



The Prince Edward Island Dairy Sector: **An Economic Impact Analysis**

Department of Agriculture and Land



PEI Department of Agriculture and Land
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EXECUTIVE SUMMARY

The dairy industry represents an important component of Prince Edward Island's (PEI) agriculture sector. The dairy sector in PEI is comprised of dairy producers, which operate farms and produce raw milk, and dairy processors, which process raw milk into a wide range of products. As part of the Canadian dairy industry, PEI dairy products are known for their variety and high-quality. The dairy sector in PEI operates under a Supply Management (SM) system. The SM system provides production limits, controls imports, and sets farm-gate prices that reflect production costs.

The overall objective of the study was to quantify the economic role of the dairy sector in the economies of PEI and Canada in terms of output, Gross Domestic Product (GDP), labour income, employment and taxes. The study estimates the total economic impact of the PEI dairy sector using Statistics Canada's 2017 Supply and Use Tables (SUTs) by running an Input-Output (I-O) model to estimate the direct, indirect and induced impact. I-O models are quantitative economic models that represent the interdependences between different sectors in an economy.

The results showed that the PEI dairy industry is an important economic contributor to the province's economy. In 2017, PEI's dairy sector, through its direct, indirect and induced impacts, generated \$579.6 million in PEI output, boosted the provincial GDP by \$183.9 million, created 1,769 Full Time Equivalent (FTE) jobs and generated over \$14.3 million in taxes. Nationally (i.e., the impact on Canada's economy including PEI), the analysis showed that the PEI dairy sector generated approximately \$825.7 million in output, boosted the national GDP by \$287.7 million, created 2,614 FTE jobs, and generated roughly \$24.3 million in taxes. Provincially, PEI's dairy sector had a total multiplier of 2.12 in output.



RÉSUMÉ

L'industrie laitière représente une composante importante du secteur agricole de l'Île-du-Prince-Édouard (Î.-P.-É.). Le secteur laitier de l'Î.-P.-É. est composé de producteurs laitiers, qui exploitent des fermes et produisent du lait cru, et de transformateurs laitiers, qui transforment le lait cru en une vaste gamme de produits. Faisant partie de l'industrie laitière canadienne, les produits laitiers de l'Î.-P.-É. sont connus pour leur variété et leur haute qualité. Le secteur laitier de l'Î.-P.-É. fonctionne selon un système de gestion de l'offre. Le système de gestion de l'offre permet de limiter la production, de contrôler les importations et de fixer des prix à la production qui reflètent les coûts de production.

L'objectif général de l'étude était de quantifier le rôle économique du secteur laitier dans les économies de l'Î.-P.-É. et du Canada en termes de production, de produit intérieur brut (PIB), de revenu du travail, d'emploi et de taxes. L'étude estime l'impact économique total du secteur laitier de l'Î.-P.-É. à l'aide des tableaux des ressources et des emplois de 2017 de Statistique Canada en exécutant un modèle d'entrées-sorties (E-S) pour estimer l'impact direct, indirect et induit. Les modèles d'entrées-sorties sont des modèles économiques quantitatifs qui illustrent les interdépendances entre les différents secteurs d'une économie.

Les résultats ont montré que l'industrie laitière de l'Î.-P.-É. contribue de manière importante à l'économie de la province. En 2017, le secteur laitier de l'Î.-P.-É., par ses effets directs, indirects et induits, a généré 579.6 millions de dollars en production à l'Î.-P.-É., a augmenté le PIB provincial de 183.9 millions de dollars, a créé 1,769 emplois équivalents temps plein (ETP) et généré plus de 14.3 millions de dollars en taxes. À l'échelle nationale (c.-à-d. l'impact sur l'économie du Canada, y compris l'Î.-P.-É.), l'analyse a montré que le secteur laitier de l'Î.-P.-É. a généré environ 825,7 millions de dollars en production, a augmenté le PIB national de 287.7 millions de dollars, a créé 2,614 emplois ETP et a généré environ 24.3 millions de dollars en taxes.



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List of Acronyms

ADL	Amalgamated Dairies Limited
CAP	Canadian Agriculture Partnership
DAL	Department of Agriculture and Land
DFPEI	Dairy Farmers of Prince Edward Island
EIA	Economic Impact Analysis
FCRs	Farm Cash Receipts
FTE	Full-Time Equivalent
GDP	Gross Domestic Product
I-O	Input-Output
NAICS	North American Industry Classification System
NOI	Net Operating Income
PEI	Prince Edward Island
RoC	Rest of Canada
SM	Supply Management
SUTs	Supply and Use Tables
US	United States

Glossery

Canadian Agriculture Partnership (CAP)	A \$3 billion five-year (2018-2023), investment by federal, provincial and territorial governments to strengthen and grow Canada's agriculture and agri-food sector.
Direct Economic Impact	An impact that related directly to the operation of an economic sector or activity.
Farm Cash Receipts (FCRs)	Revenues from the sale of agricultural commodities, program payments from government agencies, and payments from private crop and livestock insurance programs.
Full-Time Equivalent (FTE)	Total hours worked divided by average annual hours worked in full-time jobs.
Gross Domestic Product (GDP)	Market value of all the final goods and services produced in a specific time period.
Indirect Economic Impact	Impacts that affect other businesses/industries.
Induced Economic Impact	Impacts that arise through the re-spending of income earned by the participants in the direct and indirect components of an economic activity/sector.
Input-Output (i-O) models	Quantitative economic models that trace the interdependencies between different sectors in an economy. Input-Output modeling allows examining relationships among different sectors, between sectors and final consumers (households/government) within an economy.
Multiplier	Proportionality measures of how much an endogenous variable changes in response to a change in some exogenous variables.
Net Operating Income (NOI)	Income after operating expenses are deducted.
Supply and Use Tables (SUTs)	An analytical tool representing a snapshot of all economic activity taking place in a geographic region.
Supply Management system (SM)	A unique Canadian system to control supply and stabilize prices.
Total economic impact	The sum of the direct, indirect, and induced economic impacts.

BACKGROUND

The dairy industry represents an important component of Prince Edward Island's (PEI) agriculture sector. The dairy sector in PEI is comprised of dairy producers, which operate farms and produce raw milk, and dairy processors, which process raw milk into a wide range of products such as yogurt, ice cream, butter cheese and condensed and dried milk. As part of Canadian dairy industry, PEI dairy products are known for their variety and high-quality. Commitment to animal welfare practices, environmental sustainability, and strict quality standards throughout the production and processing chain enhances the dairy's industry reputation. The continuing development of new dairy products and processing methods in Canada is a result of strategic collaboration between producers, processors, universities, and federal and provincial research centers (CDIC, 2021a).

The dairy industry in PEI operates under a Supply Management (SM) system; a unique Canadian system to control supply and stabilize prices. The SM system provides production limits, controls imports,¹ and sets farm-gate prices that reflect production costs. The SM system for milk was enacted in 1972 under the *Farm Products Marketing Agencies Act* (Crane, 2020).² The SM system has three key features (i) production limitation, (ii) cost-of-production pricing, and (iii) import control. These features function together to fulfill the SM system objectives of controlling supply and stabilizing prices (Barichello et al., 2007).

Dairy Farmers of PEI (DFPEI) is the marketing organization for PEI dairy producers. DFPEI is established under the *Natural Products Marketing Act*. It is mainly responsible for regulating, administering and managing the dairy industry in PEI (DFPEI, n.d.). Amalgamated Dairies Limited (ADL) was established in 1953³ and is considered PEI's largest dairy processor. It currently has five processing plants located throughout the province. ADL produces a wide range of dairy products including yogurt, ice cream, butter, different types of cheese, and condensed and dried milk (Old Dominion University, n.d.).



¹ Tariffs on imports aim to protect a share of the Canadian market for Canadian producers. Tariffs imposed on some of out-of-quota dairy imports can exceed 300%. In-quota dairy imports from some trading partners are permitted at low or duty-free, but the majority of the Canadian market is reserved for Canadian producers (Crane, 2020; Ghaith et al., 2018).

² The Act was renamed the Farm Products Agencies Act in 1993.

³ ADL has expanded over the years by purchasing other small companies, including O'Leary Butter Factory (1955), Olympia Ice Cream Company (1958), the Crapaud Creamery Company (1980), Maple Leaf Dairy (1986), Garden City Dairy (1987), and Perfection Foods Limited (1991) (Old Dominion University, n.d.).

PEI Dairy Sector by the Numbers

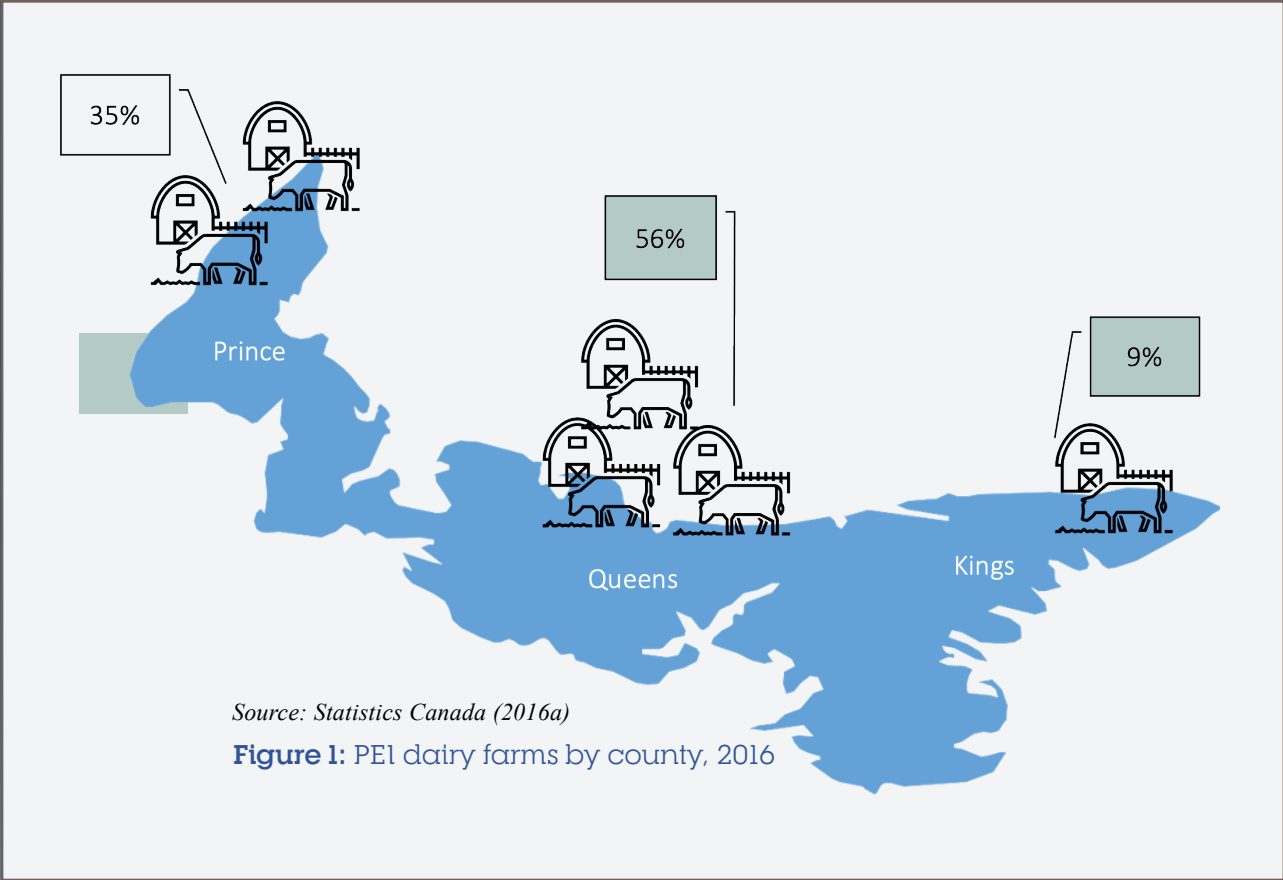
In 2020, PEI⁴ had 157 dairy farms across the province representing 1.6% of total Canadian dairy farms. The majority of dairy farms are located in Quebec and Ontario which together represent over 80% of total Canadian dairy farms (see Table 1) (CDIC, 2021b). The majority of PEI dairy farms are located in the central part of the island. The 2016 Census of Agriculture showed that about 56% of dairy farms are located in Queens County, 35% in Prince County, and 9% in Kings County (see Figure 1) (Statistics Canada, 2016a).

Table 1: Number of dairy farms by province, 2020

Province	Number of dairy farms	Share of total Canadian dairy farms (%)
Newfoundland and Labrador	24	0.2
Prince Edward Island	157	1.6
Nova Scotia	201	2.0
New Brunswick	175	1.7
Quebec	4,766	47.2
Ontario	3,367	33.4
Manitoba	263	2.6
Saskatchewan	171	1.7
Alberta	503	5.0
British Columbia	468	4.6
Canada	10,095	100

Source: CDIC (2021b)

⁴ PEI's geographic area is 1.4 million acres. PEI is the smallest province in the country, representing less than 0.1% of Canada's land area (Statistics Canada, 2016b).



Although the number of dairy farms in PEI has decreased over the years, the number of dairy cows has remained stable and has even tended to increase slightly in recent years (see Figure 2), reflecting development in the dairy industry in PEI. As of January 1st 2020, PEI had 14,500 dairy cows representing 1.5% of total dairy cows in Canada (CDIC, 2021c). Table 2 shows the total number of dairy cows by province as of January 1st 2020.

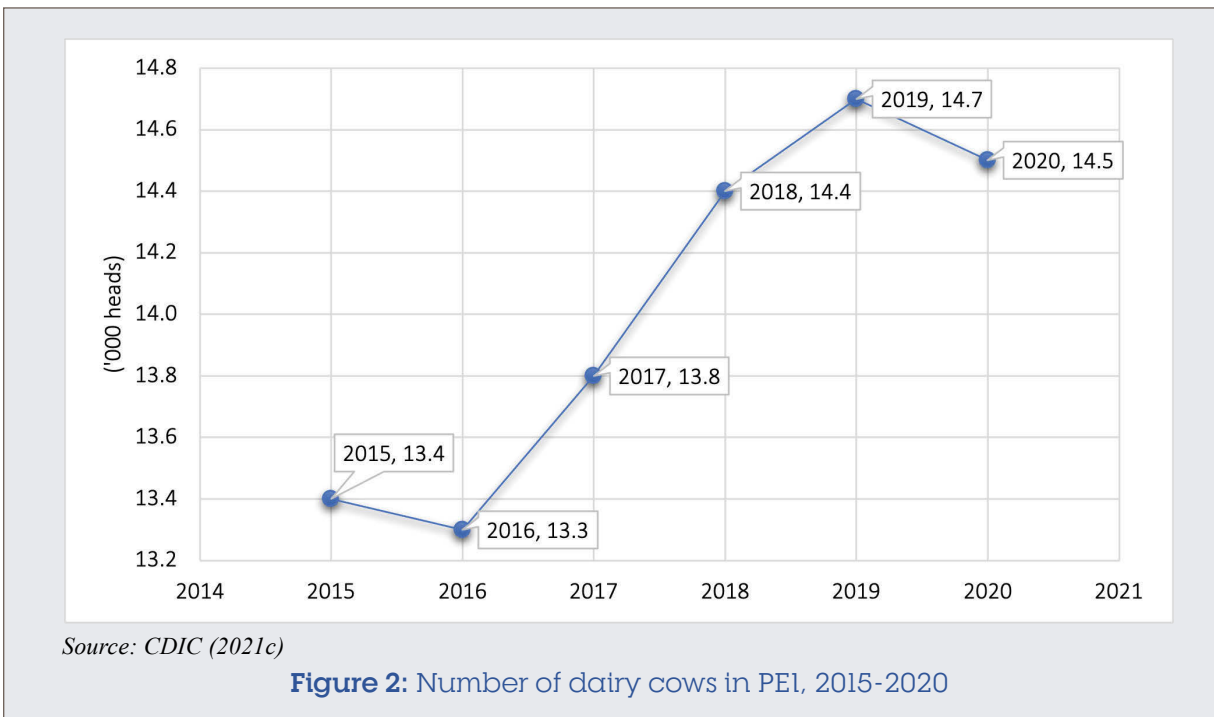


Figure 2: Number of dairy cows in PEI, 2015-2020

Table 2: Number of dairy cows by province, January 1st 2020

Province	Number of dairy cows ('000 heads)	Share of total dairy cows (%)
Newfoundland and Labrador	6	0.6
Prince Edward Island	14.5	1.5
Nova Scotia	21.2	2.2
New Brunswick	18.8	1.9
Quebec	364.8	37.2
Ontario	321.9	32.8
Manitoba	36.8	3.8
Saskatchewan	29.4	3.0
Alberta	79.9	8.1
British Columbia	87.4	8.9
Canada	980.7	100

Source: CDIC (2021c)

PEI milk production is supplied to two main markets: fluid and industrial markets. Milk sold off farms for fluid purposes represents about 10% of total milk production, while the remaining (i.e., milk sold off farms for industrial purposes) represents 90% of total PEI milk production. In 2020, PEI's milk production totaled 117.5 million liters, representing 1.3% of the total Canadian milk production (9.3 billion liters). Milk production in PEI increased by 17.4% between 2015 and 2020, reflecting efficient operations and increasing productivity (Statistics Canada, 2021a). Table 3 shows total milk production by province in 2020.

Table 3: Milk production by province, 2020

Province	Milk production (million liter)	Share of total Canadian milk production (%)
Newfoundland and Labrador	49	0.5
Prince Edward Island	117	1.3
Nova Scotia	201	2.2
New Brunswick	154	1.7
Quebec	3,348	35.9
Ontario	3,088	33.1
Manitoba	412	4.4
Saskatchewan	297	3.2
Alberta	817	8.8
British Columbia	847	9.1
Canada	9,331	100

Source: Statistics Canada (2021a)

PEI has the highest milk production per capita in Canada. In 2020, milk production per capita in PEI was 736 liters; 490 liters higher than the national average (Statistics Canada, 2021a, 2021b).

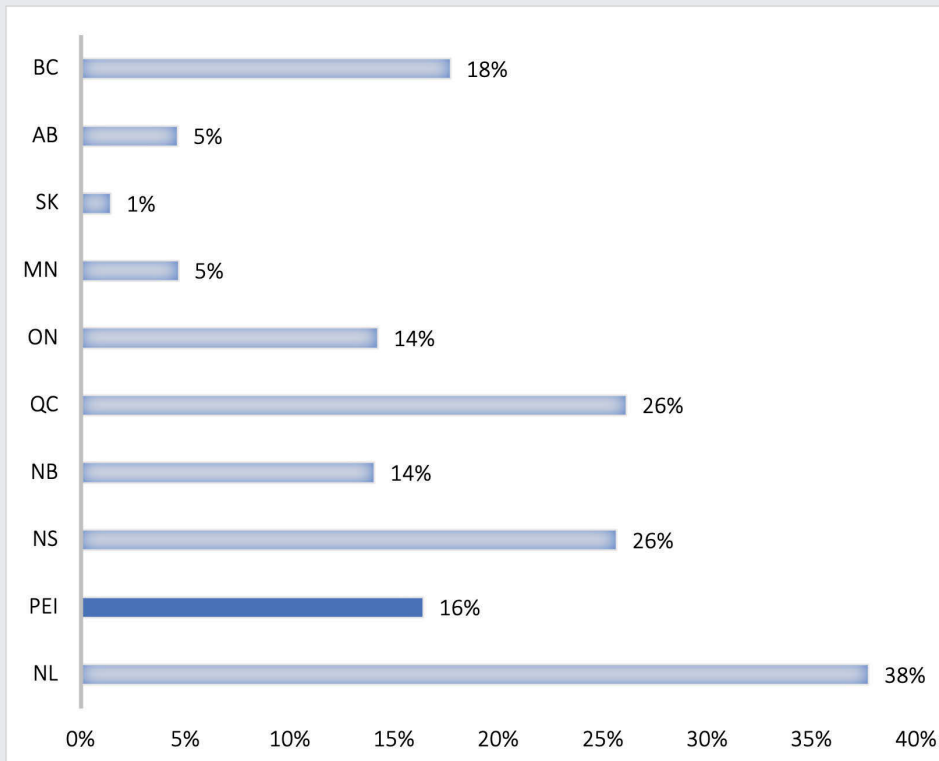
Table 4: Milk production per capita by province, 2020

Province	Milk production (liter)	Population (2020)	Milk production per capita (liter)
Newfoundland and Labrador	48,714,000	522,103	93
Prince Edward Island	117,460,000	159,625	736
Nova Scotia	201,224,000	979,351	205
New Brunswick	154,015,000	781,476	197
Quebec	3,347,880,000	8,574,571	390
Ontario	3,088,269,000	14,734,014	210
Manitoba	412,431,000	1,379,263	299
Saskatchewan	297,089,000	1,178,681	252
Alberta	816,960,000	4,421,876	185
British Columbia	847,077,000	5,147,712	165
Canada	9,331,117,000	38,005,238	246

Source: Statistics Canada (2021a, 2021b)

Farm Cash Receipts

Farm Cash Receipts (FCRs)⁵ (excluding program payments) from unprocessed milk is the number one source of farm revenue from livestock and livestock products receipts in PEI. In 2020, milk FCRs totaled approximately \$91 million, representing 16% of PEI's total FCRs. In the same year, milk FCRs represented 38%, 26% and 14% of Newfoundland and Labrador's, Nova Scotia's and New Brunswick's total FCRs respectively (see Figure 3) (Statistics Canada, 2021b).



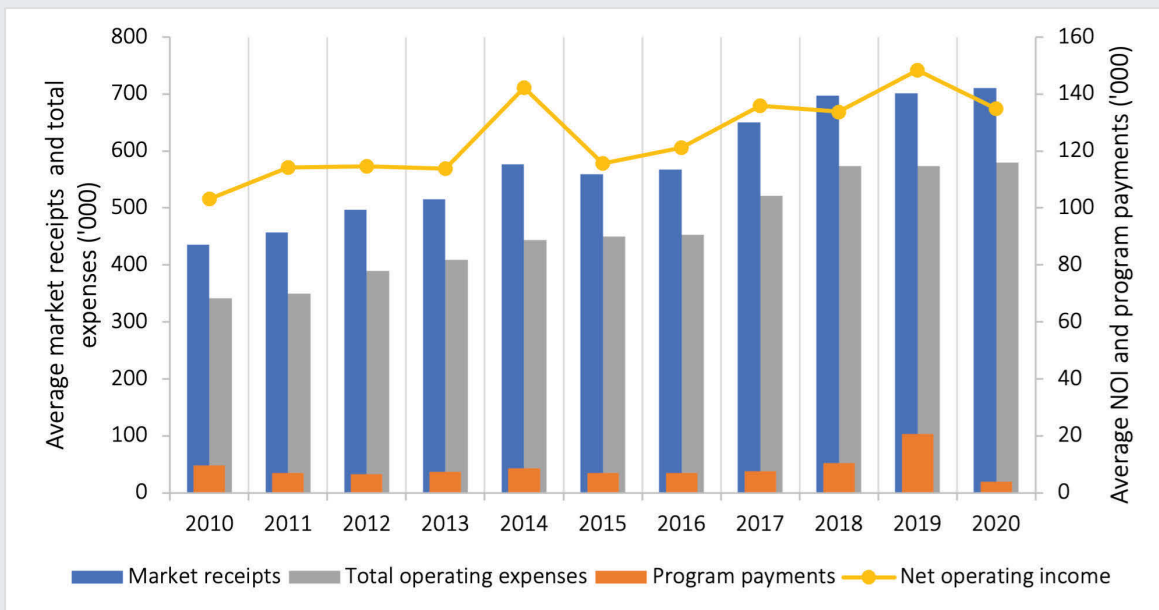
Source: (Statistics Canada, 2021b)

Figure 3: Milk cash receipts share of total FCRs by province, 2020

⁵ In this report FCRs, refer to market receipts which exclude program payments. FCRs include revenues from the sale of agricultural commodities, program payments from government agencies, and payments from private crop and livestock insurance programs (Statistics Canada, 2021d).

Operations

The Net Operating Income (NOI) of dairy farms in PEI has increased in recent times. Dairy farms expense-to-receipt ratio⁶ has ranged between 0.72 and 0.81 between 2010 and 2020. PEI dairy farms have the most favorable ratio relative to other livestock farms (e.g., cattle and hogs). In 2020, dairy farms in PEI (on average) had an expense-to-receipt ratio of 0.72 (for every dollar in receipts, farms had 72 cents in expenses) (AAFC, 2021). Figure 4 shows the average dairy farm revenue and expenses and NOI of in PEI between 2010 and 2020.



Source: AAFC (2021).

Figure 4: Average farm market receipts, program payments, total expenses and NOI (2010 - 2020)



⁶ The average amount incurred in operating expenses for a dollar in gross farm receipts (Statistics Canada, 2018c).

Dairy Processing Establishments

Dairy processing is an important part of PEI's economy. In 2020, there were 10 licensed dairy establishments in PEI (six federally-licensed and four provincially-licensed), representing about 2% of total Canadian dairy establishments. Most licensed dairy establishments are located in Quebec and Ontario which together represent about 71% of total Canadian dairy establishments (CDIC, 2021d).⁷ Table 5 shows the total number of licensed dairy establishments by province in 2020.

Table 5: Licensed dairy processing establishments by province, 2020

Province	Federally licensed	Provincially licensed	Total	Share of total establishments (%)
Newfoundland and Labrador	2	1	3	0.6
Prince Edward Island	6	4	10	1.9
Nova Scotia	8	7	15	2.9
New Brunswick	5	3	8	1.6
Quebec	95	106	201	39.1
Ontario	102	60	162	31.5
Manitoba	13	4	17	3.3
Saskatchewan	2	3	5	1.0
Alberta	23	11	34	6.6
British Columbia	34	25	59	11.5
Canada	290	224	514	100

Source: CDIC (2021d)



⁷ Although PEI is the smallest province in Canada, it has more licensed dairy establishments than Saskatchewan, New Brunswick and Newfoundland.

Trade

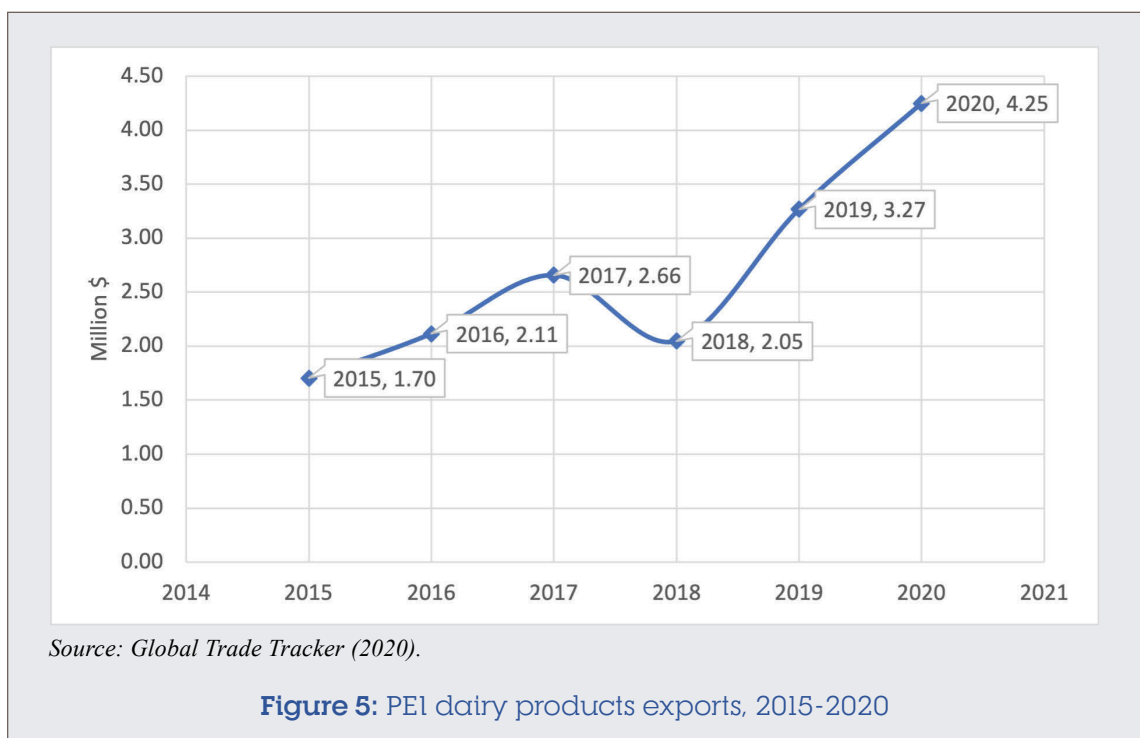
PEI dairy products including cheese, whey and milk and cream in solid and concentrated forms are exported to many countries. In 2020, PEI's international exports of dairy products totaled \$4.2 million, representing 0.9% of Canada's total dairy products exports. In 2020, Japan was the number one destination for PEI dairy products, PEI dairy exports to Japan totaled \$1.5 million (equating to 36% of PEI's total international dairy exports). Saudi Arabia⁸, the United States (US), China and Algeria were in the top five list of export markets for PEI dairy (Table 6) (Global Trade Tracker, 2020).

Table 6: PEI's top five dairy products export markets, 2020

Trading partner	Value (\$)	Share of total dairy products export (%)
Japan	1,530,845	36.0
Saudi Arabia	1,294,025	30.5
United States	896,825	21.1
China	423,527	10.0
Algeria	102,482	2.4
Other countries	459	0.0
Total	4,248,163	100

Source: Global Trade Tracker (2020).

Exports of dairy products experienced a major growth in 2020. The value of PEI's exports of dairy products increased by 30% relative to 2019 (Figure 3) (Global Trade Tracker, 2020).



⁸ In 2020, PEI dairy products were exported for the first time to Saudi Arabia.

ECONOMIC IMPACT ANALYSIS: OVERVIEW AND METHODOLOGY

The overall objective of this Economic Impact Analysis (EIA) is to quantify the economic contribution of PEI's dairy sector to the provincial and national economies. The dairy sector in PEI does not exist in isolation; it is linked to other economic activities. The activities that supply inputs are "backward linked". The activities to which goods and services are sold are "forward linked" (Davis et al., 2002). Dairy farms were at the center of the EIA. For example, backward-linked industries for dairy farms include: feed supplies, truck transportation services, veterinary services and other inputs. Forward-linked industries include dairy product manufacturing and dairy cattle and milk production. Figure 6 shows a snapshot of some backward and forward linkages of milk production and dairy manufacturing.

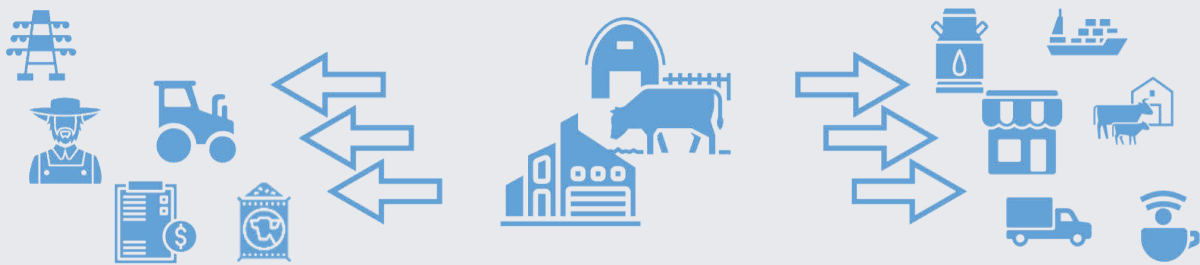


Figure 6: Dairy sector backward and forward linkages

Statistics discussed in the previous sections showed that the dairy sector plays an important role in PEI's economy. However, statistics cannot fully capture the overall impact of the sector as it is linked to other economic activities (i.e. backward and forward linkages). Therefore, this analysis utilizes EIA to evaluate the impact of the dairy sector on PEI's economy. EIA measures the sector's role in the economy in terms of jobs, sales, income and other economic indicators that are directly or indirectly created by business activity related to PEI's dairy sector.⁹

⁹ This analysis does not include environmental impact analysis of the dairy sector. Therefore, any costs that could be incurred by resource mismanagement or environmental damage is not measured in this study.

Overview

There are several EIA models that can be used to evaluate the economic contribution of a sector. The Input-Output (I-O) models are widely used to examine the economic impact of a specific sector and is utilized in this study (Miller & Blair, 2009).

For the purposes of this study, the PEI dairy sector includes dairy cattle and milk production and dairy product manufacturing. Backward and forward linkages of dairy cattle and milk production and dairy product manufacturing were included in the analysis to capture the sector's entire impact. This categorization depends on the North American Industry Classification System (NAICS)¹⁰ (Figure 6):

- i. Dairy cattle and milk production (coded 112120) comprises establishments primarily engaged in milking dairy cattle such as raising dairy cattle for both milking and meat production and raw fluid milk or cream production. This industry excludes raising dairy herd replacement and feeding or fattening cattle (Statistics Canada, 2018b).
- ii. Dairy product manufacturing (coded 3115) comprises establishments primarily engaged in manufacturing dairy products such as yogurt, cheese, butter and ice-cream (Statistics Canada, 2018b).

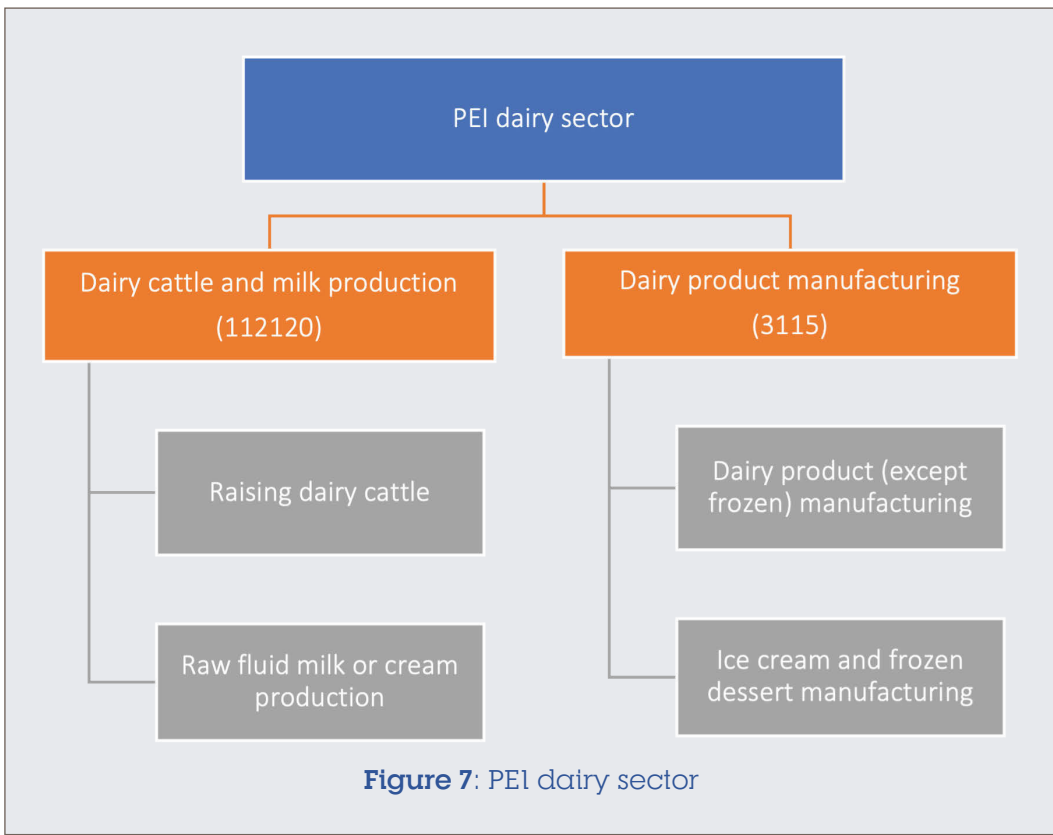


Figure 7: PEI dairy sector

¹⁰ NAICS is an industry classification system developed by the statistical agencies of Canada, Mexico and the US (Statistics Canada, 2018a).

Approach and Methodology

This study uses I-O analysis to measure the economic impact of PEI's dairy sector at provincial and national levels utilizing Statistics Canada tables. I-O models are quantitative economic models that trace the interdependencies between different sectors in an economy. This modeling allows examining relationships among different sectors, between sectors and final consumers (households/government) within an economy (ten Raa, 2009).¹¹ The model was used to measure the PEI dairy sector's impact on PEI and Canada¹² economies in terms of output, Gross Domestic Product (GDP), labour income, employment and taxes.

To capture the entire economic impact of the dairy sector on PEI's economy, this study accounted for three types of economic impacts: direct, indirect, and induced effects as described below (Pleeter, 1980):

- **Direct impact:** accounts for activities related directly to the operation of the dairy sector. For instance, this category includes expenditures incurred by dairy farmers, manufacturers, etc.).
- **Indirect economic impact:** accounts for the impacts that affect other businesses and are linked to the dairy sector (business-to-business). **Induced impact:** accounts for impacts that arise through the re-spending of income earned by the participants in the direct and indirect components. For instance, employees of dairy manufacturers using their income to purchase goods and services.
- **Total impact:** is the sum of the direct, indirect, and induced economic impacts.

I-O analysis allows quantification of the economic impact of PEI's dairy sector on output, GDP, employment, wages and tax generation.

Supply and Use Tables

Statistics Canada's Supply and Use Tables (SUTs) are an analytical tool representing a snapshot of all economic activity taking place in a geographic region. SUTs trace production of products by domestic industries, including imports, through their use as intermediate inputs or as final consumption, investment or exports. Statistics Canada publishes SUTs annually at national and provincial levels. SUTs are used as an analytical tool to understand the structure of production activities and product demand, employment, prices and costs and other economic variables. The SUTs are the basis for impact analysis, as they can be transformed into I-O tables (Statistics Canada 2018d; Statistics Canada, 2020b).

¹¹ A detailed review of the I-O modeling can be found in Miller and Blair (2009).

¹² The impact of PEI's dairy sector on the rest of Canada was calculated separately.

Multipliers

Multipliers are quantitative measures derived from supply and use tables. Multipliers are used to assess for the total impact on all industries in an economy due to changes in the demand for the output of any one industry. Multipliers measure the impact of economic activity/sector/industry interdependencies with the rest of the economy (Statistics Canada, 2020a).

Two types of multipliers were used to determine economic impact in this analysis, “Type I Multipliers” and “Type II Multipliers” (Miller & Blair, 2009)¹³.

- Type I Multiplier is the sum of the direct and indirect impacts. As discussed, direct impacts are those resulting from dairy producers’ purchases from suppliers, while indirect impacts are those generated when dairy sector suppliers purchase inputs from their suppliers.
- Type II Multiplier is the sum of the direct, indirect and induced impacts. Induced impact is generated through the re-spending (successive rounds of inter-industry transactions). For instance, a dairy sector worker’s grocery purchases are induced economic impact from the dairy sector (Cabrera et al., 2008).



¹³ See Appendix A for details on Type I and Type II multipliers.

DAIRY SECTOR ECONOMIC IMPACT ANALYSIS RESULTS

This section reports direct, indirect, and induced impacts on output, GDP, employment, income and government tax revenue. These impacts represent how the sector's operations ripple throughout the PEI and Canada economies.

- Output: the total value of goods and services produced by the PEI dairy sector (i.e., dairy cattle and dairy product manufacturing).
- GDP: refers to the additional value of GDP that PEI dairy sector adds.
- Labour Income: refers to the labour income generated by PEI dairy sector.
- Employment: is the number of additional jobs created by the PEI dairy sector. Employment is measured in terms of Full-Time Equivalent (FTE) jobs.¹⁴ FTE jobs include only employee jobs that are converted to full-time equivalence based on the overall average full-time hours worked in either the business or government sectors.
- Government tax revenues:¹⁵ are the total amount of tax revenues generated for different levels of government (i.e. federal, provincial and municipal).

Tables 7 to 10 below summarize the direct, indirect, induced and total economic impact of the PEI dairy sector on PEI and the Rest of Canada (RoC) economies in terms of output, GDP, labour income and employment. Table 11 summarizes the amount of tax revenues generated provincially and nationally by the PEI dairy sector.¹⁶



¹⁴ See Is defined as total hours worked divided by average annual hours worked in full-time jobs (Statistics Canada, 2015).

¹⁵ Tax revenue impacts are estimates and do not necessarily represent the actual tax revenues.

¹⁶ Appendix B includes a detailed summary of the economic impact of the PEI dairy sector disaggregated as two industries (i.e., dairy cattle and milk production and dairy product manufacturing).

Direct Economic Impact

In terms of output and GDP, the analysis showed that, in 2017, the PEI dairy sector contributed \$273.1 million directly to the PEI economy and added \$66.2 million to the province's GDP. Nationally, the sector contributed \$8.2 million to the RoC and added \$4 million in GDP, which sum to a total direct impact of \$281.3 million and a total contribution of \$70.2 to GDP at national level (i.e., PEI and RoC).

In terms of direct income and employment, in 2017, the PEI dairy sector generated \$24.7 million in income in the province and \$2.3 million in RoC (a total of \$27 million nationally). The analysis also showed that the sector's direct impact led to the creation of 513 FTE jobs in PEI, 35 FTE jobs in the RoC; a total of 548 FTE jobs in Canada (including PEI). Approximately 2 jobs were created directly in PEI by every \$1 million in dairy sector products sales (513 FTE jobs/\$273.1 million). Table 7 below summarizes the direct impact of the PEI dairy sector on output, GDP, labour income and employment at the provincial and national levels.

Table 7: Direct economic impacts of PEI dairy sector, 2017

Economic indicator	PEI	RoC	Total
Output ('000\$)	273,102	8,218	281,320
GDP ('000\$)	66,193	4,013	70,206
Labour income ('000\$)	24,749	2,271	27,020
Employment (FTE)	513	35	548

Source: I-O modeling, Strategic Policy and Evaluation Division, Department of Agriculture and Land.



Indirect Economic Impact

In 2017, the PEI dairy sector indirectly contributed \$275.3 million to PEI's economy, \$97.3 million to the province's GDP, \$179.2 million and \$68.5 million to the RoC economy and GDP respectively; this sums to a total indirect impact of \$454.5 million and a total indirect contribution of \$165.8 million to the GDP at the national level. In terms of indirect income and employment, the PEI dairy sector generated \$48.5 million in income in PEI and \$37.6 million to RoC (a total of \$86.2 million nationally). The sector indirectly created 1,109 FTE jobs in PEI, 576 FTE jobs in the ROC; a total of 1,685 FTE jobs in Canada. Table 8 summarizes the indirect impact of the PEI dairy sector on output, GDP, labour income and employment at the provincial and national levels.

Table 8: Indirect economic impacts of PEI dairy sector, 2017

Economic indicator	PEI	RoC	Total
Output ('000\$)	275,259	179,192	454,451
GDP ('000\$)	97,290	68,539	165,829
Labour income ('000\$)	48,548	37,622	86,170
Employment (FTE)	1,109	576	1,685

Source: I-O simulation, Strategic Policy and Evaluation, Department of Agriculture and Land.

The analysis revealed that the PEI dairy sector has impacted, and is linked to, many other industries (agricultural and non-agricultural industries) at different levels, reflecting the economic importance of the sector. Although the sector has an impact on many industries, it is mainly linked to crop and animal production, transportation and warehousing, retail trade and food services.



Induced Economic Impact

In terms of induced impact, in 2017, the PEI dairy sector contributed \$31.2 million to PEI economy and \$20.4 million to the province's GDP, while it contributed \$58.7 million to the RoC and added \$31.2 million in GDP, which sum to a total induced impact of \$89.9 million and a total contribution of \$51.6 million to the GDP at the national level (i.e., PEI and RoC). In terms of induced income and employment, the PEI dairy sector generated \$7.7 million in income in the province and \$15.4 million in the RoC (a total of \$23.1 million nationally). In terms of induced impact on jobs, the sector created 149 FTE jobs in PEI, 235 FTE jobs in the RoC; a total of 384 FTE jobs in Canada. Table 9 summarizes the induced impact of the PEI dairy sector on output, GDP, labour income and employment at the provincial and national levels.

Table 9: Induced economic impacts of PEI dairy sector, 2017

Economic indicator	PEI	RoC	Total
Output ('000\$)	31,232	58,699	89,931
GDP ('000\$)	20,413	31,217	51,630
Labour income ('000\$)	7,729	15,419	23,148
Employment (FTE)	149	235	384

Source: I-O simulation, Strategic Policy and Evaluation, Department of Agriculture and Land.



Total Economic Impact

In 2017, the PEI dairy sector contributed a total of \$579.6 million to the province's output (direct, indirect and induced), \$183.9 million to the provincial GDP, generated \$81 million in income and created 1,769 FTE jobs in PEI. In terms of impact on other provinces, the sector contributed a total of \$246.1 million in other provinces' output, \$103.8 million to their GDP, \$55.3 million in labour income and created 845 FTE jobs. Nationally (i.e., the impact on Canada's economy including PEI), the analysis showed that, in 2017, the PEI dairy sector contributed \$825.7 million in output, added \$287.7 million to the national GDP, generated \$136.3 million in labour income and created 2,614 FTE jobs.

Table 10: Total economic impacts of PEI dairy sector, 2017

Economic indicator	PEI	RoC	Total
Output ('000\$)	579,594	246,108	825,702
GDP ('000\$)	183,896	103,770	287,666
Labour income ('000\$)	81,026	55,312	136,338
Employment (FTE)	1,769	845	2,614

Source: I-O simulation, Strategic Policy and Evaluation, Department of Agriculture and Land.

Taxes¹⁷

In 2017, approximately \$14.3 million in taxes (federal, provincial and municipal) were collected in PEI as a result of the dairy sector (including taxes on all activities directly or in directly related to the PEI dairy sector). The PEI dairy sector also generated about \$10 million in federal, provincial and municipal taxes in other provinces. Nationally, tax revenues totalled \$24.3 million at different levels of government. Table 11 summarizes tax revenues (federal, provincial and municipal) generated by the PEI dairy sector at the provincial and national levels.

Table 11: Tax revenues generated by PEI dairy sector, 2017

Tax	PEI	RoC	Total
Federal ('000\$)	3,135	1,769	4,904
Provincial ('000\$)	9,891	4,828	14,719
Municipal ('000\$)	1,309	3,414	4,723
Total ('000\$)	14,335	10,011	24,346

Source: I-O simulation, Strategic Policy and Evaluation, Department of Agriculture and Land.

¹⁷ The tax revenues in this analysis are estimates based only on I-O simulation and do not necessarily represent the actual tax revenues.

Multipliers¹⁸

Multipliers for the PEI dairy sector in PEI are summarized in Table 12. The multipliers are important to understand the I-O modeling when reading the analysis outcomes. In 2017, for every \$1 million of dairy sales, there was \$2.01 million in direct and indirect impact (i.e., Type I Multiplier) and \$2.12 million of total output (i.e., direct, indirect and induced impact or Type II Multiplier) in the province's economy. Table 12 also shows GDP as a ratio to value of output. The analysis showed that for every \$1 million in dairy output, \$242.4 thousand was added directly to the provincial GDP, \$598.6 thousand was added directly and indirectly (Type I multiplier)¹⁹, and \$673.4 thousand in total provincial GDP (Type II multiplier)²⁰.

Table 12: Multipliers of PEI dairy sector in PEI, 2017

Economic indicator	Direct	Type I multiplier	Type II multiplier
Output	1	2.01	2.12
GDP/\$million	242,375	598,615	673,360
Labour income/\$million	90,622	268,387	296,688
Employment (FTE)/\$million	1.88	5.94	6.48

Source: I-O simulation, Strategic Policy and Evaluation, Department of Agriculture and Land.

In terms of labour income (i.e., labour income as ratio to output), the analysis showed that for every \$1 million of gross income, \$90.6 thousand was paid directly for labour in the dairy sector, \$177.8 thousand was paid for labour in other industries (linked to dairy sector). In total, \$296.7 thousand was paid for labour in PEI for every \$1 million in dairy sector output. Finally, Table 12 shows the impact on employment. For every \$1 million in dairy sector output, approximately 2 FTE jobs were created directly and 6 FTE jobs were created in dairy sector and linked industries (i.e., indirectly). In total (including induced impact), for every \$1 million dairy sector output, 6.5 FTE jobs were created in PEI.

¹⁸ These are overall multipliers for the PEI dairy sector (i.e., dairy cattle and milk production and dairy product manufacturing) separating these industries would result in different multipliers.

¹⁹ Type I Multiplier includes direct and indirect impact. Type I Multiplier = simple multiplier (direct + indirect) / direct impacts.

²⁰ Type II Multiplier includes direct, indirect and induced impact. Type II Multiplier = total multiplier (direct + indirect + induced) / direct impact

CONCLUSIONS

In this study, the economic impact PEI's dairy sector was quantified by estimating the sector's impact on output, GDP, labour income, employment and taxes. The dairy sector in PEI has an important role in PEI's economy. The dairy sector's economic contribution is generated through (i) dairy cattle and milk production and (ii) dairy product manufacturing. This study provided a detailed analysis of the economic impacts of PEI's dairy sector on the province and the Canadian economies in 2017, utilising I-O modeling. The economic impact of dairy farming and dairy manufacturing were estimated separately, so that the results could be combined to provide a detailed view of the contribution of PEI's dairy sector.

The dairy sector in PEI is an important economic sector. In 2017, through its direct, indirect and induced impacts, the sector generated \$579.6 million in PEI output, boosted the provincial GDP by \$183.9 million, created 1,769 FTE jobs and generated over \$14.3 million in taxes. Nationally (i.e., the impact on Canada's economy including PEI), the analysis showed that the PEI dairy sector generated approximately \$825.7 million in output, boosted the national GDP by \$287.7 million, created 2,614 FTE jobs, and generated roughly \$24.3 million in taxes. This economic analysis showed that the dairy sector is an important contributor to the PEI economy. Comparing the findings of this study with of a previous study completed by the Strategic Policy and Evaluation Division (Government of Prince Edward Island, 2020) on the economic impact of PEI's potato sector revealed that dairy sector's economic contribution represents approximately 40% of the potato sector's contribution²¹ (potato is the largest agriculture sector in PEI) (see Table 13).



²¹ Please note that potato sector economic impact analysis utilized 2016 data while the current study on dairy sector utilized 2017 data.

Table 13: Total economic impact of PEI dairy and potato sectors (comparison)

Economic indicator	Potato sector (2016)	Dairy sector (2017)	Dairy (%)
Output ('000\$)	1,348,381	579,594	43
GDP ('000\$)	527,127	183,896	35
Labour income ('000\$)	239,951	81,026	34
Employment (FTE)	5,016	1,769	35
Taxes ('000\$)	48,905	14,335	29

Support for the dairy sector's growth and ensuring its stability would enhance its contribution to the economy. Between 2018 and 2021, through the federal-PEI cost-shared Canadian Agriculture Partnership (CAP)²², the investment in PEI's dairy sector totalled approximately \$1.7 million. This economic analysis showed that any investment that enhances this sector output would benefit the economy beyond direct value of the investment. To put this in context, in 2017, the PEI dairy sector had a total multiplier of 2.12 in output, \$673.4 thousand/\$million in GDP, \$296.7 thousand/\$million in labour income and 6.48 FTE jobs/\$million. Therefore, for every \$1 million in dairy output, \$2.2 million was added to the province's economy, \$673.4 thousand to PEI's GDP, \$296.7 thousand in labour income and 6.48 FTE jobs.



²² CAP is a \$3 billion five-year (2018-2023), investment by federal, provincial and territorial governments to strengthen and grow Canada's agriculture and agri-food sector.

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APPENDICES

Appendix A: Type I and Type II Multipliers Calculation

Type I and Type II multipliers are used to determine economic impact. Type I Multipliers sum together direct and indirect effects while Type II Multipliers also include induced effects.

Type I and Type II multipliers can be calculated for output, GDP, employment, etc. In this example, output Type I and Type II multipliers are calculated for demonstration purposes. The first step to calculate Type I and Type II multipliers is to calculate Type I Inverse Matrix. This can be done using the following (Miller & Blair, 2009):

$$L = (I - T)^{-1}$$

Where:

L: is Leontiff Inverse Matrix

I: is Identity matrix (all the elements of the principal diagonal are ones, and all other elements are zeros). This matrix is known as transformation matrix.

T: is a technical coefficients matrix that derived by dividing each cell of the domestic intermediate demand.

Type I Leontief inverse matrix is constructed by subtracting the technical coefficient matrix (T) from Identity matrix and invert. Type I Leontief inverse matrix reflects the direct and indirect economic impact; household spending is not taken into account in this calculation (i.e., the spending of households take place outside the model).

Type II Leontief inverse matrix is constructed in the same way as Type I inverse matrix, but household spending is incorporated in this calculation. Household spending is treated as a separate industry in the model. This is done by adding extra rows and columns in the transformation matrix T.

Appendix B: Detailed Summary of the EIA of PEI Dairy Sector

DIRECT IMPACT	DAIRY CATTLE AND MILK PRODUCTION			DAIRY PRODUCT MANUFACTURING			TOTAL		
	PEI	RoC	Total	PEI	RoC	Total	PEI	RoC	Total
Output ('000\$)	93,199	115	93,314	179,903	8,103	188,006	273,102	8,218	281,320
GDP ('000\$)	571	34	605	65,622	3,979	69,601	66,193	4,013	70,206
Labour income ('000\$)	269	22	291	24,480	2,249	26,729	24,749	2,271	27,020
Employment (FTE)	7	1	8	506	34	540	513	35	548
INDIRECT IMPACT									
Output ('000\$)	132,653	78,776	211,429	142,606	100,416	243,022	275,259	179,192	454,451
GDP ('000\$)	45,364	29,057	74,421	51,926	39,482	91,408	97,290	68,539	165,829
Labour income ('000\$)	23,059	15,768	38,827	25,489	21,854	47,343	48,548	37,622	86,170
Employment (FTE)	541	247	788	568	329	897	1,109	576	1,685
INDUCED IMPACT									
Output ('000\$)	9,418	20,570	29,988	21,814	38,129	59,943	31,232	58,699	89,931
GDP ('000\$)	6,153	11,079	17,232	14,260	20,138	34,398	20,413	31,217	51,630
Labour income ('000\$)	2,331	5,401	7,732	5,398	10,018	15,416	7,729	15,419	23,148
Employment (FTE)	45	83	128	104	152	256	149	235	384
TOTAL IMPACT									
Output ('000\$)	235,270	99,460	334,730	344,324	146,648	490,972	579,594	246,108	825,702
GDP ('000\$)	52,088	40,171	92,259	131,808	63,599	195,407	183,896	103,770	287,666
Labour income ('000\$)	25,659	21,191	46,850	55,367	34,121	89,488	81,026	55,312	136,338
Employment (FTE)	592	330	922	1,177	515	1,692	1,769	845	2,614
TAXES									
Federal ('000\$)	935	688	1,623	2,200	1,081	3,281	3,135	1,769	4,904
Provincial ('000\$)	3,288	1,866	5,154	6,603	2,962	9,565	9,891	4,828	14,719
Municipal ('000\$)	520	1,305	1,825	789	2,109	2,898	1,309	3,414	4,723
Total ('000\$)	4,743	3,859	8,602	9,592	6,152	15,744	14,335	10,011	24,346

Source: I-O simulation, Strategic Policy and Evaluation, Department of Agriculture and Land.



The Prince Edward Island Dairy Sector: **An Economic Impact Analysis**

Department of Agriculture and Land