cost are interest on the working capital, capital cost, and taxes. The interest can be thought of as opportunity cost returns on the money used for the initial investment into the processing line (see Appendix).

Linear Programming Results

To maximize the profitability of the quick-freeze operation under certain constraints, such as acreage, seasonality, variable cost per pound, and sale price per pound for all of the different vegetables, a linear program analysis was necessary. The chart below indicates the results of the analysis. Due to the similar season among many of the vegetables, the quick freeze operation would run approximately 270 days, from April to November. The first crop to be processed would be the carrots in late April to May, then the squash and lima beans in any order. The liner program model rejected the other vegetable crops grown in the area from the equation to maximize the objective function profit. Lima beans are binding by the pounds available constraint. The researcher did not want to use more pounds then currently produced in the model. However, if an expansion in lima bean production occurs, a new model can be run on the assumption that since the lima beans carry the highest return over variable cost they should be used until binding with the new production.

Table 10. Linear Programming Model Results.

Vegetable	Current #2	Lbs/Hour	Lbs/Day	Total Lbs	VC/Lb	Price/Lb	Return	Days	Profit/VC	Full Acres
3/8" Sliced Carrots	1,853,460	2,656	21,248	1,274,880	$0.36	$0.39	$0.03	60	$25,498	58
5" Corn Coblets	54,877,960	2,240	17,920	-	$0.39	$0.43	$0.04	0	$0	0
Cut Corn	54,877,960	2,880	23,040	-	$0.34	$0.47	$0.13	0	$0	0
Cut Squash/Zucchini	5,300,517	2,800	22,400	4,496,922	$0.47	$0.60	$0.13	201	$539,631	117
Diced Potatoes	-	3,090	24,720	-	$0.51	$0.35	($0.16)	0	$0	0
Sliced Green Peppers	180,288	2,880	23,040	-	$0.43	$0.43	($0.00)	0	$0	0
Lima Beans	204,120	2,760	22,080	204,120	$0.49	$0.80	$0.31	9	$61,236	65
Melon Balls	-	2,000	16,000	-	$0.60	$0.41	($0.19)	0	$0	0
Melon Cubes	-	2,448	19,584	-	$0.55	$0.41	($0.14)	0	$0	0
Peas	140,376	3,200	25,600	-	$0.54	$0.50	($0.04)	0	$0	0
Sliced Squash/Zucchini	5,300,517	2,700	21,600	-	$0.47	$0.60	$0.13	0	$0	0
Snap Beans	2,690,651	2,900	23,200	-	$0.60	$0.47	($0.13)	0	$0	0
					Total Return Above Variable				**$626,364**	

The chart above indicates the most profitable combination of vegetables to be frozen based on the production in Decatur and Mitchell counties. The maximized return over variable cost is $626,364. The total fixed cost is $226,954. Subtracting the fixed cost from the return over variable gives a net profit figure of **$399,410**.

The pounds used above already have the shrink factor incorporated into them per product. Some vegetables are tipped and tailed while others do not need modification.

The linear programming model calculated the total pounds needed. The acres of each vegetable needed primarily for IQF are in the last column. As seen above, the acreage is minor and can be easily met by the cooperative. The purpose was to use some of the lower market #1's and high quality #2's in the processing plant and not grow specifically for freezing.

Re-packing Facility

A re-packing phase may need to be examined to increase profitability. Many IQF facilities in the United States also offer this service. Since the Decatur area has a large quantity of vegetables available, it seems natural to offer repacking close to the area of production and freezing.

According to The Baylor Group (2001) repacking facilities for large retailers, such as Kroger, often pay $.07 per pound to repackage frozen vegetables with their private label. The potential to save retailers money and time by having the product already available, lowering transportation cost, and dealing with fewer intermediaries indicates the value of investigating a repacking enterprise.

In addition to the existing packing equipment, an additional hopper would be needed. Many hoppers can handle 1 or 2 vegetable products. The largest vegetable blend contains 8 varieties, therefore, approximately 3-5 additional hoppers would need to be added. At $52,000 each, the additional cost ranges from $156,000-$260,000. If the cooperative re-packed all the vegetables they froze instead of selling them as bulk, the additional revenue would amount to $418,314.

Given the types of vegetables the linear programming model identified as profitable, lima beans and sliced squash/zucchini would be good alternatives for repacking without adding any additional cost, except smaller bags and a labeling machine. It is suggested that the cooperative contact various large institutions requesting information on repacking their private labels.

Impact Analysis

Impact analysis is a key component of any feasibility study. An impact analysis indicates the effect of a new venture on the economy. Building and implementing an IQF facility in South Georgia will impact the economy in several ways. The new plant will generate output as it begins selling frozen vegetables. These sales will, in turn, generate additional sales as the plant purchases inputs. The suppliers to the plant will increase the purchase of their inputs, thus increasing demand for those items. These increased sales will ripple through the economy. An input-output model will capture and quantify these effects.

The input-output model IMPLAN (Impact Analysis for PLANning, Minnesota IMPLAN Group) was utilized for this project. IMPLAN predicts the effects of a new venture on output (sales), employment, and tax revenue. IMPLAN models can be constructed for a state, region, or county. Input-output models work by separating the economy into its various sectors, such as agriculture, construction, manufacturing, etc. A direct change in production, such as the construction of a new packaging line, can be entered into the model for a certain sector. IMPLAN then measures the changes in the other sectors that occur because of the initial change. Therefore, IMPLAN captures the relationship between industries in the region and shows how the change in one industry relates to the others. One limitation to this model is the backward linkages in which it calculates these figures. However, it is estimated this limitation is of minor significance to the overall model.

In order to fully quantify the effect of a new IQF plant on the Georgia economy, two issues must be addressed. First, the value of vegetable production must be calculated. While production is not projected to change in the short-term, the value of employment and sales from production cannot be ignored. Production is dependent on a viable market for the output. Second, the sales and employment of the new plant must be measured. This is the impact traditionally associated with a new enterprise.

Vegetable production in Decatur and Mitchell counties has a positive impact on sales, employment, and tax revenues in Georgia. For the purpose of this study, the

impact of the production of vegetables used in the IQF plant in Decatur and Mitchell counties will be examined. The model was constructed for Decatur and Mitchell counties only. Thus, the impacts apply only to those counties. Only vegetables grown for the plant are counted in the value. The value of total vegetable production in Decatur and Mitchell counties is significantly higher. The plant intends to purchase $484,050 of raw carrots, squash, and lima beans. The production of these vegetables in turn creates another $180,210 in output in the counties. Thus, the total value associated with vegetable production is $664,260. The model indicates that 3 people will be associated with the production of these vegetables. Another 4 are employed in other industries due to the purchase of supplies. Therefore, the total number of jobs created by vegetable production is 7. Non-education, state, and local tax revenues benefit increase approximately $17,000 due to the production of vegetables.

Table 11. Impacts of the Production of IQF-Bound Vegetables on Decatur and Mitchell Counties' Economy

	Direct	Indirect	Total
Output (Sales)	$484,050	$180,210	$664,260
Employment	3	4	7
Tax Revenue	NA	NA	$17,428

The second impact analysis considers the operation of the new facility. The model constructed here was for the entire state of Georgia since the plant will have sales outside Decatur and Mitchell counties. The new IQF plant will handle lima beans, carrots, zucchini, and yellow squash. Sales are projected to be valued at roughly $3 million annually. The plant will directly employ 11 people. As a result of the plant's operation, another 28 jobs exist in the state. This brings total employment due to the plant's existence to 39. The plant also has impacts on output. The sale of frozen vegetables is responsible for another $2.5 million of economic activity in the state. This brings total economic output due to the plant to $5.9 million. Non-education, state and local taxes are also dependent on the IQF facility. IMPLAN estimates total tax revenues of $200,000 from the IQF plant. This information is shown in Table 12.

Table 12. Impacts of an IQF Facility on Georgia's Economy

	Direct	Indirect	Total
Output (Sales)	$3,358,651	$2,510,007	$5,868,658
Employment	11	28	39
Tax Revenue	NA	NA	$217,097

These two impact analyses indicate the impact of both production and processing of vegetables. The production of vegetables is actually a subset of the impacts shown from the plant. In other words, of the 28 indirect jobs created from the IQF facility, 3 of those are in the production of the vegetables. It is not completely accurate to state that 39

jobs were created by the plant and 7 by production, resulting in 46 total jobs for the new IQF facility.

Conclusion

Economically, a quick freeze processing line in the Decatur County area appears to be profitable, assuming the ability to sell the full capacity of frozen vegetables. Limitations to the processing plant will be market share and competition.

The market presently appears to be able to absorb more frozen vegetables than is currently supplied. This situation, according to one broker interviewed, should continue. The biggest obstacle to this processing plant is establishing a reputation for providing a high quality product on a consistent basis. This may become a problem if the cooperative has limited #1's available for freezing or lower quality #2's. When the fresh market price tumbles, more vegetables will be frozen. However, when the price increases dramatically, the supply of inputs to the processing plant will diminish. The lima beans and sliced squash/zucchini need to be of a higher quality nature, free of serious blemishes and marks, and uniform in size and color.

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The Center for Agribusiness & Economic Development

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>
> To provide agricultural, natural resource, and demographic data for private and public decision makers.

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