The University of Georgia

Center for Agribusiness and Economic Development

College of Agricultural and Environmental Sciences

The Economic Potential of Ethanol Production From Sweet and Irish Potatoes in Georgia

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From Sweet and Irish Potatoes in Georgia

Introduction

The Center for Agribusiness and Economic Development (CAED) was requested to provide an economic analysis of the potential for producing ethanol from both sweet and Irish potatoes in Georgia. Potato production, especially sweet potatoes, has declined over the last several years for a variety of reasons. The question posed to the CAED was "Is there enough profit from the production of potato based ethanol to provide a base for increased potato acreage in Georgia?" The following analysis will provide an answer to that question.

Potato Acreage in Georgia

Georgia agriculture produces a diverse list of fruits and vegetables. For 2006, over 40 different types of vegetables, a total of 170,279 acres, were grown in Georgia. Among the list are sweet potatoes and Irish potatoes which are the focus of to this study as a potential feedstock for the production of ethanol.

Historical data from the Center for Agribusiness and Economic Development's *2006 Farm Gate Vegetable Report* was analyzed to assess the current status of potato production in Georgia. This report, based on a survey of Georgia Cooperative Extension Agents, is used to gather comprehensive yearly data on vegetable crops in Georgia.

In 1993, Georgia planted about 3,000 acres to sweet potatoes but that level has steadily declined. Over the past decade, sweet potato acreage in Georgia has declined from a high of 1,340 acres in 1998 to a low of 574 acres in 2006. For 2006 sweet potatoes ranked number 24 in acreage and 22nd in farm gate value at $2.5 million, relative to other vegetables produced in Georgia. Total production of sweet potatoes for 2006 was 4,422 tons or 88,448 CWT.

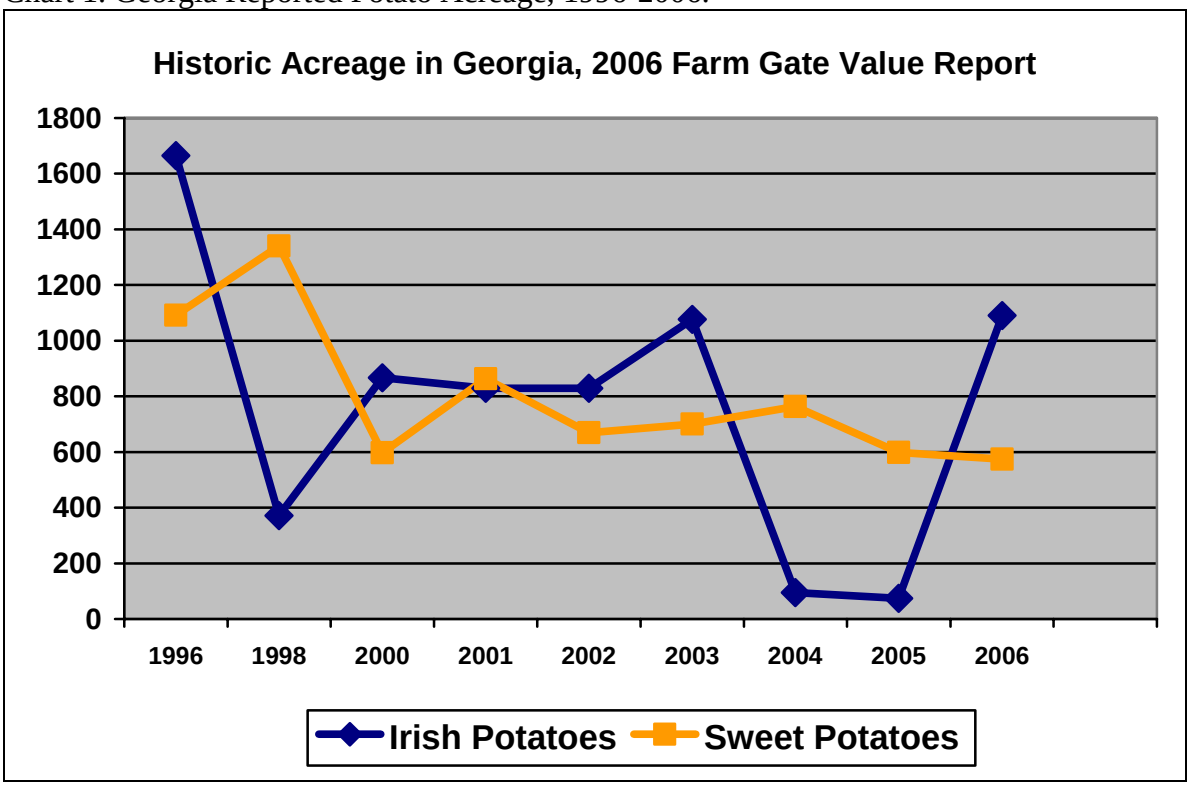
Irish potato production in Georgia has been very sporadic over the last decade. Acreage has ranged from 1,665 acres in 1996 to a low of 75 acres in 2005. For 2006, at 1,090 acres, Irish potatoes ranked 19th in respect to acreage and 27th in farm gate value at $1.4 million for Georgia. Total production of Irish potatoes in Georgia for 2006 was 8,691 tons, or 173,826 CWT, which was comprised of 684 tons (13,690 CWT) for fresh market and 8,007 tons (160,136 CWT) for processing. Historical acreage for both sweet and Irish potatoes for 1996 to 2006 based on the *2006 Georgia Farm Gate Vegetable Report* is shown for Georgia in Chart 1.

When total US acreage is considered, harvested acreage for sweet potatoes has ranged from 82.1 to 94.8 thousand acres during the 1996 to 2006 time frame, with resulting US production of 12,221 to 16,248 thousand hundredweight (1,000 CWT) based on USDA NASS Annual Crop Report data. Figure 1 shows the distribution of 2006 production for Georgia in CWT. Figure 2 shows total US production in 1,000 CWT for the 2006 crop year. It is important to note that Georgia is not included in the US map. Data has not been collected by NASS for Georgia since 2001 due to decreased acreage and production in the state.

Total US harvested acres for potatoes, all seasons and purposes, for 2006 was 1115.5 thousand. Three states, Idaho, Washington and Wisconsin, account for 56 percent of the total US production. From 1996 to 2006, US acreage has ranged from 1086.9 to 1425.9 thousand acres with production ranging from a low of 423,926 to high of 513,544 thousand hundredweight (1,000 CWT). Given Georgia's limited production, NASS does not include its production in the data collection or total production estimates. Figure 3 shows 2006 production information for potatoes in Georgia and Figure 4 shows data for the US.

Both Irish and sweet potatoes have significant levels of carbohydrates or sugars which could be converted to ethanol. The question remains as to whether the production and utilization of potatoes and/or cull potatoes is an economically feasible option for ethanol production. Key factors in the analysis include an assessment of the current production practices for these crops in the state, the costs associated with these production practices, potential supply and use of currently unmarketable potatoes produced, or improvements in technologies and methods that could be employed to meet the demand for potatoes for an alternative use.

Chart 1. Georgia Reported Potato Acreage, 1996-2006.



Source: UGA CAED 2006 Georgia Farm Gate Vegetable Report.

Figure 1. Sweet Potato Production in Georgia, 2006

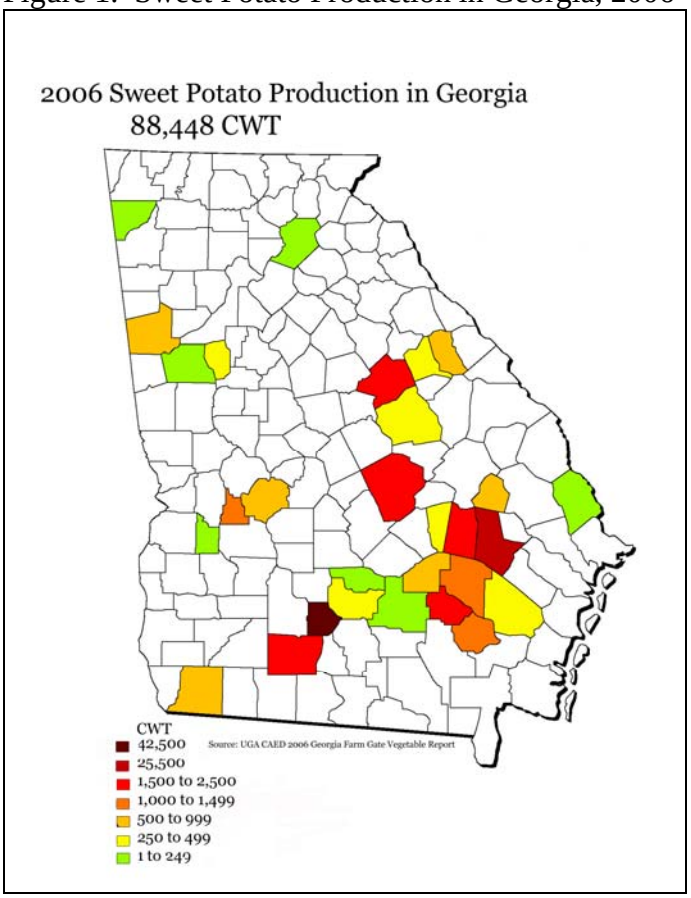


Figure 2. US Sweet Potato Production, 2006

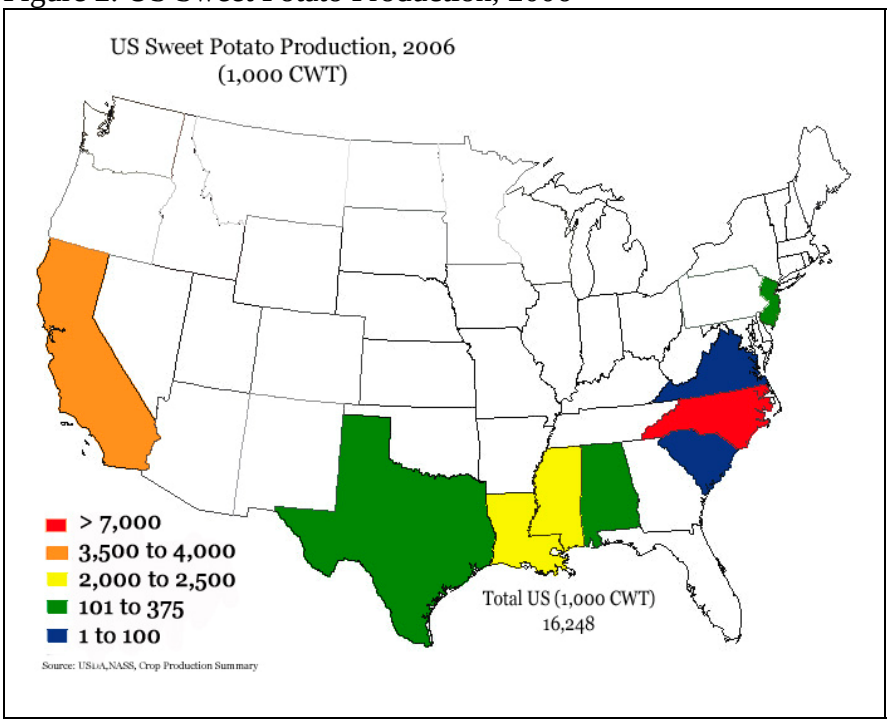


Figure 3. Potato Production in Georgia, 2006

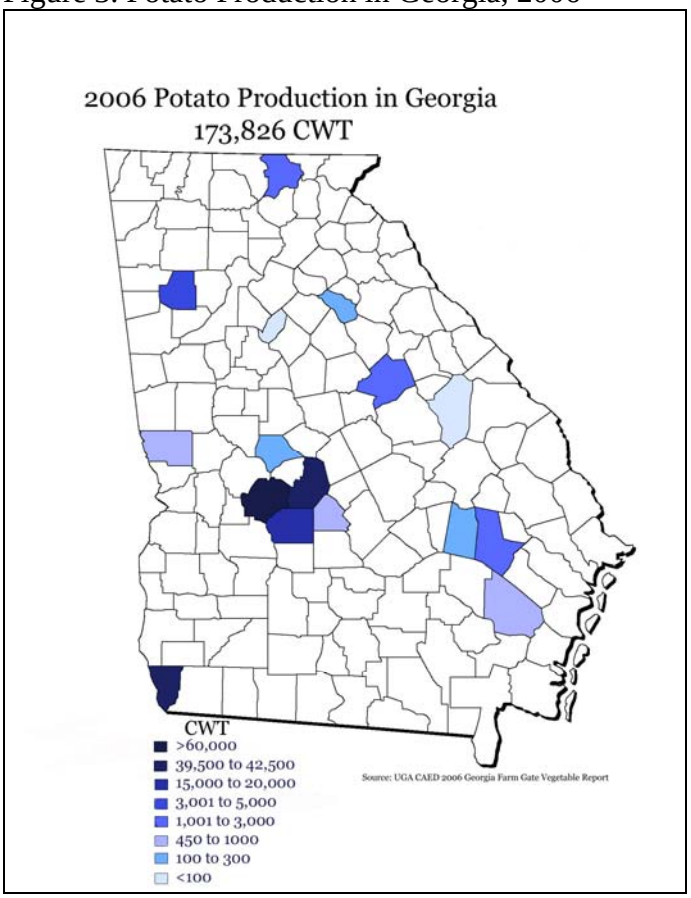
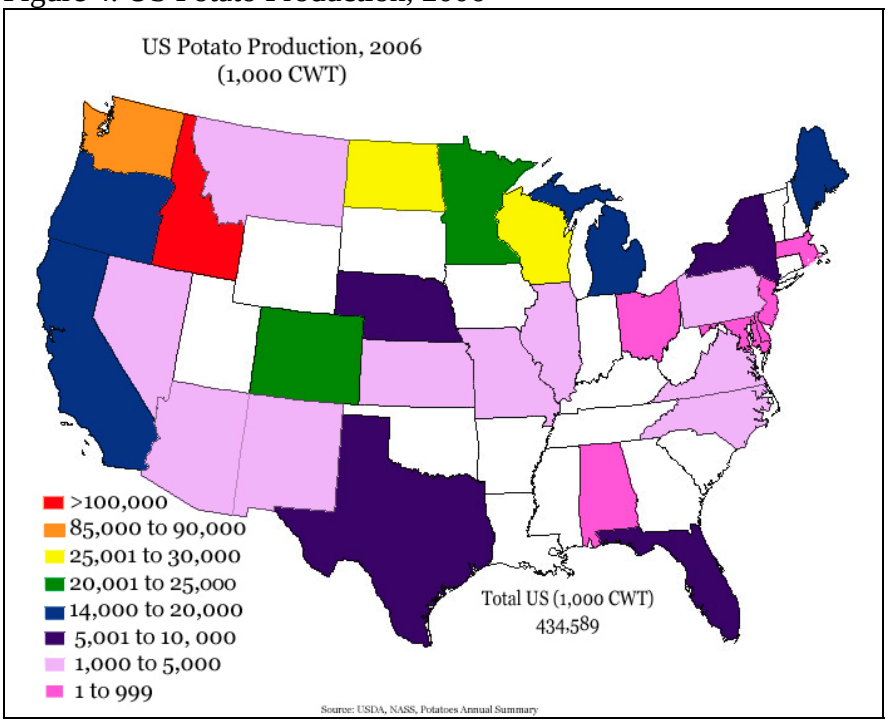


Figure 4. US Potato Production, 2006



Current Production Practices and Costs

In an attempt to accurately portray current production costs, an updated budget was developed for both sweet and Irish potatoes. Relative to total vegetable production in Georgia, these two crops have rather limited acreage representing less than 1% of total vegetable acreage. Thus, reliance upon budgets and production practices employed in other regions was necessary. Members of the UGA Vegetable Team, which includes experts in all aspects from production through harvest, storage, and marketing, were consulted. County Extension agents, whose counties include potato acreage, were also consulted. Local producers were also contacted to further validate the data.

Sweet Potatoes

Commercial sweet potato production in Georgia is typically carried out under irrigation and thus production costs are high relative to many crops, but not necessarily high compared to other vegetable crops. Fresh market sweet potatoes must be graded and packed in boxes before they are marketed. The standard container is a 40 pound box.

The marketable yield associated with the estimated cost was determined to be 450 boxes, or 9 tons per acre. It is estimated that two-thirds of this total production would be considered US #1, receiving a premium price. The balance of marketable fresh market production would be US #1 Jumbo or US #2 and sell for a discounted price relative to the US #1. Current production practices result in limited supply of culls according to conversations with local growers who estimate cull rates of only about 5 percent. The revenue generated in the estimated budgets includes income for all production except the estimated 5% currently unmarketable. Thus, for the estimated 450 boxes produced, a cull rate of 22.5 boxes per acre could be expected. Given the 2006 acreage (574), total culls available in Georgia would only be 12,915 boxes or 5,166 CWT.

Current production costs for fresh market production were considered for several states in the Southeastern US. Budgets, which had been updated within the last year, were available for production in Alabama, Louisiana, Mississippi, and South Carolina. Budgets developed in 2001 were available for Virginia, North Carolina, and Georgia. Total budgeted costs for 2007 ranged from $1,910 per acre in Louisiana to $4,098 per acre in South Carolina. The older budgets for North Carolina, Virginia and Georgia had total estimated costs ranging from $2,136 to $3,310 per acre with Georgia's cost estimated to be $3,188 per acre.

Considering all relevant input, a budget for Georgia for 2007 was developed. The total cost of producing an acre of fresh-market sweet potatoes, excluding land, was estimated to be $3,865 or $429 per ton ($21.47 per CWT). Budgeted costs included direct inputs such as plants or slips, fertilizer, pesticides, machinery fuel and repairs/maintenance, and labor costs. Direct costs total $1,520 per acre. Harvest and marketing costs add an additional $4.25 per 40 # container, or $1,912.50 per acre. Fixed costs including depreciation, taxes, insurance, and housing for machinery, irrigation costs and general overhead and management total an additional $432 per acre.

One theory initially proposed was to utilize sweet potatoes that are currently considered unmarketable or "culls" as a potential source for ethanol production. However, given the limited supply of cull sweet potatoes, that does not seem to be a viable option. Most of the potatoes that are not sold into the fresh market can be sold into the processing market. Therefore, a second alternative to consider is if the current methods of production can be modified to reduce costs and produce a sweet potato crop designated for processing such as ethanol production.

Developing a production system for sweet potatoes specifically targeted for bulk handling could significantly reduce the total cost of production. The harvest, boxing and marketing costs for fresh market production total about $1,912 per acre and account for nearly one-half of the budgeted production costs. If one were to produce sweet potatoes for a bulk use such as processing into ethanol, much of the marketing costs could be reduced or eliminated entirely.

Variable preharvest expenses would not differ between fresh market production and bulk processing production. However, it is estimated that variable harvest and marketing costs could be reduced by as much as two-thirds, reducing the total variable cost per acre to $2,158 or $240 per ton ($12 per CWT). Thus the total costs, excluding land, would be $2,590 per acre or $288 per ton ($14.39 per CWT) for a production system specifically targeted for bulk harvesting and handling. It might also be possible to see an increase in yield by leaving the sweet potatoes in the field longer and allowing a higher percentage to become heavier "jumbos".

Figure 5 shows the estimated costs and returns for fresh-market irrigated sweet potato production in South Georgia for 2007. Figure 6 represents the estimated cost for the same production practices, but with bulk handling of the final commodity.

Irish Potatoes

Production of Irish potatoes in Georgia is rather limited. However, acreage reported in 2006 was significantly higher than the previous two years. Various production budgets from other states in the Southeastern US were considered to derive a representative budget for South Georgia. Budgets were available for both fresh-market and "chipping" or processing potatoes. Considering the purpose of this study, a chipping budget was developed.

Considering all relevant input, an irrigated budget for growing chipping potatoes in Georgia for 2007 was developed. The average yield, based on reported production from the 2006 Vegetable Farm Gate Value Report, was determined to be 172 CWT or 8.6 tons per acre. The total cost of producing an acre of processing Irish potatoes, excluding land, was estimated to be $2,126 or $247 per ton ($12.36 per CWT). Budgeted costs included direct inputs such as plants or slips, fertilizer, pesticides, machinery fuel and repairs/maintenance, labor and harvesting costs. These direct costs total $1,665 per acre. Fixed costs including depreciation, taxes, insurance, and housing for machinery, irrigation costs and general overhead and management total an additional $461 per acre. Production of fresh-market potatoes results in an additional cost of about $800 to $1,000 per acre with two-thirds of that increase related to harvest, grading and packing. Figure 7 shows the estimated costs and returns for producing processing potatoes in Georgia for 2007.

Market for Potatoes

There are currently two main markets for both sweet and Irish potatoes: the fresh market and the processing market. Discussions with industry sources indicate a very low level of culls that do not have a viable market. The cull rate would typically be near or below the five percent level for most producers. Culls would include diseased, severely malformed or damaged potatoes. If the total production for 2006 in Georgia is considered, the total estimated culls for sweet potato and Irish potatoes in Georgia would be 4,422 and 8,691 CWT respectively. If all acreage were to produce the estimated yields of 450 boxes for sweet potatoes and 172 CWT for Irish potatoes the cull estimates would increase to 5,166 and 9,374 CWT respectively.

The five-year average of terminal market prices reported by USDA AMS Fruit and Vegetable Market News for Atlanta for sweet potatoes across all grades in the Southeast has been $13.18 per 40 pound box. That equates to a price of $659 per ton.

For Irish potatoes the historic five-year average price per 50# box across all varieties and grades as reported by USDA AMS is $13.93 which would equate to $560 per ton for fresh market production. Processing or chipping prices, however, are significantly lower. The average market year US price, as reported by ERS in the *Vegetables and Melons Outlook,* for the past five years is $6.54 per CWT or $131 per ton. Considering only processing market prices, results in a slightly lower average of $5.29 per CWT or $106 per ton. To establish a price for Georgia, the price reported in the 2006 Georgia Vegetable Farm Gate Value Report can be considered. The average price reported for chipping potatoes was $120 per ton for 2006.

Figure 5. Estimated Costs and Returns for Irrigated Fresh-Market Sweet Potatoes

Sweet Potatoes
Irrigated, Fresh Market
SOUTH GEORGIA, 2007

ESTIMATED COSTS AND RETURNS

			Revenue/Acre
US # 1	**300**	**$ 16.39**	**$ 4,915.89**
#1, Jumbo	**75**	**$ 10.40**	**$ 779.69**
#2	**75**	**$ 10.83**	**$ 812.11**
Expected Yield per Acre	**450**	Containers, 40#	**$ 6,507.69**

	40# Container	Ton	CWT
Expected Yield per Acre	450	9.00	180.00
Average Revenue per unit	$ 14.46	$ 723.08	$ 36.15

VARIABLE COSTS	Unit	Number of Units	$/Unit	Cost/Acre	$/Containers, 40#	Cost/ton	Cost/CWT
Plants/Slips	1,000	12.00	$ 30.00	$ 360.00	$ 0.80	$ 40.00	$ 2.00
Lime	Ton	0.50	$ 32.00	$ 16.00	$ 0.04	$ 1.78	$ 0.09
Fertilizer							
Nitrogen	Lb.	30.00	$ 0.43	$ 12.90	$ 0.03	$ 1.43	$ 0.07
Phospate (P2O5)	Lb.	90.00	$ 0.31	$ 27.90	$ 0.06	$ 3.10	$ 0.16
Potash (K2O)	Lb.	180.00	$ 0.23	$ 41.40	$ 0.09	$ 4.60	$ 0.23
Starter Fertilizer	Acre	1.00	$ 45.00	$ 45.00	$ 0.10	$ 5.00	$ 0.25
Weed Control	Acre	1.00	$ 34.00	$ 34.00	$ 0.08	$ 3.78	$ 0.19
Insect Control	Acre	1.00	$ 59.84	$ 59.84	$ 0.13	$ 6.65	$ 0.33
Disease Control*	Acre	1.00	$ 55.00	$ 55.00	$ 0.12	$ 6.11	$ 0.31
Machinery: Preharvest							
Fuel	Gallon	19.79	$ 2.25	$ 44.53	$ 0.10	$ 4.95	$ 0.25
Repairs & Maintenance	Acre	1.00	$ 21.86	$ 21.86	$ 0.05	$ 2.43	$ 0.12
Machinery: Harvest							
Fuel	Gallon	13.14	$ 2.25	$ 29.57	$ 0.07	$ 3.29	$ 0.16
Repairs & Maintenance	Acre	1.00	$ 14.19	$ 14.19	$ 0.03	$ 1.58	$ 0.08
Irrigation**	Acre	3.00	$ 10.50	$ 31.50	$ 0.07	$ 3.50	$ 0.18
Labor	Hrs	5.83	$ 10.00	$ 58.25	$ 0.13	$ 6.47	$ 0.32
Preharvest	Hrs	21.00	$ 10.00	$ 210.00	$ 0.47	$ 23.33	$ 1.17
Harvest	Hrs	40.00	$ 10.00	$ 400.00	$ 0.89	$ 44.44	$ 2.22
Interest on Operating capital	Percent	$ 730.97	8.00%	$ 58.48	$ 0.13	$ 6.50	$ 0.32
Harvest & Marketing Costs							
Containers, 40#	Each	450.00	$ 1.00	$ 450.00	$ 1.00	$ 50.00	$ 2.50
Curing & Storage	Container	450.00	$ 1.00	$ 450.00	$ 1.00	$ 50.00	$ 2.50
Boxing	Container	450.00	$ 1.25	$ 562.50	$ 1.25	$ 62.50	$ 3.13
Brokerage	Container	450.00	$ 1.00	$ 450.00	$ 1.00	$ 50.00	$ 2.50
Total Variable Costs				**$ 3,432.92**	**$ 7.63**	**$ 381.44**	**$ 19.07**
Fixed Costs:							
Machinery: Depreciation, Taxes, Insurance, and Housing							
Preharvest	Acre	1.00	$ 62.36	$ 62.36	$ 0.14	$ 6.93	$ 0.35
Harvest	Acre	1.00	$ 51.30	$ 51.30	$ 0.11	$ 5.70	$ 0.29
Irrigation	Acre	1.00	$ 90.00	$ 90.00	$ 0.20	$ 10.00	$ 0.50
General Overhead	% of PH VC	$ 1,520.42	7.50%	$ 114.03	$ 0.25	$ 12.67	$ 0.63
Management	% of PH VC	$ 1,520.42	7.50%	$ 114.03	$ 0.25	$ 12.67	$ 0.63
Etc.	Acre	1.00	$ -	$ -	$ -	$ -	$ -
Other _____							
Total Fixed Costs				**$ 431.73**	**$ 0.96**	**$ 47.97**	**$ 2.40**
TOTAL COSTS AND PROFIT GOAL							
Total Costs Excluding Land				**$ 3,864.65**	**$ 8.59**	**$ 429.41**	**$ 21.47**
Net Returns above Specified Costs				$ 2,643.04	$ 5.87	$ 293.67	$ 14.68

Figure 6. Estimated Costs and Returns for Irrigated Sweet Potatoes, Bulk Harvest

Sweet Potatoes
Irrigated, Bulk Harvest
SOUTH GEORGIA, 2007

ESTIMATED COSTS AND RETURNS

			Revenue/Acre
US # 1	**300**	**$ 16.39**	**$ 4,915.89**
#1, Jumbo	**75**	**$ 10.40**	**$ 779.69**
#2	**75**	**$ 10.83**	**$ 812.11**
Expected Yield per Acre	**450**	Containers, 40#	**$ 6,507.69**

	40# Container	Ton	CWT
Expected Yield per Acre	$ 450.00	9.00	180.00
Average Revenue per unit	$ 14.46	$ 723.08	$ 36.15

VARIABLE COSTS	Unit	Number of Units	$/Unit	Cost/Acre	$/Containers, 40#	Cost/ton	Cost/CWT
Plants/Slips	1,000	12.00	$ 30.00	$ 360.00	$ 0.80	$ 40.00	$ 2.00
Lime	Ton	0.50	$ 32.00	$ 16.00	$ 0.04	$ 1.78	$ 0.09
Fertilizer							$ -
Nitrogen	Lb.	30.00	$ 0.43	$ 12.90	$ 0.03	$ 1.43	$ 0.07
Phospate (P2O5)	Lb.	90.00	$ 0.31	$ 27.90	$ 0.06	$ 3.10	$ 0.16
Potash (K2O)	Lb.	180.00	$ 0.23	$ 41.40	$ 0.09	$ 4.60	$ 0.23
Starter Fertilizer	Acre	1.00	$ 45.00	$ 45.00	$ 0.10	$ 5.00	$ 0.25
Weed Control	Acre	1.00	$ 34.00	$ 34.00	$ 0.08	$ 3.78	$ 0.19
Insect Control	Acre	1.00	$ 59.84	$ 59.84	$ 0.13	$ 6.65	$ 0.33
Disease Control*	Acre	1.00	$ 55.00	$ 55.00	$ 0.12	$ 6.11	$ 0.31
Machinery: Preharvest							
Fuel	Gallon	19.79	$ 2.25	$ 44.53	$ 0.10	$ 4.95	$ 0.25
Repairs & Maintenance	Acre	1.00	$ 21.86	$ 21.86	$ 0.05	$ 2.43	$ 0.12
Machinery: Harvest							
Fuel	Gallon	13.14	$ 2.25	$ 29.57	$ 0.07	$ 3.29	$ 0.16
Repairs & Maintenance	Acre	1.00	$ 14.19	$ 14.19	$ 0.03	$ 1.58	$ 0.08
Irrigation**	Acre	3.00	$ 10.50	$ 31.50	$ 0.07	$ 3.50	$ 0.18
Labor	Hrs	5.83	$ 10.00	$ 58.25	$ 0.13	$ 6.47	$ 0.32
Preharvest	Hrs	21.00	$ 10.00	$ 210.00	$ 0.47	$ 23.33	$ 1.17
Harvest	Hrs	40.00	$ 10.00	$ 400.00	$ 0.89	$ 44.44	$ 2.22
Interest on Operating capital	Percent	$ 730.97	8.00%	$ 58.48	$ 0.13	$ 6.50	$ 0.32
Harvest & Marketing Costs							
Bulk Harvesting & Handling	Each	450.00	$ 1.42	$ 637.50	$ 1.42	$ 70.83	$ 3.54
Total Variable Costs				**$ 2,157.92**	**$ 4.80**	**$ 239.77**	**$ 11.99**
Fixed Costs:							
Machinery: Depreciation, Taxes, Insurance, and Housing							
Preharvest	Acre	1.00	$ 62.36	$ 62.36	$ 0.14	$ 6.93	$ 0.35
Harvest	Acre	1.00	$ 51.30	$ 51.30	$ 0.11	$ 5.70	$ 0.29
Irrigation	Acre	1.00	$ 90.00	$ 90.00	$ 0.20	$ 10.00	$ 0.50
General Overhead	% of PH VC	$ 1,520.42	7.50%	$ 114.03	$ 0.25	$ 12.67	$ 0.63
Management	% of PH VC	$ 1,520.42	7.50%	$ 114.03	$ 0.25	$ 12.67	$ 0.63
Etc.	Acre	1.00	$ -	$ -	$ -	$ -	$ -
Other _____							
Total Fixed Costs				**$ 431.73**	**$ 0.96**	**$ 47.97**	**$ 2.40**
TOTAL COSTS AND PROFIT GOAL							
Total Costs Excluding Land				**$ 2,589.65**	**$ 5.75**	**$ 287.74**	**$ 14.39**
Net Returns above Specified Costs				$ 3,918.04	$ 8.71	$ 435.34	$ 21.77

Figure 7. Estimated Costs and Returns for Irrigated Irish Potatoes for Processing (Chipping).

Irish Potatoes
Irrigated, Chipping
SOUTH GEORGIA, 2007

ESTIMATED COSTS AND RETURNS

			Revenue/Acre
5 YEAR AVG MARKET YEAR PRICE	**172**	**$ 6.54**	**$ 1,125.43**
			$ -
			$ -
Expected Yield per Acre	**172**	CWT	**$ 1,125.43**

		CWT	Ton	50 # Sack
Expected Yield per Acre		172.08	8.60	344.17
Average Revenue per unit		$ 6.54	$ 130.80	$ 3.27

VARIABLE COSTS	Unit	Number of Units	$/Unit	Cost/Acre	$/CWT	Cost/ton	Cost/50# Sack
Seeds	CWT	14.00	$ 22.00	$ 308.00	$ 1.79	$ 35.80	$ 0.89
Lime	Ton	0.50	$ 32.00	$ 16.00	$ 0.09	$ 1.86	$ 0.05
Fertilizer						$ -	$ -
Nitrogen	Lb.	100.00	$ 0.43	$ 43.00	$ 0.25	$ 5.00	$ 0.12
Phospate (P2O5)	Lb.	200.00	$ 0.31	$ 62.00	$ 0.36	$ 7.21	$ 0.18
Potash (K2O)	Lb.	200.00	$ 0.23	$ 46.00	$ 0.27	$ 5.35	$ 0.13
Starter Fertilizer	Acre	150.00	$ 0.18	$ 26.25	$ 0.15	$ 3.05	$ 0.08
Weed Control	Acre	1.00	$ 31.25	$ 31.25	$ 0.18	$ 3.63	$ 0.09
Insect Control	Acre	1.00	$ 49.75	$ 49.75	$ 0.29	$ 5.78	$ 0.14
Disease Control*	Acre	1.00	$ 86.00	$ 86.00	$ 0.50	$ 10.00	$ 0.25
Machinery: Preharvest						$ -	$ -
Fuel	Gallon	19.96	$ 2.25	$ 44.92	$ 0.26	$ 5.22	$ 0.13
Repairs & Maintenance	Acre	1.00	$ 22.32	$ 22.32	$ 0.13	$ 2.59	$ 0.06
Machinery: Harvest						$ -	$ -
Fuel	Gallon	14.36	$ 2.25	$ 32.30	$ 0.19	$ 3.75	$ 0.09
Repairs & Maintenance	Acre	1.00	$ 25.96	$ 25.96	$ 0.15	$ 3.02	$ 0.08
Irrigation**	Acre	3.00	$ 10.50	$ 31.50	$ 0.18	$ 3.66	$ 0.09
Labor (Machinery/Tractor)	Hrs	6.05	$ 10.00	$ 60.54	$ 0.35	$ 7.04	$ 0.18
Preharvest	Hrs	14.00	$ 10.00	$ 140.00	$ 0.81	$ 16.27	$ 0.41
Harvest & Packing	Hrs	50.00	$ 10.00	$ 500.00	$ 2.91	$ 58.11	$ 1.45
Interest on Operating capital	Percent	$ 762.89	8.00%	$ 61.03	$ 0.35	$ 7.09	$ 0.18
Harvest & Marketing Costs						$ -	$ -
Harvest Crates	Each	68.83	$ 1.15	$ 79.16	$ 0.46	$ 9.20	$ 0.23
Total Variable Costs				**$ 1,665.98**	**$ 9.68**	**$ 193.62**	**$ 4.84**
Fixed Costs:							
Machinery: Depreciation, Taxes, Insurance, and Housing							
Preharvest	Acre	1.00	$ 64.74	$ 64.74	$ 0.38	$ 7.52	$ 0.19
Harvest	Acre	1.00	$ 67.74	$ 67.74	$ 0.39	$ 7.87	$ 0.20
Irrigation	Acre	1.00	$ 90.00	$ 90.00	$ 0.52	$ 10.46	$ 0.26
General Overhead	% of PH VC	$ 1,586.82	7.50%	$ 119.01	$ 0.69	$ 13.83	$ 0.35
Management	% of PH VC	$ 1,586.82	7.50%	$ 119.01	$ 0.69	$ 13.83	$ 0.35
Etc.	Acre	1.00	$ -	$ -	$ -	$ -	$ -
Other _____							
Total Fixed Costs				**$ 460.50**	**$ 2.68**	**$ 53.52**	**$ 1.34**
TOTAL COSTS AND PROFIT GOAL							
Total Costs Excluding Land				**$ 2,126.48**	**$ 12.36**	**$ 247.15**	**$ 6.18**
Net Returns above Specified Costs				$ (1,001.05)	$ (5.82)	$ (116.35)	$ (2.91)

Converting Potatoes into Ethanol

The process of converting potatoes into ethanol is well known. The process is similar to that used for converting corn into ethanol and in fact uses the same type of facilities, the wet milling process. According to information provided to the CAED by Dr. Elliot Altman at the University of Georgia, the following yield information from converting potatoes into ethanol have been obtained: One ton of sweet potatoes yields about 24.6 gallons of ethanol plus 288 pounds of dried distiller grains and solubles (DDGS). The sweet potato DDGS is about 8.2 percent protein and 4.3 percent fiber. One ton of white or Irish potatoes yields 25.4 gallons of ethanol and 170 pounds of DDGS. The Irish potato DDGS is about 24.1 percent protein and 4.7 percent fiber. For comparison purposes, one ton of corn yields about 96 gallons of ethanol and 643 ponds of DDGS that is about 25 percent protein.

Ethanol Production Facilities

A web search yielded the results of an ethanol impact assessment for the State of Idaho that included economic and operating cost data for four different sized, relatively small by current industry standards, ethanol production facilities capable of using potatoes as a feedstock. There were two ethanol plants in Idaho that at one time did in fact process potatoes into ethanol. Industry reports indicate that one of those plants has converted to using corn for the feedstock and no longer use potatoes or potato products while the other plant was idled. The following section relies heavily upon that study.

This study investigates the costs of producing ethanol with potatoes as a feedstock in four different sized plants: 10, 20, 32 and 37 million gallons of annual capacity. The feedstock requirements for the four plants if fed exclusively with potatoes are approximately: 406,000, 813,000, 1.3 million and 1.5 million tons, respectively. Recall that the combined sweet and Irish potato production in Georgia in 2006 was about 13,000 tons. Even the smallest plant studied would need a large supply of additional feedstocks unless potato production expanded by at least 63 fold and all the production was used to make ethanol. Of course, it may be possible to market any available potatoes to an existing nearby ethanol plants rather than construct a plant just for the potato supply.

There are significant economies of scale to be realized in the ethanol production industry. While small sized plants can be constructed, the capital cost per unit of output is high relative to larger plants. The following table illustrates the economies of scale for four small scale ethanol facilities capable of using potatoes and sweet potatoes as feedstock.

Capital Investment Costs of Various Sized Potato Ethanol Plants

	10mm Gal	**20mm Gal**	**32mm Gal**	**37mm Gal**
Total Investment	**$22.6 Mil.**	**$34.0 Mil.**	**$46.0 Mil.**	**$50.8 Mil.**
Capital Cost per Gallon	**$2.26**	**$1.70**	**$1.44**	**$1.37**

Capital costs per unit of capacity decline sharply as capacity rises. The high per unit capital investment places a large financial burden on the smaller plants. Since most plants will be constructed using debt to finance a portion of the capital costs, the per unit debt service level is higher on the smaller facilities than on the larger facilities. In other words, operating costs are also higher for the smaller plants because of the higher per unit debt service and return to equity.

The economies of scale can be observed in the operating costs of the various sized plants. Larger plants can spread several of the costs of operation over larger volumes of output. The following table illustrates the economies of scale in operation for most of the costs of operating ethanol production facilities. Since per unit costs of feedstock purchased are generally constant for various sized operations, that cost element is excluded. Note that many of the operating costs are directly proportional to plant size. However, the costs categories of direct labor and benefits, management and overhead, interest on capital and depreciation show appreciable scale economies. The result can be observed in the last line of the table where the per gallon cost of production declines as plant size increases.

The point of this discussion is that while it may be possible to erect a small sized ethanol plant to process a modest sized volume of feedstock, it is much more economical to erect a larger facility capable of utilizing multiple feedstocks that can be cost competitive with today's large volume facilities.

Economies of Scale in Operation of Various Sized Ethanol Facilities

Operating Expenses	10mm Gal	20mm Gal	32mm Gal	37mm Gal
Variable Expenses				
Chemical, Enzymes & Yeast	$769,524	$1,539,048	$2,462,476	$2,847,238
Natural Gas	$1,451,884	$2,923,977	$4,531,781	$5,097,111
Electricity	$439,665	$885,450	$1,372,331	$1,543,527
Denaturants	$340,000	$680,000	$1,088,000	$1,258,000
Fresh Water	$115,671	$236,720	$376,621	$437,280
Effluent Treatment & Disposal	$28,918	$59,180	$94,155	$109,320
Direct labor & Benefits	$644,828	$868,995	$1,083,476	$1,185,874
Management & Consulting	$200,000	$400,000	$640,000	$740,000
Administration & Overhead	$1,543,994	$1,871,537	$2,356,931	$2,508,104
Total Variable Expenses per Unit	**$0.55**	**$0.47**	**$0.44**	**$0.43**
Fixed Costs				
Interest on Capital	$1,019,007	$1,533,155	$2,070,502	$2,284,329
Depreciation	$982,808	$1,470,025	$1,970,635	$2,169,635
Total Fixed Expenses per Unit	**$0.20**	**$0.15**	**$0.13**	**$0.12**
Total Operating Costs	$7,536,300	$12,468,088	$18,046,908	$20,180,419
Cost per Unit	**$0.75**	**$0.62**	**$0.56**	**$0.55**

Total Cost of Ethanol Production

The processing cost for producing ethanol is typically only about one-third of the total costs of the operation. The major cost element is feedstocks which are typically around two-thirds of the total costs. Those numbers will vary slightly as feedstock prices change but the key point is that feedstock is the primary cost item in producing ethanol.

Breakeven Price for Potato Feedstocks for Ethanol Production

One method for determining the feasibility of converting potatoes into ethanol is to determine the price that could be paid for the potatoes that would generate a no-profit/no-loss or breakeven result at the ethanol plant. The following table illustrates the breakeven potato price for the four different sized ethanol plants. These results were derived from economic models derived from the Idaho study. The production models for the four plants use the UGA ethanol yield data and an ethanol sales price of $2.39 per gallon and a DDGS sales price of $85.00 per ton. At prices paid for the feedstock greater than those listed below, losses in the ethanol conversion plant will be incurred. Alternatively, in order to make a profit at the ethanol plant, the price paid for the potatoes must be less than those shown below.

Breakeven Price per Ton for Feedstock Potatoes used to Produce Ethanol

	10mm Gal	20mm Gal	32mm Gal	37mm Gal
Sweet Potatoes	$52.50	$55.80	$57.25	$57.60
Irish Potatoes	$49.20	$52.50	$54.00	$54.50

When one compares the breakeven feedstock prices with the cost of production for potatoes, it becomes clear that it would not be feasible to produce potatoes strictly for the ethanol market. Cull potatoes with little or no value do not seem to be readily available in Georgia. Thus, there would seem to be limited potential for ethanol production from potatoes at this time. Even if the information gathered from the industry concerning cull rates is in error, even the smallest size facility would require 180,000 acres to produce potato ethanol at 25 percent cull rate or 90,000 acres at 50 percent cull rate.

So, to answer the question posed in the introduction, it is not likely that there is sufficient potential income from converting potatoes into ethanol to stimulate the expansion of the potato industry in Georgia.

The Center for Agribusiness & Economic Development

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>
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