# Economic Impact of the North American Cranberry Industry

Report

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## Executive Summary

This study reports on the economic impact of the North American cranberry industry. The study entailed collection of primary data on cranberry production and processing from public sources and, in some cases, from proprietary sources on a confidential basis. These data were assimilated and interpreted to create a complete picture of the production and processing of cranberry products and the economic value derived from this activity in key U.S. states and Canadian provinces and for the United States and Canada in total.

The primary economic activity created by the production and processing of cranberries stimulates additional economic activity through the normal workings of the economy. Income created in one sector of the economy reverberates to other sectors as people and businesses purchase goods and services. These so-called “multiplier” impacts were estimated using widely accepted regional economic modeling frameworks, the Impact Analysis for Planning (IMPLAN) model for the U.S. cranberry industry and the Statistics Canada’s input-output model for the Canadian cranberry industry. Both models were adapted by the research team to enable them to best fit the economic conditions of the cranberry industry. The findings illustrate the important economic contributions made by the industry to income and employment in the regions where production and processing take place.

On average, during the four most recent years in which complete data are available, 2009–2012, the cranberry industry in the United States was responsible annually for $3.55 billion in value-added output and 11,610 jobs. During this same period, on average the cranberry industry in Canada has been responsible for $411

million in value added output and 2,708 jobs annually. The cranberry industry is an integral part of the economies of key states and provinces. At $936 million in total value added, the cranberry sector in Wisconsin is just shy of being a one billion dollar industry. In total, cranberries are responsible for 3,977 jobs in Wisconsin. The loss of 100 acres planted to cranberries in Wisconsin would reduce the value of sector output in the State by $6.34 million, and would imply losses of an estimated 29 jobs, $386,000 in federal tax revenues, and $185,000 in state and local tax revenues. The cranberry sector in Massachusetts is over a quarter billion dollar industry and is responsible for 1,682 jobs. Québec is the leading cranberry producing and processing Province in Canada, responsible for $365 million in value added and 2,269 jobs.

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# 1 Introduction

This study reports on the economic impact of the North American cranberry industry. Although the impacts of various segments of the industry have been analyzed in previous studies, no study of the industry to date is as comprehensive as this study in terms of its geographical coverage and inclusion of both the production and the processing sectors. Although some prior studies have used the same input-output modeling tools utilized here, none has augmented those models to better represent conditions in the cranberry industry, as has been done here.

The study was undertaken at the behest of the Cranberry Marketing Committee (CMC) jointly on behalf of the Cranberry Institute and the British Columbia Cranberry Growers Commission. Cranberry production takes place mostly on small farms, principally in the U.S. Northeast (Massachusetts and New Jersey), Upper Midwest (Wisconsin), and Northwest (Oregon and Washington). Canadian production occurs in the East (Quebec and Maritime Provinces—New Brunswick, Nova Scotia, and Prince Edward Island) and West (British Columbia).

To economize on costs of transporting the farm product, primary processing of cranberries into concentrate, sweetened dried cranberries, cranberry sauce, and fresh cranberries generally occurs near the producing regions. Frozen cranberry concentrate is readily transportable, so cranberry juice products are manufactured from concentrate elsewhere, as well as in the producing regions. For the purposes of the study, the industry is defined to include all cranberry production in the United States and Canada, as well as value-added activities consisting of transport of cranberries and processing them into various products including concentrate, juice, sauce, fresh cranberries, and sweetened dried cranberries (SDCs).[1]

On average over the four most-recent years in which complete data are available, 2009–2012, the cranberry industry in the United States was responsible annually for $3.55 billion in value-added output and 11,610 jobs, and the cranberry industry in Canada was responsible annually for $411 million in value-added output and 2,708 jobs. This income and employment derive from farm production of cranberries in key states and provinces, augmented by value-added processing occurring in these same states and provinces, as well as others. This primary economic activity begets additional economic activity through the normal workings of the economy. Income created in one sector of the economy reverberates to other sectors as people and businesses purchase goods and services. We estimated these indirect and induced (aka "multiplier") impacts using widely accepted regional economic modeling frameworks, the Impact Analysis for Planning (IMPLAN) model for the U.S. cranberry industry and the Statistics Canada's input-output model for the Canadian cranberry industry.

The first phase of the project involved collection of primary data on cranberry production and processing from public sources and, in some cases, from proprietary sources on a confidential basis. Phase 2 involved assimilating and interpreting these data to create a complete picture of the production and processing of cranberry products in key U.S. states and Canadian provinces and for the United States and Canada in total.

Both the IMPLAN model and the Statistics Canada input-output model are too aggregative to deal specifically with cranberry production and processing. Instead,

[1] Economic activity associated with cranberries certainly extends "downstream" beyond this processing stage to include food manufacturers who use cranberry products as ingredients, food service, and grocery

cranberries are subsumed within broader industry categories. Phase 3 of the analysis thus involved modifying the input-output models using accepted methods to enable them to better depict the U.S. and Canadian cranberry industries. In the case of the IMPLAN model, production coefficients for the broader industry categories were modified to better suit cranberry production and processing using cost-of-production studies for cranberries compiled by various sources and processing cost information provided by U.S. cranberry handlers on a confidential basis. Phase 4 of the analysis then involved application of the modified input-output models to estimate the multiplier effects from cranberry production and processing on the U.S. and Canadian economies. We also utilized the input-output models to simulate "what if" scenarios involving (i) an incremental expansion of cranberry production in each major producing state and province and (ii) increasing the net revenue from cranberry production by $1.00 per barrel as a result, for example, of changes in tax or regulatory policies.

This report has five main sections following this Introduction. Section 2 provides an overview of the industry including its structure and production and pricing trends and patterns. Section 3 briefly reviews prior studies on the impact of various segments of the cranberry industry. Section 4 describes our methodology in detail, while section 5 provides the core impact results from the analysis. Section 6 reports results of the what-if simulations.

## 2 Overview of the Industry

Cranberries are a perennial crop grown in bogs or marshes. They have an exceptionally long productive life—100 or more years in some cases. The global cranberry industry is dominated by production in the United States and Canada. United Nations Food and

Agricultural Organization (FAO) statistics indicate that in 2012 the United States produced 364,915 metric tons (8.04 million barrels—bbl) of cranberries and Canada produced 126,963 metric tons (2.79 million bbl).[2] This amounts to 94% of global production of cranberries; Chile and a few European countries account collectively for the remaining 6% of total world production. Our study of the North American industry is, therefore, tantamount to a study of the global cranberry industry.[3]

### *2.1 Industry Structure*

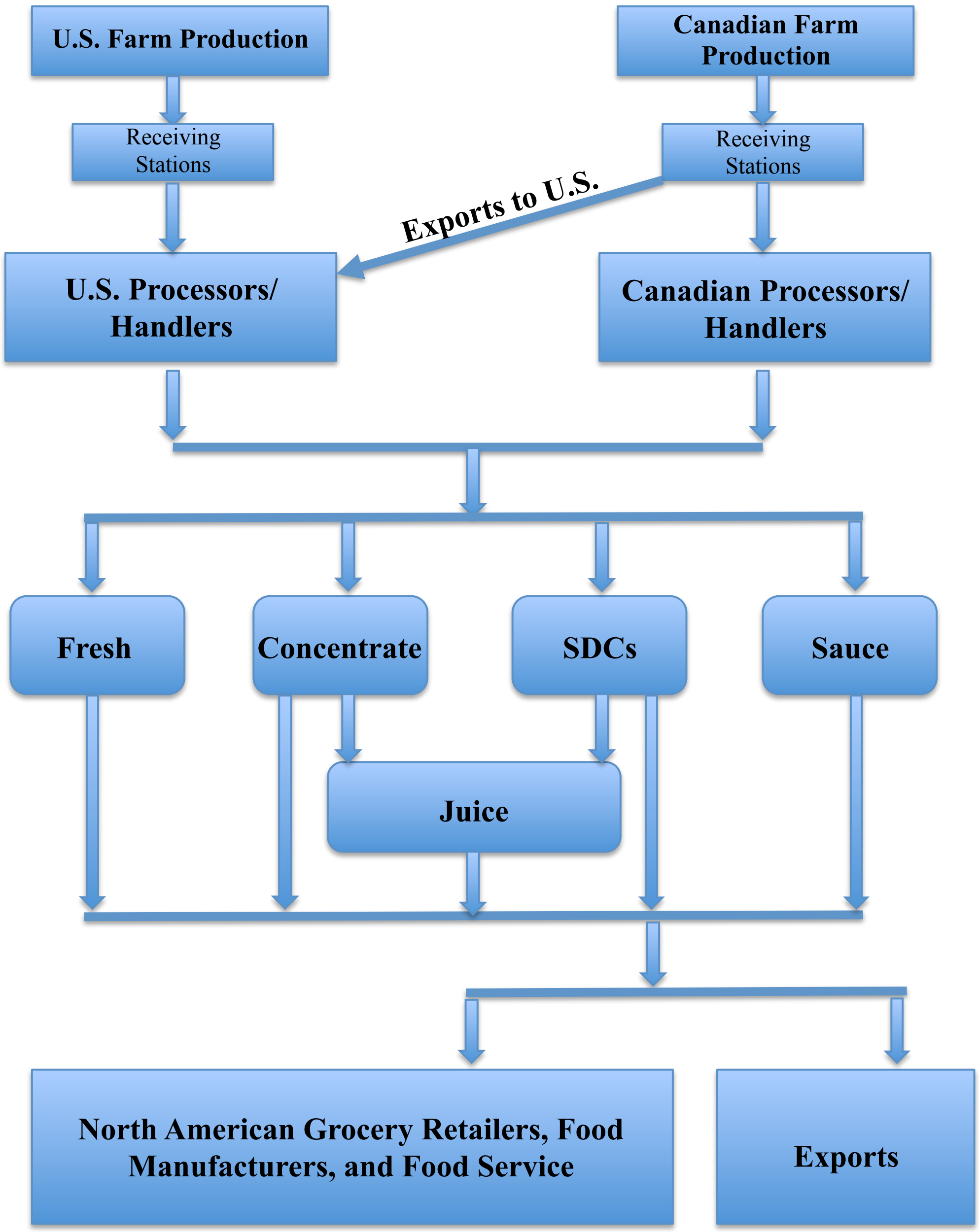
Figure 1 summarizes the structure of the North American cranberry industry. Production takes place mostly on small farms, principally in the U.S. Northeast (Massachusetts and New Jersey), Upper Midwest (Wisconsin and to a minor extent Michigan), and Northwest (Oregon and Washington).[4] Canadian production occurs in the East (Quebec and Maritime Provinces—New Brunswick, Nova Scotia, and Prince Edward Island) and West (British Columbia). Cranberries (*vaccinium macrocarpon*) are harvested in the fall in North America and either shipped directly to processing facilities or to receiving stations operated by processor/handlers en route to processing facilities.

[2] A 100 lb. barrel (bbl) is a standard unit of measurement for the cranberry industry and in this report.

[3] Our analysis refers only to production and processing that takes place in North America. Consequently Chilean production was excluded. Primary processing of Chilean cranberries takes place in Chile but Chile produces and exports some concentrate. Our analysis would be impacted to the extent that Chilean concentrate came to the United States for secondary processing, but it seems much more likely that Chilean concentrate is processed elsewhere. Errors, if any, from this source will have been very small.

[4] The average farm size in the five major producing states in the U.S. is 42.2 acres.

**Figure 1.** *North American Cranberry Industry Structure*




The largest processor/handler is a grower-owned cooperative, Ocean Spray, located in Lakeville-Middleboro, Massachusetts. Ocean Spray has about 750 members in the United States and Canada. Although most Ocean Spray members grow cranberries, the cooperative also has citrus grower members in Florida. Ocean Spray annually handles over 50% of the U.S. cranberry harvest, and sources fruit from all major producing areas in the United States. Ocean Spray also imports substantial volumes from both Eastern and Western Canada. The company manufactures all major cranberry products including fresh cranberries, cranberry concentrate, sweetened dried cranberries (SDCs), cranberry-based juices, and cranberry sauce.

Other major processor/handlers in the United States include Clement Pappas, a subsidiary of Lassonde Industries, headquartered in Carneys Point, New Jersey; Decas Cranberry Products, located in Carver, Massachusetts; Mariani Packing Company with headquarters in Vacaville, California; and Milne Fruit Products, located in Prosser, Washington.

Clement Pappas sources cranberries in the U.S. Northeast and Eastern Canada and specializes in producing sauces and juice for private-label brands. Decas Cranberries also sources product in this same region and sells primarily cranberry concentrate and SDCs to retail, industrial, and food service buyers. Mariani's cranberry operations are located in Wisconsin, where it specializes in selling SDCs to industrial users and under its own label. Milne Fruit Products sources cranberries in the Northwest and specializes in production of cranberry juice concentrates and SDCs.

About 77% of cranberries grown in Québec are processed there. The leading processor/handler is Fruit d'Or, located in Notre-Dame-de-Lourdes, Québec. Fruit d'Or sources fruit mainly in Québec, and manufactures a variety of cranberry products including SDCs and juice concentrate. Québec is the largest organic cranberry producing area in North America and Fruit d'Or markets the majority of that production. Atoka Cranberries is located in Manseau, Québec and sells primarily SDCs and fresh cranberries. Most cranberry growers in British Columbia are members of Ocean Spray, and Ocean Spray maintains offices in Richmond, BC. Production by Ocean Spray's British Columbia members is processed by Ocean Spray primarily in Washington. Thus, little processing is done in British Columbia—on average only about 6% of the Provincial production has been processed locally. Lucerne Foods, which operates a processing plant in Abbotsford, BC, purchases most of the British Columbia production that is not handled by Ocean Spray.[5] Most or all of the production in the Maritime Provinces is processed in the United States

Cranberry production in the United States is conducted under the auspices of a Federal marketing order that was established in 1962. The order is administered by the Cranberry Marketing Committee (CMC), which consists of 13 grower members, nine grower alternates, one public member, and one public alternate member. Members are elected from four regional production districts, and the Order includes provisions for representation by growers who market with the major cooperative, Ocean Spray, and who market through independent processor/handlers.[6] The Order contains provisions for the Committee to recommend to the USDA a volume regulation that would apply to cranberry production within the area defined by the Order and to collect assessments for the purposes of funding research and promotions in both the domestic and international markets.

Cranberries are expensive to ship in their raw form because they are bulky and require refrigerated transportation. For this reason first-stage processing is conducted near the growing regions. Key processing and handling facilities in the Northeast include Clement Pappas and Ocean Spray receiving stations in Carver, MA, an Ocean Spray

[5] Fenske (2011) provides an overview of the cranberry sector in British Columbia.

[6] The public member and alternate are not elected, but rather, nominated by Committee members.

concentrate and SDC manufacturing plant in Middleboro, MA, and a Decas concentrate and SDC manufacturing plant in Carver. In New Jersey, Ocean Spray operates a receiving plant in Chatsworth and a juice plant in Bordentown.[7] Clement Pappas operates a juice and sauce manufacturing plant in Seabrook.

Several facilities are located in Wisconsin, given that State's status as the largest cranberry producer. Ocean Spray operates a receiving station in Babcock, a concentrate and SDC plant in Wisconsin Rapids, an SDC plant in Tomah, and a juice and sauce plant in Kenosha. Mariani's plant is also located in Wisconsin Rapids. Habelman Brothers is an integrated grower-handler in Wisconsin that specializes in sales to the fresh market. Its plants are located in Milliston and Tomah. Small amounts of SDCs are also manufactured in neighboring Michigan by diversified dried-fruit processors, Graceland Fruit and Cherry Central.

In the Northwest, Ocean Spray operates a receiving station in Long Beach, WA and a diversified processing plant in Markham, WA that produces sauce, SDCs, and fresh cranberries. Milne Fruit's plant is located in Prosser, WA. Oregon fruit acquired by Ocean Spray is processed in Washington. There are several grower-handler and handler operations in Oregon that collectively produce a mix of cranberry products.

Production of concentrate reduces a 100 lb. barrel of raw berries into approximately 1.7 gallons of semi-finished product, with the exact conversion rate depending upon the brix (sugar) content of the berries. Concentrate manufacture also yields a byproduct, cranberry presscake, which is high in phytonutrients. Frozen cranberry concentrate is

[7] Ocean Spray's Bordentown plant was scheduled for closure in 2014 coinciding with the launching of a new juice-manufacturing facility in Lehigh Valley, Pennsylvania. The Bordentown plant operated throughout the 2009–2012 period of this study.

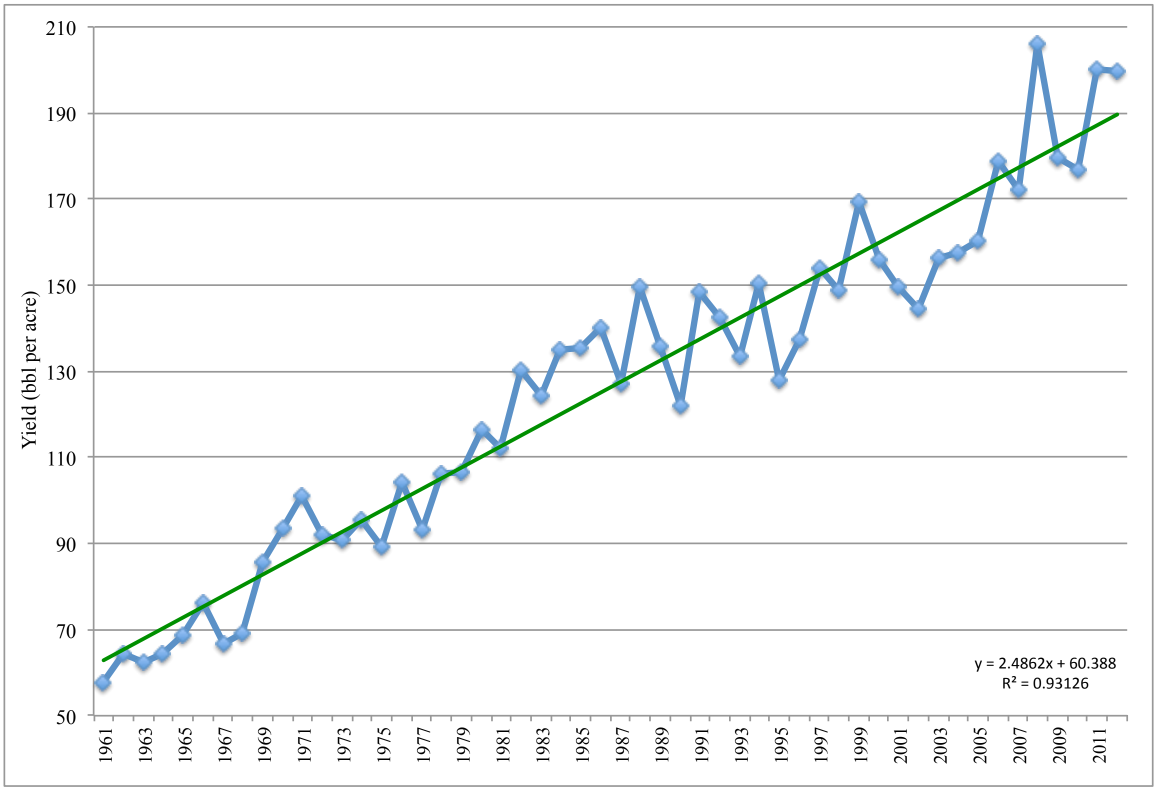
readily transportable, and for this reason a significant portion of juice manufacturing takes place outside of the cranberry producing areas. It is economical to blend in water and other ingredients with concentrate closer to consuming areas rather than to ship it in finished form exclusively from the producing regions. For example, Ocean Spray operates juice-manufacturing facilities in Sulphur Springs, Texas and Henderson, Nevada, in addition to doing juice manufacturing in the producing regions at Kenosha, Wisconsin, and Bordentown, New Jersey.

A 100 lb. barrel of cranberries yields approximately 50 lbs. of SDCs and a gallon of concentrate as a byproduct. As with concentrate manufactured directly from raw berries, this byproduct, known as CCE concentrate, is used primarily in the manufacture of juices.

### *2.2 Cranberry Production Patterns*

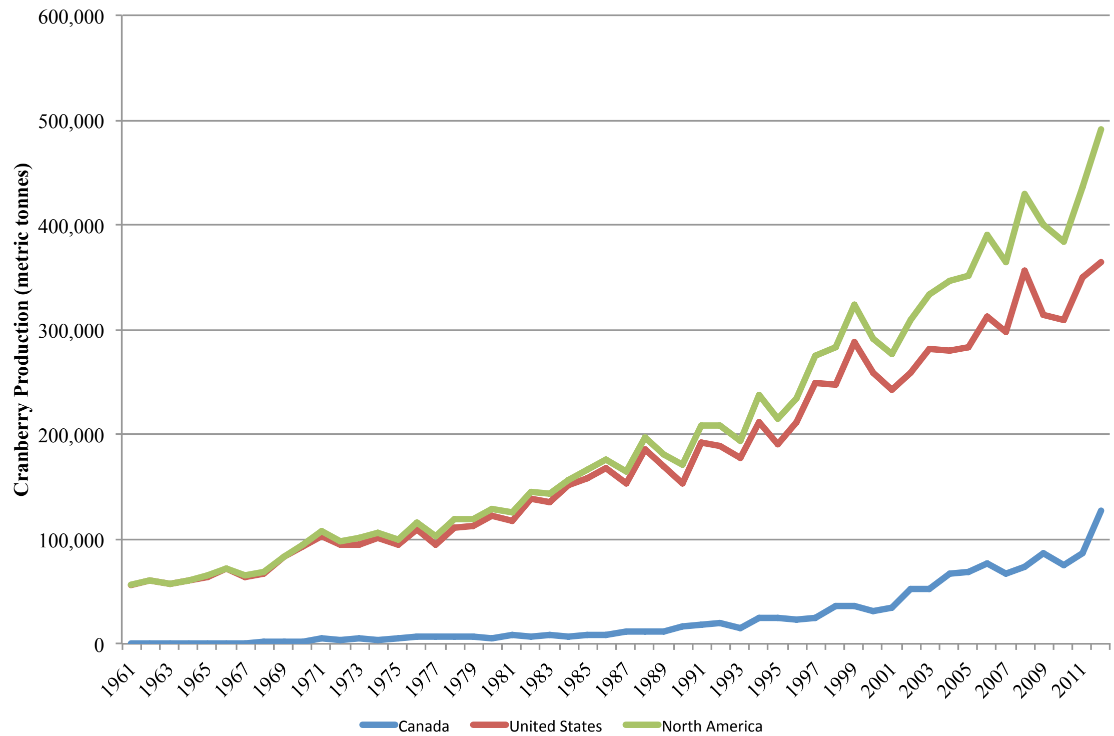
Cranberry production in North America has been increasing over time, reflecting both acreage and yield growth. After growing from the mid-1980s through 2000, total harvested acres in the United States remained relatively steady for the next decade, but jumped sharply in 2012 to a total of 40,300 acres, an all-time high. Yields have increased steadily over this period as illustrated in Figure 2. A linear trend line fitted to bbl per acre yields over the 52 years, 1961–2012 accounts for about 90% of the variation in yields over this period. The slope of the trend line indicates that U.S. average cranberry yield has increased by 2.5 bbl per acre per year on average over this entire period, but the rate of increase has been faster, 4.9 bbl per acre per year, for the most recent ten-year period.

**Figure 2.** *U.S. Cranberry Yield, bbl per Acre, 1961–2012*




Canadian production has also been increasing, reflecting both rising yields and increasing acreage. Figure 3 depicts North American production for the years 1961–2012 (the raw data, in metric tonnes, are contained in Appendix Table 1). Since 1961, Canadian production has grown faster than U.S. production. Consequently, the Canadian share of North American production has trended up from less than 2% in the 1960s to around 5% in the mid-1980s, thereafter increasing rapidly to around one-fifth, before spiking at over one-fourth of the total in 2012. Combining the U.S. and Canadian totals, North American production of cranberries grew at an average annual rate of 4.3% over the period 1961–2012.

**Figure 3.** *North American Cranberry Production, 1961–2012*




Source: UN FAO, FAOSTAT.

Cranberry production by leading U.S. states and Canadian provinces is summarized in Table 1. Wisconsin is the leading U.S. cranberry producer by a considerable margin, producing over 4.8 million bbl in 2012, about 60% of the U.S. harvest. Cranberries are the seventh-most important agricultural product in Wisconsin. The State's production has been increasing relatively rapidly—by 880,000 bbl from 2009 to 2012. Massachusetts, the second-leading U.S. producer, harvested over 2.1 million bbl in 2012, 26% of the U.S. total, and cranberries are the second-most important agricultural product in Massachusetts, behind only greenhouse and nursery products.

The largest producing Canadian province is Quebec, which produced 1.855 million bbl in 2012, more than double its production only two years previously and over 60% of the total Canadian supply. Because cranberry bogs are relatively young in Quebec and contain modern vines, Quebec's yields, 262 bbl/acre in 2012, tend to be the highest in North America. British Columbia produces much of the rest of Canada's production—944 thousand bbl in 2012. Cranberry production has only recently become established in the Maritime Provinces of Atlantic Canada and totaled 155 thousand bbl in 2012.

**Table 1.** *U.S. and Canadian Cranberry Production (bbl): 2009–2012*

| **United States** | | | | |
|---|---|---|---|---|
| | **2009** | **2010** | **2011** | **2012** |
| Massachusetts | 1,817,000 | 1,891,000 | 2,317,000 | 2,123,000 |
| New Jersey | 555,000 | 562,000 | 510,000 | 550,000 |
| Oregon | 430,000 | 287,000 | 361,000 | 405,000 |
| Washington | 161,000 | 108,200 | 115,700 | 137,000 |
| Wisconsin | 3,950,000 | 3,960,000 | 4,410,000 | 4,830,000 |
| ***U.S. Total*** | ***6,913,000*** | ***6,808,200*** | ***7,713,700*** | ***8,045,000*** |
| **Canada** | | | | |
| | **2009** | **2010** | **2011** | **2012** |
| British Columbia | 788,419 | 643,851 | 607,521 | 944,051 |
| Quebec | 963,619 | 918,959 | 1,193,306 | 1,854,980 |
| Atlantic Canada | N/A | N/A | 110,000 | 154,750 |
| ***Canadian Total*** | ***1,752,038*** | ***1,562,810*** | ***1,910,827*** | ***2,953,781*** |
| Source: CMC. | | | | |

### *2.3 Demand and Price Trends*

Grower prices and prices received downstream for processed products in the cranberry industry reflect the consequences of growth in global supply (mainly in North America) and growth in global demand. Table 2 details U.S. exports to counties where CMC conducts product promotions. U.S. exports have grown eightfold over the most recent 10-year period. The fundamental sources of growth in demand, both domestically and abroad, are rising population and increasing per capita incomes, the latter being especially important for foods like cranberries for which demand is relatively responsive to income growth.

**Table 2.** *U.S. Exports (bbl) to Countries where CMC Conducts Promotions (Sept./Aug.)*

| Exports (bbl) to Countries where CMC Conducts Promotions | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2002/03** | **2003/04** | **2004/05** | **2005/06** | **2006/07** | **2007/08** | **2008/09** | **2009/10** | **2010/11** | **2011/12** | **2012/13** |
| Australia | | | 59,532 | 52,588 | 84,572 | 77,562 | 64,116 | 96,080 | 100,169 | 112,044 | 97,573 |
| Austria | 33 | | | | | | | 6,815 | 8,832 | 8,892 | 2,883 |
| China | 7,370 | | 1,804 | 1,398 | 1,961 | 7,414 | 5,022 | 14,297 | 18,670 | 15,496 | 28,861 |
| Czech Republic | 1,233 | | | | 283 | 391 | 471 | 3,077 | 7,098 | 5,795 | 8,350 |
| France | 200 | 25 | 21,564 | 29,876 | 43,641 | 70,122 | 69,849 | 87,279 | 91,171 | 111,273 | 106,858 |
| Germany | 50,847 | 80,091 | 73,099 | 60,552 | 107,637 | 167,470 | 159,173 | 175,615 | 278,963 | 242,503 | 245,035 |
| Japan | 27,538 | 33,479 | 27,987 | 20,145 | 19,617 | 16,543 | 21,506 | 17,097 | 27,299 | 19,601 | 21,367 |
| Korea | 200 | 1,439 | 2,025 | 2,050 | 2,972 | 5,319 | 8,743 | 8,962 | 14,083 | 15,463 | 27,070 |
| Mexico | 16,989 | 18,532 | 16,259 | 24,667 | 34,469 | 49,813 | 70,619 | 72,837 | 98,621 | 109,502 | 123,471 |
| Netherlands | 516 | | 2 | | 37,118 | 46,222 | 40,931 | 55,258 | 55,874 | 69,705 | 70,415 |
| Poland | | | | | 2,014 | 1,117 | 985 | 6,999 | 31,194 | 23,143 | 37,033 |
| Russia/Baltics | 2,000 | | | | 11,427 | 3,213 | 843 | 2,351 | 55,750 | 66,377 | 72,197 |
| Spain | | 7 | 2,968 | 2,003 | 2,685 | 2,698 | 3,350 | 10,106 | 15,413 | 19,561 | 12,558 |
| Switzerland | | | | 1,911 | 15,331 | 16,168 | 22,096 | 31,110 | 27,241 | 19,623 | 24,133 |
| **Total** | 106,926 | 133,572 | 205,239 | 195,191 | 363,727 | 464,054 | 467,705 | 587,883 | 830,379 | 838,977 | 877,804 |
| Source: Exports by Volume spreadsheet provided by Bryant Christie, Inc. (FY 2000/02 - FY 2012/13). | | | | | | | | | | | |

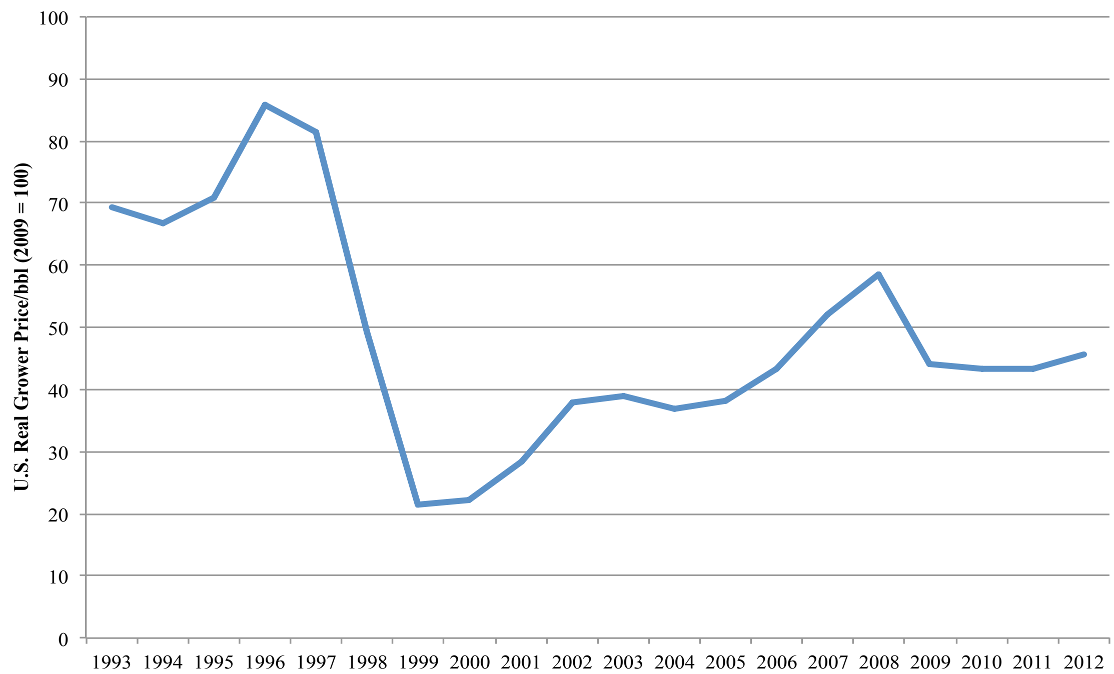
Demand growth for cranberries has also been enhanced by successful investments in new, value-added products (such as SDCs and foods made with them, and innovative juice drinks) and other marketing efforts, especially to take advantage of increasing health consciousness of consumers. The cranberry industry has engaged in such marketing through the voluntary efforts of handlers and a collective program operated under the auspices of the CMC.[8] These efforts appear to have been successful based upon the recent study conducted by Sexton and Saitone (2012).

Figure 4 plots the average annual real grower prices of U.S. cranberries over a 20-year period, 1993–2012.[9] The several forces promoting demand growth have been sufficient to sustain and even increase real prices over much of this time, despite the rapid growth in supply over this same period, as illustrated in Figures 2 and 3. However, prices fell precipitously in the late 1990s when supply growth, fueled by rising real prices, outpaced demand growth and inventories accumulated as a consequence.

[8] The British Columbia Cranberry Marketing Commission has partnered with the CMC on promotions to export markets (Fenske 2011).

[9] Prices are deflated using the GNP deflator, base year 2009.

**Figure 4.** *U.S. Real Grower Prices for Cranberries, 1993–2012*




Source: U.S. Department of Agriculture, National Agricultural Statistics Service

Because cranberries are storable across crop years, weak prices motivate handlers to carry greater inventories in hopes that prices will improve. Increasing inventories, however, have a depressing effect on market prices because any impetus for price to increase due to tightening of supply, relative to demand, is quickly quelled by releases of product from inventories. Thus, above-normal inventories have a depressing impact on price for both growers and handlers.[10]

The U.S industry implemented a volume-control program for the 2000-01 and 2001-02 crop years through its Federal Marketing Order. Ocean Spray growers in British Columbia also cooperated with this volume-control program. The ensuing reduction in supplies enabled the industry to draw down inventories to manageable levels and return

[10] The normal volume of year-end inventories varies across handlers depending upon their marketing practices. Experts suggest that on an industry-wide basis a 45–50% end-of-season inventory is appropriate, and that the optimal percentage of inventory to carry forward is probably increasing over time due to the rising importance of SDCs and international markets as outlets for cranberries.

to a path of rising real grower prices. Real grower prices remained stable in the mid $40/bbl range from 2009 through 2011 despite total production increasing nearly 10% during this period as a result of the industry's success in growing demand. One key element of this success were the rapid growth in sales of SDCs domestically and internationally.

## 3 Prior Impact Analyses of the Cranberry Industry

A few prior studies have conducted impact analyses of segments of the North American Cranberry industry. None has been as comprehensive as this study. Kashian et al. (2012) recently examined the impact of the cranberry industry in Wisconsin. The authors report that, based upon a five-year average for crop yield and price, the industry contributed $388,347,447 in sales to Wisconsin's economy and created 3,839.5 annual full-time jobs. The effective sales multiplier was 1.74.[11] A similar study by Jesse and Deller (2007) for Wisconsin reported that a 1,000-acre expansion in cranberry acreage would increase total industry output by $15.4 million and increase employment by 223.3 jobs. The sales multiplier in this study was 1.68, similar to that employed in the study by Kashian et al. (2012). In a study of specialty crop production and processing, Arledge and Mitchell (2010) concluded that the cranberry (production) sector for Wisconsin generates about $300 million in total economic activity and 3,400 jobs, with multiplier effects of 1.51 for sector output and 1.48 for employment.

Knudson (2012) studied the economic impact of a 500- or 2,500-acre expansion of cranberry production in Michigan. The study found that expanding Michigan cranberry

[11] Although the study is not explicit on this point, it appears that these impacts apply only to cranberry production—i.e., the processing sector is not a part of the study.

acreage by 500 (2,500) acres would generate an economic impact of $5.93 million ($29.7 million) and 75 (383) jobs for farm production. This study also considers the downstream impact on concentrate production: the net impact of this segment of the industry for a 2,500-acre expansion was estimated to be $14.7 million and 103 jobs annually.

A study conducted by Zins Beauchesne et associés (2012), on behalf of Association des Producteurs de Canneberges du Québec, estimated the economic impact of the Québec cranberry industry to be $60.3 million and 1,202 annual full-time jobs. To date, however, no comprehensive economic impact assessment has been conducted for the North American cranberry industry, including crop production and processing.

## 4 Methodology

As noted, for the purposes of this study the cranberry industry encompasses all aspects of producing cranberries, transporting them to processing facilities, processing them into concentrate, sauces, SDCs, and fresh cranberries (i.e., primary, or first-stage processing), and processing the concentrate into value-added products, most notably juices (i.e., secondary, or second-stage processing) in North America. In this section, we describe the methodology used to estimate the economic impact of the industry. Methods used differed between the United States and Canada owing to differences in data availability and availability of economic models for estimating secondary impacts. Thus, we discuss methods used for the two countries separately, first addressing the methods used to quantify primary impacts, then discussing the procedures for estimating secondary or multiplier effects.

### *4.1 Generating Measures of Primary Impacts for the U.S. Cranberry Industry*

Good data are available on cranberry production by U.S. state and Canadian province, as reported in Table 1. Data on acquisitions of cranberries from Canada by U.S. handlers are also available through the CMC. This information is important to the study because, for cranberries imported into the United States from Canada, the primary production value is an economic impact in Canada, but the value added in processing is an impact in the United States.

The USDA National Agricultural Statistics Service (NASS) reports the average value of farm production in each crop year. Ocean Spray's position as the largest cranberry processor/handler in North America complicates the interpretation of average grower prices. Cranberry growers who are members of Ocean Spray receive a price that reflects not only the (commodity) market value of raw cranberries but also the per bbl net value associated with Ocean Spray's processing and marketing activities. This fact is important to our analysis because, given Ocean Spray's large share in the North American market, the price it pays its growers has a large impact on cranberry prices reported by the USDA and, thus, those reported prices need not reflect the actual (commodity) market value of cranberries at the farm level. In order to accurately depict and isolate the impacts attributable to farm production and processing/handling activities, we utilized the price paid by Ocean Spray in its "B pool" to represent to commodity value of cranberries at the farm.[12]

[12] Ocean Spray utilizes both an A and a B pool. The A pool reflects all of the value added activities that the Cooperative undertakes. Cranberries in the B pool are utilized mainly in the manufacture of concentrate, and thus the B pool value more closely represents the pure commodity value of a bbl of cranberries.

Data on production and commodity prices were combined to generate measures of the primary impacts of cranberry production on value of output and employment. Both production and cranberry prices can be somewhat volatile, and particular years may not be representative of the longer-term structure of production and prices. To prevent any particular year's production and prices from unduly influencing results, we used average production and values over the years 2009–2012, the most recent four years for which complete data are available for both raw cranberries and processed cranberry products in order to prevent the variability in any one year's production cycle from unduly influencing results.

Data on downstream processing activities and values are not publicly available for the most part, [13] and we relied therefore upon various methods, including the cooperation of the industry partners to generate the necessary information on primary impacts from processing activities. We solicited detailed information from the major firms handling the vast majority of production, but we did not contact every cranberry handler or processor in North America and some of those whom we contacted did not respond and provide all the information we requested.

This incomplete response does not invalidate our methodology and does not mean our analysis does not encompass every handler. We had complete data on cranberry production. Our methodology ensured that every cranberry produced in the United States and Canada was counted as being processed into concentrate (and then to juice), SDC, or

[13] Publicly available data on food production and manufacturing activities is available through the U.S. Census Bureau's North American Industry Classification System (NAICS). However, both cranberry production and processing are part of broader industry classifications. Cranberry production is included in NAICS 111334, Berry (except strawberry) farming, while most cranberry processing is included within NAICS 311421, Fruit and Vegetable Canning. For the most part, these classifications were too aggregative to be useful for the purposes of this study.

sauce, or sold as fresh cranberries. Since we did not get information from some processors as to what they produced, we had to make inferences and educated guesses to fill in the gaps in the data provided about the disposition of the cranberries among products. Similarly we had to base the parameterization of our models of primary and secondary processing—in terms of value added and employment—for the industry as a whole, state-by-state and province-by-province, on the information that was provided by the cooperating processors.

To make the analysis as accurate as possible, each of the major processing activities—manufacture of concentrate, SDCs, sauce, juice, and fresh cranberries—was first measured and analyzed separately. The disaggregated results were later aggregated across processing activities, and are reported in that form here to preserve the confidentiality of information provided by individual processor/handlers.

In general, we knew the quantity of processed product(s) produced in each of the major processing facilities discussed in section 2 and, in some but not all instances, the throughput capacity of the plant in terms of bbl of raw cranberries. In most cases we did not know the breakdown of throughput within a plant when the plant produced multiple processed products, as several do, and had to make educated inferences in those cases.

A key to guaranteeing the accuracy of the analysis of economic impacts from cranberry processing activities was our requirement that each barrel of cranberries produced in North America be processed into one of the aforementioned forms at a plant in North America.[14] In any single year, this assumption might not be completely accurate

[14] We did not account specifically for minor products made from cranberries, such as cranberry powders, because we lacked any information on how much of these products were produced and where they were produced. This omission will not bias our analysis of industry impacts unless the value added associated with these minor products is markedly different from that of the major products that were studied.

because of the accumulation and drawdown of inventories as discussed previously.[15] However, given that handlers seek to carry forward 45–50% of anticipated demand to handle the transition across crop years, over a period of years gains and losses to inventories should roughly balance. Indeed that is the case for the period, 2009–2012 analyzed in this study. Based upon CMC statistics, carryout inventories stood at 4.445 million bbl in 2009 and 4.610 million bbl in 2012.

Because we are interested in measuring economic impacts for key individual states and provinces, as well as the United States and Canada generally, it was necessary to estimate interstate transshipments of raw cranberries to processing facilities, as well as to estimate where in the United States cranberries imported from Canada were processed.[16] This was a problem mainly in the Northeast United States, and for allocation of production in New Jersey and Massachusetts and imported berries from Eastern Canada to processing plants in New Jersey and Massachusetts.[17] In the West it was reasonable to infer that most imports were processed in Washington because those berries are mainly grown for Ocean Spray, and its West Coast processing capacity is located in Washington.

Value added from processing was determined as the value of the processed product less the value of the cranberry input used in producing the product. This avoids

[15] International trade with partners beyond North America will not change this requirement because, although trade has been increasing rapidly, it occurs in processed-product forms. It is not efficient to ship raw cranberries for processing in third countries.

[16] Flow between provinces in general was not a problem because about 94% of berries grown in British Columbia are exported to the United States and nearly all of the production in the Maritime Provinces is exported to the United States.

[17] Three handlers, Ocean Spray, Clement Pappas, and Decas, operate processing facilities in Massachusetts and New Jersey, and each sources product from Eastern Canada. We inferred the flow of production from Massachusetts and New Jersey and imports from Eastern Canada to these plants based mainly upon information on the plants' capacities.

double counting of impacts. Thus, for concentrate, SDCs, and sauce, the cranberry input is measured in terms of barrels of raw cranberries valued at the Ocean Spray B-pool return. For juice, the cranberry input is concentrate valued as described below. In all cases we measured the processed products in barrel-equivalent units to allow for easy comparison across the various products. In other words, based upon conversion rates between raw and processed products, we would compute the value of a bbl of raw cranberries when processed into either concentrate, sauce, or SDCs, and then determine the value of the same quantity of concentrate when it was further processed into juice products. If there were important by-products associated with any of these products—as is true in particular with SDC production, which, as noted, yields about a gallon of concentrate per bbl—, we would whenever possible also include the by-product value.

Wholesale values for the processed products were determined in a variety of ways based upon the information that was available. Concentrate values were based upon results of the Ocean Spray concentrate auction.[18, 19] In most years the USDA, AMS purchases cranberry sauce as part of its commodity purchase program to support school lunch programs.[20] AMS reports purchase date, cases purchased, size of can, seller, and purchase price. We converted the cases to their bbl equivalent quantities and averaged the

[18] Concentrate is a pure, unbranded commodity. Ocean Spray sells concentrate mainly via open auction, so these auction prices provide a very good snapshot of the product's market value. The Cooperative holds four auctions per year, so the concentrate price used in our analysis was the average price across each auction conducted during a crop's typical marketing year. Ocean Spray reports the results of the concentrate auctions publicly: (http://www.cranberryauction.info/LatestResults.aspx).

[19] AMS also purchases other products, including SDCs and juice. However, prices for those commodities were obtained from other sources.

[20] We did not, however, have AMS purchase data for the 2009 crop year and inferred that value by extrapolating the 2010 sauce value using the ratio of raw cranberry prices for 2009 and 2010.

AMS purchase prices across each crop year to obtain the wholesale value of cranberry sauce.[21]

Wholesale values for SDCs and cranberry juice were provided on a confidential basis through industry partners. There are, of course, a great variety of cranberry juice products, so the per bbl value of cranberries converted into juice was a composite from the different types of juice products produced with cranberries. Cranberry juice may also have a considerable brand value depending upon the manufacturer. We were provided the data on juice in a way that allowed us to differentiate between the values of branded juice and juice manufactured for the private-label market and then, based upon the particular plant producing the juice, assign either the branded or private-label value to that production.

### *4.2 Generating Measures of Primary Impacts for the Canadian Cranberry Industry*

In general, we had far less information on the Canadian cranberry industry than for the United States. Fortunately, given the generally good data available for the United States, we do not consider the limited data available for Canada to unduly constrain the analysis. Most importantly, we did have good data on cranberry production data for Canada for the four-year period of analysis (Table 1), although production data were available only for 2011 and 2012 for the Maritime Provinces. This is especially significant, given that most British Columbia and Maritime production is exported to the United States, making cranberry production, and not processing the primary economic activity in those regions.

[21] AMS mainly purchases cranberry sauce in 6/10 and 24/300 sizes. The former contains about 0.111 bbl of cranberries and the latter contains 0.073 bbl. AMS announces publicly its intent to make purchases, and several cranberry handlers participate in this program, so the resulting purchases prices should be a good reflection of the wholesale value of cranberry sauce.

We did not have any independent data on Canadian prices, and, therefore, applied the U.S. data on prices for cranberries and all processed products to Canada as well. This step should involve little loss in accuracy. Because of free trade between the U.S. and Canada, both raw and processed cranberry products can move across the border with few restrictions. This means that the "law of one price" applies to the U.S. and Canadian cranberry industries. In other words, except for differences due to transportation costs, prices must equalize between the United States and Canada for the same product; otherwise shipments from the low-price country to the high-price country would take place until the prices were equalized, except for differences attributable to transportation costs.

The second data limitation for Canada pertained to the mix of processed products produced from the berries that were processed in Canada. Importantly, through data on foreign acquisitions of cranberries provided by USDA, AMS, we did know how much Canadian production was exported and, thus, how much remained to be processed in Canada. We also knew from publicly available information that the Canadian processors collectively produced a variety of processed products, and we reported briefly on the product mix for Canadian handlers in section 2. Lacking any better alternative, we simply assumed that the mix of processed products in Canada on aggregate was the same as the mix in the United States.

### *4.3 Generating Measures of Secondary (Multiplier) Impacts*

A key part of any impact study is estimating the secondary or multiplier impacts from a primary economic activity. These impacts occur as the value added from the primary activity, cranberry production and processing in our case, reverberates through the local and regional economies, creating additional income and employment for the businesses that supply inputs to the primary activity, and for commercial enterprises generally as income earned is spent on a multitude of products and services in the local or regional economy.

We estimated secondary impacts derived from the primary activities of the cranberry industry using regional and inter-regional input-output models. The validity of this approach is well established, and it has a history dating back to the Nobel Prize winning work of Leontief (1941). Input-output models provide a snapshot of a regional economy by tracing relationships among commercial sectors, as well as government, households, and the rest of the world.

The input-output models provide measures of the multiplier or spillover effects attributable to a primary economic activity. These spillover impacts are broken down into two main categories: indirect and induced effects. Indirect effects are changes in local inter-industry spending transmitted through economic linkages among the different sectors of the economy. Induced effects are the result of spending of household incomes generated from the sectors directly and indirectly affected by the primary economic impact.

The magnitudes of both indirect and induced impacts are determined by the degree to which income "leaks" from the local economy by being spent outside its boundaries. Naturally, the larger and more economically developed the area of consideration, the smaller is the rate at which economic activity leaks beyond its boundaries. Thus when aggregating from state to national impacts, multiplier effects become magnified (e.g., within-state multiplier effects are smaller than national multiplier effects because economic activity that leaks outside a particular state or province is nonetheless captured within the country).

### *4.4 The IMPLAN Modeling Framework*

We selected the Impact Analysis for Planning (IMPLAN) model to estimate the multiplier impacts generated by the cranberry industry in the United States, and for Canada we utilized the input-output model developed by Statistics Canada (Poole 1995). The IMPLAN model is one of the most widely used and respected models for regional economic analysis. It is utilized extensively in economics, planning, and engineering studies to account for interrelationships among sectors and institutions within regional economies, and ultimately to ascertain the full economic impacts of injections or withdrawals of regional economic activity. Several Federal agencies that have utilized the IMPLAN model including the Army Corps of Engineers, Forest Service, and Department of Transportation.

The research team acquired state and national level IMPLAN 2012 databases (the most recent available) for Massachusetts, Oregon, New Jersey, Washington, Wisconsin and the United States. IMPLAN is not disaggregated to the level of the cranberry industry, but we used accepted methods for tailoring the IMPLAN production coefficients for the more aggregate agricultural and food-processing sectors that subsume the cranberry industry within the IMPLAN model to better fit the specific characteristics of cranberry production and processing. Specifically, we employed information from cranberry cost-and-return studies—including Zweigbaum (2000), Jesse et al. (2008), and Farm Credit East (2010)—to customize IMPLAN production functions related to cranberry crop production. Similarly we used confidential information provided by multiple cranberry handlers, on employment and other inputs used in cranberry processing, to tailor IMPLAN's processing production coefficients to apply specifically to cranberries.

### *4.5 The Statistics Canada Input-Output Model*

Statistics Canada provides information on economic activity at the inter-provincial and national levels. The latest version of the input-output tables and the multipliers of the inter-provincial Statistics-Canada input-output model, with data for 2010, were employed for the present study. The model information was obtained directly from the Input-Output Division of Statistics Canada (Statistics Canada 2009).

Unlike the IMPLAN model, the Statistics Canada's input-output model does not allow a high degree of user customization to tailor specific sectors. However, we employed the most disaggregated level possible to represent cranberry production and the manufacture of processed cranberry products. Specifically, we used the crop production sector (excluding greenhouse, nursery, and floriculture production) output multipliers for British Columbia, Québec and the Maritimes (represented as the weighted average of Prince Edward Island, Nova Scotia and New Brunswick). These sector output multiplier values are 1.76, 1.68 and 1.48 for British Columbia, Québec, and the Maritimes, respectively. They are comparable to the multiplier impacts for most U.S. states based upon the IMPLAN model.

The ratio of employment per unit of output from the Statistics Canada model, however, was much higher than the corresponding U.S. ratio from IMPLAN, as tailored to fit specifically the cranberry sector. Given what we considered to be greater reliability for the U.S. IMPLAN data and the similarity in cranberry production in the United States and Canada, we chose to match provinces to the closest comparable U.S. state based upon cranberry yield per acre, assuming they apply similar production technology and rates of labor use, and then applied that State's employment multipliers to the matching Province. On this basis, British Columbia was matched to Oregon, and Quebec and the Maritimes were matched to Wisconsin.

The cranberry processed products sector (SDC, concentrate, sauce, fresh and juice) is included within the fruit and vegetable preserving and specialty food-manufacturing sector of the Statistics Canada's input-output model. The sector output and employment multipliers from the Canadian model were within the same range as found for the United States from IMPLAN, and, thus, no adjustments to the Canadian model were deemed necessary for Canadian cranberry processing. The British Columbia and Québec sector output multipliers for processing were 1.41 and 1.77 respectively. Likewise, multipliers for employment were 2.22 and 3.33. Ratios of 3.72 and 2.46 jobs per million dollars of sector output in British Columbia and Québec were used.

To avoid double counting for the value of primary production (and primary processing in the case of juice), only the value added proportion of each of the processed products was used in obtaining the multiplier effects of cranberry processed products.

## 5 Measures of Economic Impact

Direct, indirect, and induced effects on total cranberry sector output and employment were estimated. These analyses were performed at the state and provincial level for key producing and processing states and provinces, and at the national level for the United States and Canada. Results are presented first for the United States and then for Canada. Unless otherwise stated, all of the measures are annual estimates of output and employment and related measures, corresponding to an industry producing at the average over the four years 2009–2012, with all monetary measures in nominal U.S. dollar values corresponding to that time period.

### *5.1 Cranberry Sector Economic Impacts in the United States*

Tables 3, 4, and 5 summarize the key results for the analysis of economic impacts of the cranberry sector in the United States. Table 3 reports direct and indirect and induced (multiplier) impacts from cranberry production for Massachusetts, New Jersey, Oregon Washington, and Wisconsin and for the United States in aggregate.

**Table 3.** *Economic Impact of Cranberry Production in the United States*

| **Gross Value of Production ($ Thousands/year)** | | | | | | |
|---|---|---|---|---|---|---|
| | **MA** | **NJ** | **OR** | **WA** | **WI** | **5 States** |
| Direct | 49,270 | 13,007 | 9,026 | 3,161 | 103,120 | 177,584 |
| Indirect & Induced | 39,658 | 12,018 | 8,176 | 2,996 | 103,599 | 166,447 |
| ***Total Impact*** | ***88,928*** | ***25,026*** | ***17,202*** | ***6,157*** | ***206,718*** | ***344,031*** |
| **Employment (Jobs/Year)** | | | | | | |
| Direct | 537 | 117 | 77 | 25 | 1,031 | 1,787 |
| Indirect & Induced | 475 | 107 | 90 | 28 | 1,023 | 1,724 |
| ***Total Impact*** | ***1,012*** | ***224*** | ***167*** | ***54*** | ***2,055*** | ***3,511*** |
| **Multipliers** | | | | | | |
| *Output* | *1.80* | *1.92* | *1.91* | *1.95* | *2.00* | *1.94* |
| *Employment* | *1.88* | *1.91* | *2.18* | *2.12* | *1.99* | *1.96* |

Table 4 provides the same information for cranberry processing, including primary processing of cranberries into concentrate, SDCs, sauce, and fresh cranberries and secondary processing of concentrate into juice.[22] Significant processing activity occurs beyond the boundaries of the five leading producing states, so table 4 contains information on cranberry processing activity in the rest of the United States. Table 5

[22] As noted, minor processed products, although not accounted for explicitly, are not excluded and, rather, are subsumed within one of the core processing activities based upon our requirement that all cranberries produced in the United States or imported from Canada are processed into one of the aforementioned primary processing activities. Similarly the analysis assumes that all concentrate is processed into juice.

combines the information from Tables 3 and 4 to derive measures of total impacts from the cranberry sector.

**Table 4.** *Economic Impact of Cranberry Processing in the United States*

| Value Added for Processed Products and Fresh Fruit ($ Thousands/year) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **MA** | **NJ** | **OR** | **WA** | **WI** | **Other** | **US** |
| Direct | 122,294 | 311,368 | 35,811 | 71,606 | 420,628 | 909,676 | 1,871,382 |
| Indirect & Induced | 54,210 | 224,685 | 25,022 | 45,084 | 308,341 | 681,417 | 1,338,758 |
| ***Total Impact*** | 176,504 | 536,052 | 60,833 | 116,689 | 728,969 | 1,591,093 | 3,210,140 |
| **Employment for Processed Products and Fresh Fruit (Jobs/year)** | | | | | | | |
| Direct | 374 | 357 | 102 | 201 | 705 | 885 | 2,623 |
| Indirect & Induced | 297 | 987 | 188 | 234 | 1,217 | 2,553 | 5,476 |
| ***Total Impact*** | 670 | 1,344 | 291 | 434 | 1,922 | 3,437 | 8,099 |
| **Multipliers** | | | | | | | |
| *Output* | *1.44* | *1.72* | *1.70* | *1.63* | *1.73* | *1.75* | *1.72* |
| *Employment* | *1.79* | *3.76* | *2.84* | *2.17* | *2.73* | *3.89* | *3.09* |

As the leading cranberry-producing state, Wisconsin generates the greatest economic impact. Based upon the four-year average, 2009–2012, the direct impact of cranberry production in Wisconsin was just over $100 million per year. Wisconsin's production multiplier at 2.0 was the highest among the key cranberry producing states, meaning that the direct value of Wisconsin production is roughly doubled through its indirect and induced impacts for a total impact from production of just over $200 million per year, on average over 2009–2012. As to jobs, we estimate that cranberry production accounts for just over 1,000 jobs in Wisconsin, and that roughly another thousand jobs are generated from the indirect and induced impacts, resulting in our estimate that cranberry production in Wisconsin is responsible for 2,055 jobs.[23]

[23] Employment estimates for the United States pertain to full-time, part-time, and seasonal jobs. To convert total jobs to full time equivalent (FTE) jobs, IMPLAN recommends multiplying 0.85 in the farm sector and 0.96 in the processing sector. The Statistics Canada model, used to generate estimates for Canada, provides estimated employment on an FTE basis.

Wisconsin has a highly developed cranberry processing sector; nearly all primary processing of Wisconsin production is done in-state, and secondary processing of cranberry juice is important in Wisconsin as well. We estimate that, on average over 2009–2012, cranberry processing in Wisconsin including fresh cranberries was directly responsible for $421 million per year of economic activity. The output multiplier for cranberry processing for Wisconsin was estimated to be 1.73, resulting in indirect and induced impacts from cranberry processing for Wisconsin of just over $300 million per year, with the total impact of Wisconsin's cranberry processing sector estimated to be $729 million per year on average for 2009–2012. This activity was responsible for 1,922 jobs on average over this time period. Given that our procedures avoid double counting, the impacts from production and processing can be summed to obtain the total impact of the cranberry sector in each state, as done in Table 5. Thus, we see that at $936 million, the cranberry sector in Wisconsin is just shy of being a one billion dollar industry. We estimate that in total cranberries are responsible for 3,977 jobs in Wisconsin.

**Table 5.** *Total Economic Impact of the Cranberry Industry in the United States*

| | MA | NJ | OR | WA | WI | Other | US |
|---|---|---|---|---|---|---|---|
| **Total Value of Production, Processing and Handling ($Thousands/year)** | | | | | | | |
| Direct | 171,564 | 324,375 | 44,837 | 74,767 | 523,748 | 909,676 | 2,048,967 |
| Indirect & Induced | 93,868 | 236,703 | 33,198 | 48,079 | 411,939 | 681,417 | 1,505,205 |
| ***Total Impact*** | ***265,432*** | ***561,078*** | ***78,035*** | ***122,846*** | ***935,687*** | ***1,591,093*** | ***3,554,171*** |
| **Total Employment in Production, Processing and Handling (Jobs/year)** | | | | | | | |
| Direct | 910 | 474 | 179 | 226 | 1,736 | 885 | 4,410 |
| Indirect & Induced | 771 | 1,094 | 279 | 262 | 2,240 | 2,553 | 7,200 |
| ***Total Impact*** | ***1,682*** | ***1,569*** | ***458*** | ***488*** | ***3,977*** | ***3,437*** | ***11,610*** |
| **Multipliers** | | | | | | | |
| *Output* | *1.55* | *1.73* | *1.74* | *1.64* | *1.79* | *1.75* | *1.73* |
| *Employment* | *1.85* | *3.31* | *2.56* | *2.16* | *2.29* | *3.89* | *2.63* |

Turning now to Massachusetts, the second-leading producing state, we see that cranberry production accounted on average for nearly $50 million in direct economic activity annually over 2009–2012. The Massachusetts production multiplier was estimated to be 1.8, meaning indirect and induced impacts accounted for another $40 million in sector output. Cranberry production in Massachusetts was responsible for just over 1,000 jobs during this time period.

Massachusetts also has a significant cranberry-processing sector that was responsible for $122 million annually in direct value-added activity on average for 2009–2012. The processing output multiplier for Massachusetts, at 1.44, was lowest among the five major producing states. Still it implies that the primary processing activity was responsible for another $54 million in economic activity. Cranberry processing in Massachusetts was estimated to be directly or indirectly responsible for 670 jobs on average over 2009–2012. Combining the production and processing impacts for Massachusetts in Table 7, we see that with combined direct and multiplier impacts of $265 million per year, the cranberry sector is over a quarter billion dollar industry in Massachusetts and is responsible for 1,682 jobs.

Cranberry production in New Jersey is a rather small industry, accounting for just over $25 million annually through direct and multiplier impacts and 224 jobs for the time period of our analysis. However, New Jersey is the second-most important state for cranberry processing, with $311 million in direct processing activity and another $225 million in indirect and induced activity (multiplier of 1.72). Cranberry processing in New Jersey, through direct and multiplier impacts, is responsible for 1,344 jobs.

The cranberry industry in the U.S. Northwest is relatively small but nonetheless economically important. Oregon and Washington combined have production impacts similar to New Jersey. Although Washington has considerably less cranberry production than Oregon, Washington has a relatively large processing sector, obtaining berries from both Oregon and British Columbia. Through direct and multiplier impacts cranberry processing in Washington is a $115 million industry, responsible for 434 jobs. Oregon's processors are individually small in scale but collectively they accounted for over $60 million in economic activity and 291 jobs annually during 2009–2012.

Aggregating economic activity for the U.S. cranberry industry to the national level is done simply by summing values across the five states since we have no information on the very limited production that may occur in other states. Thus, in Table 5 we see that cranberry production on average over 2009–2012 accounted for $178 million annually in direct value and, with a national multiplier of 1.94, nearly that much again in indirect and induced impacts, for a total annual value of $344 million during this time period. Cranberry production accounted for 3,511 jobs, on average.

Value added from cranberry processing in the United States was estimated to be $1.9 billion annually. Significant cranberry processing is conducted beyond the boundaries of the five major producing states, primarily due to juice manufacturing conducted at diverse locations in the United States. Because the manufacture of juice from concentrate is a high value-added activity, we estimate that $900 million, nearly half of the value added in processing, occurs beyond the boundaries of the five states. Cranberry processing was estimated to be directly responsible for 2,623 jobs and, through multiplier effects, 8,099 jobs in total.

Combining impacts from production and processing, the U.S. cranberry industry is directly responsible for over $2 billion in economic activity and 4,410 jobs. When indirect and induced impacts from this activity are taken into account via the IMPLAN model, we find that the sector was responsible annually for $3.55 billion in total sector output and 11,610 jobs on average over 2009–2012.

### *5.2 Cranberry Sector Economic Impacts in Canada*

Tables 6, 7, and 8 report economic impacts for the Canadian cranberry industry following the same reporting protocols as used in the previous subsection for the United States. To provide a common basis for comparison, Canadian values are reported in nominal U.S. dollars.[24] The direct annual value of cranberry production in Canada on average for 2009–2012 was about $50.5 million (Table 6).

About two-thirds of this value is in Québec, with most of the remainder in British Columbia. The multiplier for cranberry production in Canada was estimated to be 1.68, implying an additional $34 million annually in indirect and induced impacts, making cranberry production responsible for about $85 million in total sector output and nearly 1,000 jobs. These values to some extent understate the current impact of cranberry production in Canada because averaging over 2009–2012 obscures the very rapid increases in production that have occurred recently in Québec.

As noted, most processing of cranberry products is done in Québec. We are aware of no processing activity in the Maritime Provinces, and, as Table 7 shows, only minor processing activity occurs in British Columbia, as most of its production is exported to neighboring Washington State. The Québec processing industry, however, is important,

[24] Users wishing to convert to Canadian dollars can do so simply by multiplying monetary values in Tables 6 – 8 by whatever exchange rate the user deems appropriate.

generating on average about $178 million in value added annually, and, with a multiplier for processing of 1.77, another $137 million in indirect and induced effects, for a total of $315 million in economic activity annually for 2009–2012. Direct, indirect, and induced employment from this activity was estimated to be 1,679 jobs.

**Table 6.** *Economic Impact of Cranberry Production in Canada*

| | | | | |
|---|---|---|---|---|
| **Gross Value of Production ($ Thousands/year)** | | | | |
| | **BC** | **QC** | **MAR** | **Canada** |
| Direct | 17,836 | 29,576 | 3,116 | 50,528 |
| Indirect & Induced | 13,596 | 19,182 | 1,487 | 34,265 |
| ***Total Impact*** | ***31,432*** | ***48,759*** | ***4,603*** | ***84,793*** |
| **Employment (Jobs/year)** | | | | |
| Direct | 152 | 296 | 31 | 478 |
| Indirect & Induced | 178 | 294 | 31 | 503 |
| ***Total Impact*** | ***330*** | ***589*** | ***62*** | ***981*** |
| **Multipliers** | | | | |
| *Output* | *1.76* | *1.65* | *1.48* | *1.68* |
| *Employment* | *2.18* | *1.99* | *1.99* | *2.05* |

**Table 7.** *Economic Impact of Cranberry Processing in Canada*

| | | | | |
|---|---|---|---|---|
| **Value Added for Processing ($ Thousands/year)** | | | | |
| | **BC** | **QC** | **MAR** | **Canada** |
| Direct | 6,996 | 178,370 | - | 185,365 |
| Indirect & Induced | 2,915 | 137,558 | - | 140,472 |
| ***Total Impact*** | ***9,910*** | ***315,927*** | ***-*** | ***325,837*** |
| **Employment (Jobs/year)** | | | | |
| Direct | 26 | 458 | - | 485 |
| Indirect & Induced | 21 | 1,221 | - | 1,242 |
| ***Total Impact*** | ***48*** | ***1,679*** | ***-*** | ***1,727*** |
| **Multipliers** | | | | |
| *Output* | *1.42* | *1.77* | - | *1.76* |
| *Employment* | *1.81* | *3.66* | - | *3.56* |

Aggregate processing numbers for Canada nationally are only slightly larger than Québec's totals—$348 million in total annual economic activity and 1,727 jobs. Combining the production and processing activity for Canada in Table 8 we see that the Canadian cranberry industry through its direct impacts is nearly a quarter billion dollar industry. Accounting for its multiplier impacts on the rest of the Canadian economy, the impact is $411 million and 2,708 jobs annually.

**Table 8.** *Total Economic Impact of the Cranberry Industry in Canada*

| **Total Value of Production, Processing and Handling ($Thousands/year)** | | | | |
|---|---|---|---|---|
| | **BC** | **QC** | **MAR** | **Canada** |
| Direct | 24,831 | 207,946 | 3,116 | 235,893 |
| Indirect & Induced | 16,511 | 156,740 | 1,487 | 174,737 |
| ***Total Impact*** | ***41,342*** | ***364,686*** | ***4,603*** | ***410,630*** |
| **Total Employment in Production, Processing and Handling (Jobs/year)** | | | | |
| Direct | 178 | 754 | 31 | 963 |
| Indirect & Induced | 200 | 1,514 | 31 | 1,745 |
| ***Total Impact*** | ***378*** | ***2,269*** | ***62*** | ***2,708*** |
| **Multipliers** | | | | |
| *Output* | *1.66* | *1.75* | *1.48* | *1.74* |
| *Employment* | *2.12* | *3.01* | *1.99* | *2.81* |

Because cranberry production in North American is a highly integrated industry, with considerable transshipment of product across the border, it is reasonable to sum the total impacts across the two countries to report a combined impact from production and processing of cranberries in North America. Thus, summing across Tables 5 and 8, we estimate that cranberry production and processing in North America is directly responsible for $2.29 billion per year in economic activity, and, through multiplier effects, responsible for $3.97 billion per year in total economic activity. On the employment side, the North American industry creates 5,073 jobs directly through its production and processing activities and 14,318 jobs overall.

## 6 Policy Simulations

In this section we report two policy-relevant simulations for the cranberry industry in the United States and one simulation for Canada. We cannot perform the second simulation for Canada because we cannot access all features of the Statistics Canada input-output model. In the simulation performed for both countries we ask what would be the economic impact in each producing state or province if cranberry production in the state/province were to be reduced by 100 acres, holding all prices for both inputs and outputs constant. This simulation has considerable relevance in light of the economic difficulties confronting the industry at the time when this study was performed.

In the second simulation, performed only for the U.S. states, we investigate the economic impact from increasing the net revenue to cranberry growers by one dollar per bbl. This simulation can answer a broad range of questions pertaining to tax and regulatory policies at the state or national levels that would impact earnings of cranberry growers. Although we report results for an increase in net revenues, they apply with a reversal of sign for policies that would decrease net revenues per bbl.

### *6.1 100-Acre Reduction of Production*

In performing the simulation of a 100-acre reduction in cranberry production we assumed that (i) the 100 acres had the same productivity as the 2009–2012 average in the state or province, (ii) the portion of the production from the 100 acres that was processed in the producing state (province) was the same as for the state's (province's) total production, and (iii) the reduction in output would leave processed product mix (concentrate, SDCs, sauce, fresh cranberries, and juice from concentrate) from the cranberries processed in state (province) unchanged, the same as it was over 2009–2012.

Table 9 reports the results for the 100-acre reduction in production for annual output, employment, and tax revenue for each of the five U.S. states. This impact depends importantly on the state's average yield, the extent to which processing is done in-state, and the product mix of the in-state processing, particularly the extent to which concentrate produced in the state is processed into juice there as well.[25]

**Table 9.** *Economic Impact of 100-Acre Decrease in Production for U.S. States*

| **Decreases in Total Sector Output ($ Thousands/year)** | | | | | |
|---|---|---|---|---|---|
| | **MA** | **NJ** | **OR** | **WA** | **WI** |
| Direct | 1,284 | 2,399 | 821 | 746 | 3,532 |
| Indirect & Induced | 726 | 1,851 | 637 | 537 | 2,812 |
| ***Total Impact*** | ***2,010*** | ***4,250*** | ***1,459*** | ***1,283*** | ***6,344*** |
| **Decreases in Employment (Jobs/year)** | | | | | |
| Direct | 7 | 5 | 5 | 3 | 10 |
| Indirect & Induced | 6 | 11 | 6 | 4 | 18 |
| ***Total Impact*** | ***13*** | ***16*** | ***11*** | ***7*** | ***29*** |
| **Multipliers** | | | | | |
| *Output* | *1.57* | *1.77* | *1.78* | *1.72* | *1.80* |
| *Employment* | *1.91* | *3.24* | *2.20* | *2.28* | *2.78* |
| **Decreases in Total Tax Income ($ Thousands/year)** | | | | | |
| Federal | 162 | 370 | 86 | 88 | 386 |
| State & Local | 60 | 149 | 34 | 30 | 185 |
| ***Total*** | ***221*** | ***519*** | ***120*** | ***118*** | ***571*** |

Wisconsin fares relatively poorly under each of these criteria. It has the most productive cranberry acreage in the United States, most processing is done in state, and it

[25] Of course, additional impacts from these 100-acre expansions will occur beyond the state boundaries but be captured within the United States as a country.

has significant juice manufacturing capacity. Thus, a loss of 100 acres of cranberries grown in Wisconsin yields direct losses in excess of $3.5 million per year. The applicable multiplier for Wisconsin is 1.8, which means that losing 100 acres of cranberry production would reduce total economic activity in the State by $6.34 million per year. This reduced production would entail losses of an estimated 29 jobs, $386,000 in federal tax revenues, and $185,000 in state and local tax revenues.

The second greatest fiscal impact from a 100-acre reduction of cranberry production is in New Jersey, reflecting both relatively productive acreage and a well-established processing sector. We estimate that the loss of 100 acres would yield a direct impact in production and processing of $2.4 million and a total impact of $4.25 million per year. Sixteen jobs would be lost, along with $370,000 in federal taxes as well as $149,000 in state and local taxes.

The simulated reduction of acreage has a lesser impact in Massachusetts than New Jersey because Massachusetts' average yield is lower and the value added produced by Massachusetts' key processed products—concentrate and SDCs—is less than for the cranberry sauce and juice produced in New Jersey. Nonetheless, considering both direct and multiplier impacts, the loss of 100 acres of cranberries in Massachusetts would imply a reduction in sector output of just over $2 million per year, 13 fewer jobs, and reductions of $162,000 and $60,000 in income from federal and state and local taxes, respectively.

The impacts of reducing cranberry production by 100 acres in Oregon and Washington are smaller still and rather similar in magnitude, but for different reasons. Average yields are lowest in Washington among the five states, but Washington has considerable processing activity, and thus when 100 acres of production is lost, so too is the value added from the lost production. Oregon has little processing but relatively productive cranberry acreage. More jobs are lost in Oregon than in Washington because cranberry production in general is more labor intensive than cranberry processing.

Table 10 reports results from the simulation of a 100-acre reduction in Canadian production. The results for Québec are very comparable to those for Wisconsin, given Québec's highly productive cranberry acreage and well-developed processing sector. We estimate that in total such a reduction would imply a reduction in sector output of $6.54 million and the loss of 23 jobs. Impacts are comparable between British Columbia and the Maritime Provinces and much smaller than for Québec. Although cranberry acreage is more productive in the Maritimes than in BC, the modest amount of processing that does occur within BC increases its impact to approximate that in the Maritimes.

**Table 10.** *Economic Impact of 100-Acre Decrease in Production in Canada*

| **Total Sector Output ($Thousands/year)** | | | |
|---|---|---|---|
| | **BC** | **QC** | **MAR** |
| Direct | 418 | 3,723 | 526 |
| Indirect & Induced | 271 | 2,812 | 251 |
| ***Total Impact*** | ***689*** | ***6,535*** | ***777*** |
| **Employment (Jobs/year)** | | | |
| Direct | 3 | 9 | 5 |
| Indirect & Induced | 3 | 14 | 5 |
| ***Total Impact*** | ***6*** | ***23*** | ***10*** |
| **Multipliers** | | | |
| *Output* | *1.65* | *1.76* | *1.48* |
| *Employment* | *2.11* | *2.65* | *1.99* |

### *6.2 One Dollar Additional Net Revenue per Barrel*

Here we analyze the economic impacts of any tax or regulatory policy that would have the impact of increasing cranberry net revenues by one dollar per bbl. This impact is experienced directly at the farm level, and is assumed to have no impacts on downstream processing stages. The simulated impacts should be considered short-run effects, with production held constant. We assume that cranberry producers bear 100% of the incidence of the hypothetical tax or subsidy responsible for the net revenue change. This assumption is likely to be correct in the short run because the short-run supply of a perennial crop such as cranberries is unresponsive (inelastic) to price or net revenue changes. Over a longer time horizon, producers would respond to higher net revenues by planting more cranberries and taking other actions to increase yields. This will result in some portion of the incidence of the tax or subsidy being passed forward to downstream processors and, ultimately, consumers through the normal workings of the market.

Table 11 contains the results of the simulation for each of the five cranberry-producing states. The impact of the hypothetical subsidy of one dollar per bbl is greatest in Wisconsin owing to its large base of production. We estimate that 78 additional jobs would be created. The additional revenue to cranberry growers in Wisconsin is $3.95 million per year, and, with an output multiplier of 2.03, this direct effect is approximately doubled via the indirect and induced effect, yielding just over $8 million per year in additional revenue.

The second-largest impact is in Massachusetts, where an additional $1.82 million in revenue is created for cranberry growers, with an additional $1.5 million in indirect and induced impacts, together resulting in $3.32 million per year in additional value of output. About 37 additional jobs would be created in Massachusetts were net cranberry revenues to increase by one dollar. As Table 11 shows, impacts decline as we consider New Jersey, Oregon, and Washington, respectively.

**Table 11.** *Economic Impact of a One Dollar Increase in Net Revenue per Barrel*

| **Total Sector Output ($ Thousands/year)** | | | | | |
|---|---|---|---|---|---|
| | **MA** | **NJ** | **OR** | **WA** | **WI** |
| Direct | 1,817 | 555 | 430 | 161 | 3,950 |
| Indirect & Induced | 1,505 | 527 | 400 | 156 | 4,084 |
| ***Total Impact*** | ***3,322*** | ***1,082*** | ***830*** | ***317*** | ***8,034*** |
| **Employment (Jobs/year)** | | | | | |
| Direct | 20 | 5 | 4 | 1 | 39 |
| Indirect & Induced | 17 | 5 | 4 | 1 | 39 |
| ***Total Impact*** | ***37*** | ***9*** | ***8*** | ***3*** | ***78*** |
| **Multipliers** | | | | | |
| *Output* | *1.83* | *1.95* | *1.93* | *1.97* | *2.03* |
| *Employment* | *1.89* | *1.92* | *2.17* | *2.08* | *1.99* |

## 7 Conclusion

This study represents the most comprehensive and accurate evaluation of the North American cranberry industry produced to date. The industry is an important element of the economies of several states and provinces, as well as nationally. Factors that affect the economic health of the industry also have important spillover effects on related industries in the local economies where cranberry production and processing is a key primary industry.

We hope that this study will be a valuable asset for participants in the North American cranberry industry and for local, state, and national policymakers in both the United States and Canada. At the time of this writing, July 2014, the study is as up-to-date as possible, given the unavoidable lags in reporting data. The averaging of production and prices over the most recent four years makes the results robust to fluctuations in prices and production for any single year.

If recent trends in production and demand growth continue, as we expect they will, the impacts on output and employment reported here will soon understate the industry's true impacts. However, the multiplier values reported in this report should be relatively stable over time. Thus, it should be possible for future analysts to update this work for cranberry production relatively easily by applying the multipliers to publicly available updated information on the value of production. Full information on the value of processed products is unlikely to be available, moving forward, without good participation by cooperating handlers. However, a reasonable assumption is that the "margin" on processed production is relatively stable over time. For example, from Tables 3 and 4, the ratio of processing value added to total farm production value in the United States is 1,871,382/177,584 = 10.54. The comparable ratio in Canada is 185,365/50,528 = 3.67, which is considerable lower than for the United States due to Canada's less developed processing sector. In our opinion, a future analyst would be on solid ground in applying this margin to updated information on the value of cranberry production in either country to estimate the value added by the processing sector to that production.

The processing multipliers contained in Tables 4 and 7 for the United States and Canada, respectively, could then be applied to obtain the indirect and induced impacts from the processing activities. Employment impacts can also be derived from the employment multipliers contained in the tables, as they, too, should be relatively stable over time. Finally, the same ideas can be applied to current production information for individual states or provinces to obtain up-to-date estimates of economic impacts in specific locations.

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## 9 Appendix

**Table 12.** *North American Cranberry Production, 1961–2012*

| Year | Canada | United States | North America | Year | Canada | United States | North America |
|---|---|---|---|---|---|---|---|
| | Metric tonnes | | | | Metric tonnes | | |
| **1961** | 326 | 56,082 | 56,408 | **1987** | 11,353 | 153,900 | 165,253 |
| **1962** | 240 | 60,078 | 60,318 | **1988** | 12,533 | 185,100 | 197,633 |
| **1963** | 485 | 56,903 | 57,388 | **1989** | 11,236 | 170,000 | 181,236 |
| **1964** | 472 | 60,078 | 60,550 | **1990** | 16,391 | 153,850 | 170,241 |
| **1965** | 703 | 64,537 | 65,240 | **1991** | 17,690 | 191,400 | 209,090 |
| **1966** | 815 | 71,286 | 72,101 | **1992** | 20,110 | 188,700 | 208,810 |
| **1967** | 1,105 | 63,698 | 64,803 | **1993** | 15,630 | 177,808 | 193,438 |
| **1968** | 1,451 | 66,533 | 67,984 | **1994** | 25,360 | 212,370 | 237,730 |
| **1969** | 1,300 | 82,694 | 83,994 | **1995** | 24,620 | 190,240 | 214,860 |
| **1970** | 2,686 | 92,378 | 95,064 | **1996** | 22,990 | 211,920 | 234,910 |
| **1971** | 4,796 | 102,729 | 107,525 | **1997** | 24,960 | 249,400 | 274,360 |
| **1972** | 3,559 | 94,256 | 97,815 | **1998** | 36,180 | 246,753 | 282,933 |
| **1973** | 5,289 | 95,268 | 100,557 | **1999** | 35,680 | 288,396 | 324,076 |
| **1974** | 4,270 | 101,423 | 105,693 | **2000** | 31,810 | 259,093 | 290,903 |
| **1975** | 5,741 | 94,125 | 99,866 | **2001** | 34,784 | 241,766 | 276,550 |
| **1976** | 6,498 | 109,193 | 115,691 | **2002** | 51,562 | 258,096 | 309,658 |
| **1977** | 6,882 | 95,354 | 102,236 | **2003** | 52,651 | 280,957 | 333,608 |
| **1978** | 7,161 | 111,515 | 118,676 | **2004** | 66,790 | 280,140 | 346,930 |
| **1979** | 7,430 | 112,290 | 119,720 | **2005** | 67,870 | 283,225 | 351,095 |
| **1980** | 5,819 | 122,360 | 128,179 | **2006** | 77,090 | 312,980 | 390,070 |
| **1981** | 7,948 | 117,620 | 125,568 | **2007** | 66,360 | 297,280 | 363,640 |
| **1982** | 7,130 | 137,850 | 144,980 | **2008** | 72,688 | 356,796 | 429,484 |
| **1983** | 8,452 | 135,440 | 143,892 | **2009** | 86,776 | 313,569 | 400,345 |
| **1984** | 6,124 | 150,680 | 156,804 | **2010** | 75,405 | 308,815 | 384,220 |
| **1985** | 8,185 | 158,100 | 166,285 | **2011** | 86,286 | 349,888 | 436,174 |
| **1986** | 8,488 | 167,400 | 175,888 | **2012** | 126,963 | 364,915 | 491,878 |

*Source:* UN FAO, FAOSTAT, available at http://faostat3.fao.org/faostat-gateway/go/to/home/E

## 10 Investigator Bios

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