ECONOMIC IMPACTS OF CATTLE SECTOR IN CANADA – A REGIONAL MULTIPLIER ANALYSIS

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Report Prepared For
CanFax Research Services & the
Beef Cattle Research Council

DEPARTMENT OF AGRICULTURAL AND RESOURCE ECONOMICS
UNIVERSITY OF SASKATCHEWAN
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RESEARCH REPORT **APRIL 2021**

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S.K.
C.N.

EXECUTIVE SUMMARY

Economic systems are getting increasingly complex over time. Decisions taken by one individual or a firm affect many other individuals or agencies than what is obvious through casual observation. The Canadian cattle sector operates under such a complex economic system. Here, actions taken by producers and other economic agents impact other members of society. This is because of the nature of the economic system, where one economic agent depends on other economic agents to execute its own production decisions.

Every economic activity that takes place in a region involves a certain amount of monetary expenditures. Such expenditures create some economic repercussions felt elsewhere in the economy, some of which are within the same region, while others are felt in other parts of the national (or even international) economy. On a national scale, these repercussions have been identified in Keynesian economics as the multiplier effect. Although for the aggregate economy such multipliers are useful, their major limitation is that they do not differentiate among sectors[1]. Every economic activity and every economic sector are different in terms of its multiplier effect. Knowledge of these differences is therefore considered important for national and regional economic development planning and related policy making.

Cattle production is a major industry in Canada. To most observers, its economic contribution is mainly seen in terms of initial monetary expenditures incurred by various producers and processors in the industry. Since the repercussions of this activity are not always that obvious, the usual practice is to ignore them. These impacts are commonly known as secondary impacts and are created through the multiplier effect of a sector. Ignoring these impacts leads to serious underestimation of the sector's importance to the regional and national (or provincial) economies. To understand the total economic impacts of an industry, one needs to look 'under the hood' and see how the regional / national economy functions and develops.

The main feature of a regional multiplier activity is the recognition of interdependencies among sectors along with intra-regional and interregional trade. Trade flows, particularly the imports of various products, act as a leakage (or drain) on the economy. Secondary impacts are produced only though the activities that occur within the regional boundaries. To capture the true contribution to regional development from a selected development alternative, one needs to know not only the outlays associated with that alternative but also where they lead to – local economy or elsewhere. If the expenditures are retained within the regional economy, they create multiplier activity.

Secondary impacts are generated through two types of changes in the economy: one, indirect impacts created though purchase of inputs from other industries in the region. These are also called

[1] A sector is an aggregate of similar industries.

backward linkages; two, induced impacts created through re-spending of income of workers and other human resources on consumer goods and services. In addition to the backward linkages, some businesses contribute to the regional / national economy in another manner. They purchase live cattle and calves and process them further, thereby adding more value to the product, and thus, adding to the regional / national economic growth and prosperity. These industries are called forward linked industries.

Total secondary impacts of a sector are thus a sum of three major types of impacts – (1) direct impacts of the Canadian cattle sector (or its components); (2) direct, indirect, and induced impacts of the backward-linked industries associated with the sector; and (3) direct, indirect, and induced impacts through forward-linked industries associated with the sector. An input-output model is a useful method of estimating secondary impacts of any economic activity. In this study this approach was used by developing an input-output model of the Canadian and regional (Western and Eastern Canada) economies using 2016 as the base year.

This study was designed to estimate total economic impacts (direct and secondary impacts from backward and forward linkages) of farm level cattle production and related induced economic activities. This was accomplished through the creation of a cattle sector, which included farm level live animals, plus slaughtering and meat processing (S&MP). This sector was defined as those industries that have both farm level and forward linkages with cattle production. The sector consisted of three sub-farm level activities: Cow-calf production, Backgrounding operations, and Feeders or feedlot operations. The forward linkage industry was the S&MP industries. The analysis was undertaken for Canada as a whole and for its three regions – Western Canada, Eastern Canada, and province of Alberta. Western Canada, in this study, included the province of Alberta.

The study model was a modification of Statistics Canada's provincial input-output transactions table. This model contained four sub-models one each for Canada and its three regions (as noted above). Economic impact results were measured through four economic indicators: Value of goods and services sold (also called output or sales); gross domestic product at market process generated; household (personal) incomes, and employment.

Results of Canadian analysis in terms of gross domestic product (in market prices) and employment are shown in Table E.1. Based on the results presented above, the following conclusions can be drawn:

Table Ex.1: Summary of Economic Impacts of Net Aggregate Cattle Sector on National /Regional Economy, by Regions

Region	GDP in Million $	Employment in Person-Years

	Direct	Total (Type II)	Direct	Total (Type II)
Canada	$19,567	$51,628	71,453	347,352
Western Canada	$14,798	$38,820	51,923	258,130
Eastern Canada	$4,767	$12,808	19,530	89,222
Alberta	$10,341	$20,467	26,158	80,724

1. The major conclusion of this study is that cattle sector in Canada (and its various regions) is intimately tied to many other economic activities, including slaughtering and meat production industries. Each of these cattle producing farms contributes to the economy not only through direct impacts on the national / regional economy, but they also generate additional impacts through secondary mechanisms – indirect and induced. For Canada as a whole, the cattle sector contributes $51.6 billion to the national gross domestic product and is directly or indirectly associated with creation of 347,352 full-time equivalent jobs.

2. There is a significant difference between the direct contributions of the sector and its total impacts. Overall, direct impacts constitute about a one-quarter to a half of the total economic impacts, while indirect impacts, contributed mainly by industry-support provided by other non-agricultural sectors, constitute the next largest.

3. Based on the results of this study, if relative contributions of a sector are estimated using direct impacts only, it will lead to serious underestimation. One of the inferences that can be drawn from the results of the study is that the cattle sector makes a much higher contribution to the economy than what is obvious from traditional measures related to direct contribution.

4. In terms of multipliers of cattle sector, individual types of economic activities within the sector provide different level for various locations (region). For comparison purposes, output-based multipliers (called Pseudo multipliers) for various activities are shown in the Table E.2.

5. Projections of the Canadian cattle sector were made for various region for the period 2030 using two different approaches: One, Trends Based Scenario -- continuation of previous trends based on a literature review, and Two, Growth Based Scenario -- imposing a growth rate of 10 % on all regions and except on irrigated farms. The Growth based scenario results suggested that the cattle sector in Canada could contribute $14 to 21 billion as gross domestic product (GD) associated with 178 to 340,000 person-years of employment.

The study suffers from several limitations, the most significant being the availability of accurate farm level cost of production and margins data. Lack of comparability between various regions and comprehensiveness of farm level regional data are a major limitation of the estimated value of multipliers.

Table Ex.2: Summary of Ratio-form Multipliers of Net Aggregate Cattle Sector on National /Regional Economy, by Regions

Region	GDP		Employment	
	Type I	Type II	Type I	Type II
Canada	2.280	3.355	2.545	4.861
Western Canada	2.302	3.338	2.638	4.971
Eastern Canada	2.215	3.408	2.296	4.568
Alberta	2.294	3.258	2.118	2.822

The second limitation of the study is that regional data used for processing activities was for Canada as a whole, adjusted for self-sufficiency. Actual regional data could have produced a better estimate of the total impacts. Furthermore, the data collected by Statistics Canada is for all meat production, which does not separate beef production from other meat hogs, sheep and lamb, and poultry) production. In addition, veal production is a product of both beef farms and dairy farms. Major data collection effort to sort these issues is needed to improve future economic impact analysis for this sector.

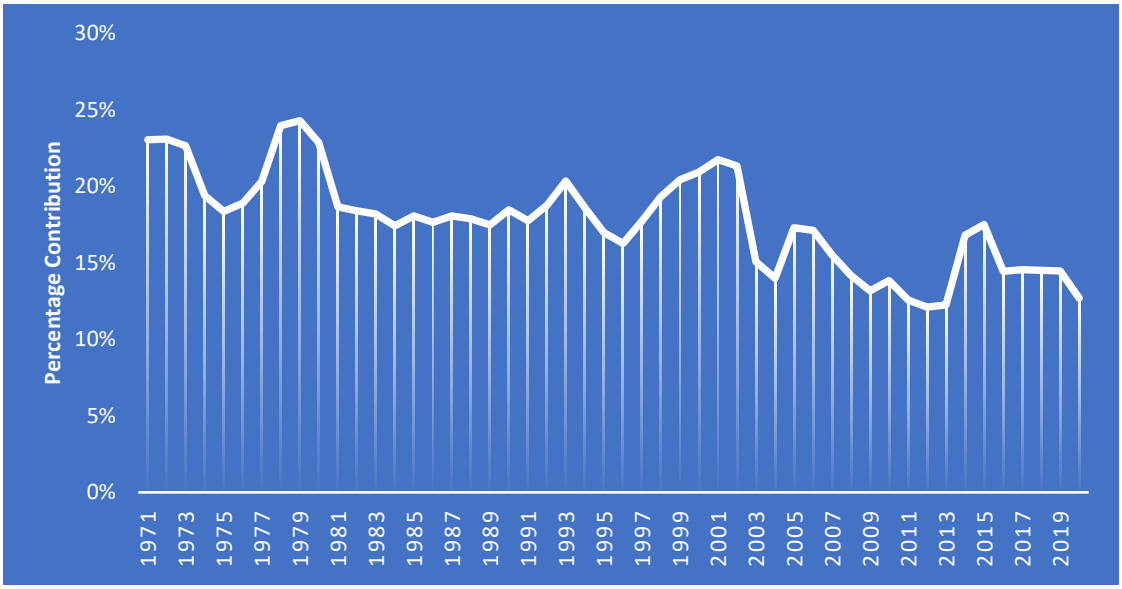
Chapter 1

INTRODUCTION

1.1 Background

Economic change is a complex process. It may consist of changes that occur instantaneously / or perhaps in some cases in a sequential manner until the economic system reaches a new equilibrium. The degree of the complexity in this process is dependent upon the nature of the economy and the interdependencies between goods producing sectors that exist. Development of a new industry or expansion of an existing one could create a significant impact on the economic engine of a region or a nation.

Canadian cattle sector is the highest component of the total farm cash income. During the past decade (2011-2020), it contributed an average of 14.2% of total Canadian farm cash income Source: Statistics Canada (2020a).
Figure 1.1). The highest contribution was recorded for 1999-2002 period when the share of the cattle farm cash receipts increased to 20%. As shown in Figure 1.1, over the last three decades, its contribution has been decreasing slightly from 21.7% over the 1971-1980 period to 14.2% over the 2011-2020 period.



Source: Statistics Canada (2020a).

Figure 1.1: Contribution of Cattle Industry to Canadian Cash Farm Income, 1971-2020

Beef cattle production on farms in Canada is concentrated in a few select provinces (Table 1.1). In Eastern Canada, the cattle sector is more important in the provinces of Ontario and to a lesser extent Quebec. In Western Canada, this activity is highly concentrated in the provinces of Alberta and Saskatchewan. In fact, for Canada as a whole, Alberta produces slightly over half of the farm cash income from sales for the sector.

Table 1.1: Share of Cattle and Calves Sector to Total Farm Cash Income by Province, Canada, 2020

Province	Level of Farm Cash Income from Cattle and Calves in Million $	% of Total Canadian Cash Farm Income in 2020	% o the Total Canadian Cash Farm Income in 2011	Shift in shares in 2020 over 2011
Newfoundland and Labrador	3.4	0.04%	0.05%	-0.01%
Prince Edward Island	30.7	0.34%	0.33%	+0.01%
Nova Scotia	33.7	0.37%	0.37%	0
New Brunswick	47.9	0.53%	0.38%	+0.15%
Quebec	439.1	4.82%	7.97%	-3.15%
Ontario	1,269.3	13.94%	15.95%	-2.01%
Manitoba	619.3	6.80%	6.53%	+0.27%
Saskatchewan	1,374.0	15.09%	16.11%	-1.02%
Alberta	5,052.9	55.51%	49.11%	+6.40%
British Columbia	232.0	2.55%	3.19%	-0.64%
Canada	9,102.4	100.00%	100.00%	0

Source: Statistics Canada (2020a).

Over the last decade (2011-2020), there have been some shifts in the farm level cattle industry. Alberta's share has increased from 49% in 2011 to slightly over 55% in 2020[2]. This gain has come through a reduction in Quebec (-3.1%) and Ontario (-2.1%). In terms of Canada as a whole, Ontario and Alberta are the two provinces with a relatively higher share of the sector (as measured through farm cash income). These two provinces claim about 69% of the total farm level Canadian cattle production. Such regional shifts also create a ripple effect through the regional economies and have implications for their future economic development.

[2] Caution is advised since these values are based on a single year of observation.

1.2 Need for the Study

To most observers, contribution of an industry (or business) is measured through the intuitively obvious economic changes it generates in an economy. These are typically the contribution it makes directly to a given economic criteria (sales, income, gross domestic product, interregional or international imports, or employment). However, such comparisons rarely reveal the true importance of the sector in question. Since in our modern economy, one sector of production depends on other sectors for inputs, direct contributions underestimate the total contributions of the sector.

Economic activities of an industry cannot be undertaken without the support of other industries in the region as well as those located outside the region, and the cattle sector is no exception to this statement. Frequently, the production of a sector generates economic activities in other sectors within the region (where it is located) as well as outside the region and sometimes even in the rest of the world. This is because Canadian agricultural activities are undertaken in a relatively open-trading environment. Entrepreneurs make the best decision in terms of the optimal place of purchase under this environment. The net result of these economic activities is that one sector affects another sector within a region, and economic activities in one province affect those in other provinces and even in other countries around the world (although more limited to the North American region -- namely U.S.A and Mexico). Therefore, it is contended that if contributions of an industry are measured only in terms of direct impacts, this may not provide a realistic picture of total contributions of the industry to the province/region or nation. This is because many of the economic impacts are not that obvious intuitively; only those that are directly related to the industry are obvious. In addition to direct impacts, many other impacts are associated with the economic activities of an economic sector, such as agricultural production.

To illustrate the above point, let us take an example of a cattle producer using feed grains to maintain his/her herd. Let us further assume that these feed grains are supplied from an adjoining crop farm. We can now pursue the chain of reactions that would take place because of this single decision of the cattle producer.

1. Experiencing higher expected demand for feed grains, the neighbouring crop producer would likely add more area to these crops.
2. The new area of feed grain production would require some additional inputs, such as fertilizer, chemicals, workers, among others.
3. Let us assume that this neighbouring producer decides to buy more fertilizer. The fertilizer would likely be purchased locally, thereby putting additional money in the hands of the fertilizer dealer.
4. The fertilizer dealer, in turn, must order this additional fertilizer quantity from a wholesale distributor, which would eventually be met by additional manufacturing activity.

5. Manufacturing of fertilizer would require some input (such as natural gas, and workers) to produce it.
6. Once it is produced, it is transported to the wholesale distributor and then to the retail dealers, creating jobs in the transportation sector, in addition to the wholesale and retail sectors.
7. In addition, a portion of the expenditures by all these agents is paid to workers which are employed to perform various functions related to these activities. This money, in turn, is typically spent within the region on available goods and services. Some of these expenditures are also on activities that are labelled import oriented – money is leaked to other regions of the world.
8. A portion of the new expenditures at various levels is collected by the various levels of the governments as payment of taxes at various levels.

The longer run effect of increased demand for feed grains is to add more capacity to produce by the various economic agents in the region. Here the new demand at the manufacturer's level, invariably must be met through new production[3]. If the demand increase is perceived to hold in the long run, it may require an expansion in plant capacity. Such an action would involve new construction and/or new investment in plant machinery and equipment. In either situation, the plant would require new inputs from other goods producing sectors. Soon after this expansion in plant capacity there would be increased production, which could only be met through purchases of various goods and services procured from other sectors locally, or from outside the region. The above set of interactions apply to cattle sector as well.

The above type of new regional economic growth cannot be seen through perusal of direct contributions of any industry, including cattle production. Since the economy is interlinked, new methods of analysis must be developed. Many of these methods are based on a mathematical formulation. Since it is plausible to assume that all economic sectors are affected by the above process, one needs tools that have its origin in general equilibrium economic theory. One such model is the input-output model. Such a model provides a relatively inexpensive means of generating impact of private and public decisions – such as bringing or fostering new economic activities in a region, or of changing policies.

In the context of cattle production in Canada (or any of its provinces), many questions need answering. What industries are affected by activities associated with cattle production in various regions of Canada? What would the regional economy look like if there were no cattle production units? What contribution could be expected in the future form the cattle production? In other words, major issues relate to developing information on total contribution made by cattle production in Canada and in its (as well as in various regions), which is needed for private and

[3] It is conceivable that small increases in demand could be met through withdrawals from inventory as well. However, such would not be possible for large level of demand.

public decision making. Given that such information does not exist, the current study was undertaken to fill this void.

1.3 Objective of the Study

The major objective of this study is to estimate the total economic impact of the Canadian cattle sector on the national and regional economies. These contributions are made by considering the various linkages of the cattle sector with other economic activities in the region where this production takes place. In addition, both backward and forward linkages are assumed to exist. Estimated impacts include those through various types of changes that are created by various activities undertaken by the cattle sector.

1.4 Scope of the Study

In this study, estimation of economic impacts of the cattle sector was done both at the national and regional (including selected provincial) levels. These impacts were estimated for the following geographical jurisdictions: (1) Canada; (2) Eastern Canada; (3) Western Canada; and (4) Province of Alberta.

The cattle sector was defined in this study as an aggregate of two sub-sectors: (1) Farm level production of live cattle; and (2) Processing of live animals into meat by the slaughtering and meat production (S&MP) sub-sector.

Analysis of economic impacts of the sector was done in a disaggregated manner: Different types of production processes (cow-calf, backgrounding, and feedlots) included in the sector were analyzed separately. In addition, impact of the sector on further value-added production processes (such as through the activities of S&MP sub-sector) were also estimated. Two types of economic impacts were estimated: gross impacts of a given type of production activity, and marginal (net) impacts. The latter was estimated by avoiding all double counting of inputs of one type of production process purchased from other production processes whose impacts have already been estimated.

Estimation of impacts in this study were limited to economic and employment impacts. No attempt was made to identify and/or estimate social and environmental impacts of the sector. Furthermore, total economic impacts that are realized in other parts of Canada or the world were also excluded (except the direct impact on these regions) due to lack of data / information.

1.5 Organization of the Report

The rest of this report is divided into ten chapters. Chapter 2 introduces the cattle sector in various regions of Canada. Discussion on the nature of economic impacts through production activities, such as those from the cattle sector, is provided in Chapter 3, which is followed by a description of the study model in Chapter 4. The scenarios used for the impact analysis are presented in Chapter 5. The respective results of the analysis for the three levels of aggregations are presented in Chapters 6 to 9 for Canada, Western Canada, Eastern Canada, and Alberta, respectively. In Chapter 10 an attempt is made to forecast the sector for the year 2030 and estimate its economic impacts. A summary of results and areas for further research are the topics for discussion in Chapter eleven.

Chapter 2

CANADIAN BEEF CATTLE SECTOR: A BRIEF REVIEW

As noted earlier, in this study, the Canadian beef cattle sector was defined as a composite of all activities directly or indirectly related to cattle production and processing. Thus, it is therefore composed of two separate sub-sectors – Farm level beef cattle production sub-sector, and the S&MP sub-sector. These two sub-sectors are intimately related and depend on each other for their economic survival. This dependence is in terms of the sale of raw materials produced by the farm level sub-sector to the S&MP sub-sector.

2.1 Canadian Farm Level Cattle Production Sector

Canada is among the top 20 beef producing countries in the world, coming 10th in 2010 (CME Group, 2010). By 2020, Canada had dropped to the 11th country in beef production (Table 2.1). The United States of America (USA) and Brazil are the top beef producing countries in the world, with a combined share of 37.3% in 2020. Canada is a small player in the world beef market, with a share of 2.2%. However, the sector is an important one for Canada in general and very important for certain regions/provinces. The industry contributes to the economy through various stages of the supply chain (including backward and forward linkages) from the inputs at the farm level to the final product at the retail stores and food service sector.

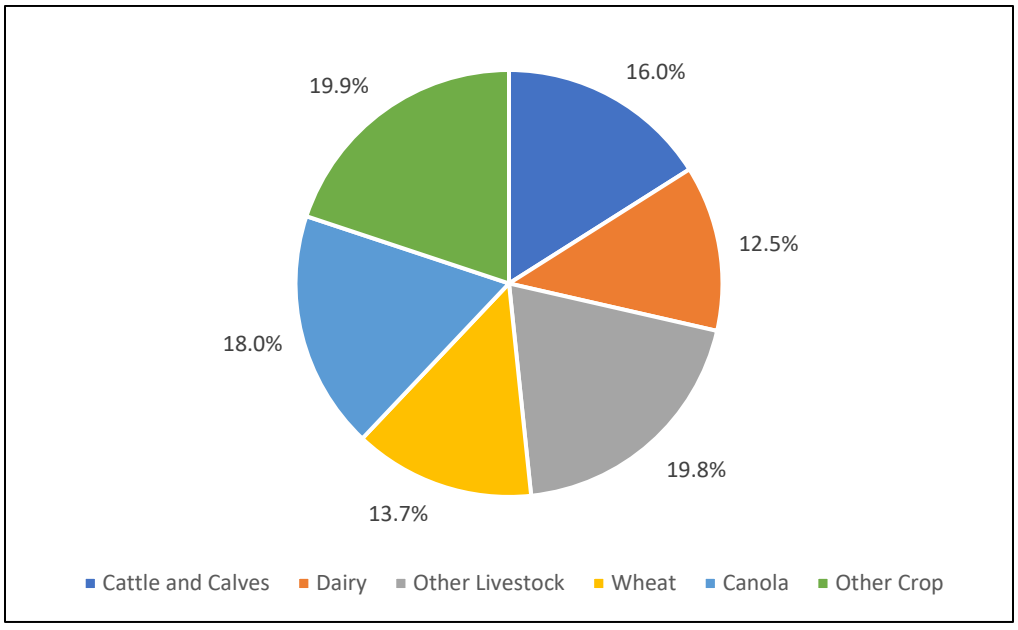
Canada has the 12th largest beef cattle herd is the 7th largest exporter of beef and veal and the 10th largest importer of beef and veal (AAFC 2021d, 2021f). Most of Canadian beef and veal exports (73%) and most of the imports (66%), go to and come from the United States, respectively. Also, live cattle export, primarily to the USA, is a market outlet for cattle producers for calves, feeder cattle, and slaughter cows and bulls.

Canada's beef industry is the 2nd largest single source of farm cash income in Canada, contributing on average $9.1 billion during 2016-2020 period. This is almost double the farm cash receipts in 1971, when this sector sold $4.65 billion worth of cattle and calves. As shown in Figure 2.1, cattle production contributes 16% to the total Canadian farm cash receipts. Similarly, the red meat processing industry (consisting of beef, veal, pork, lamb, and horsemeat) is the largest sector of the food manufacturing industry in Canada with annual revenues valued at over $16.3 billion and total employment of over 58,000 people (FPSC, 2017). Within Canada, farm level beef production is concentrated in Western Canada with over 83% of beef cows on farms in Alberta, Saskatchewan, and Manitoba (Figure 2.2).

Table 2.1: Top Beef Producing countries in the World, 2020.

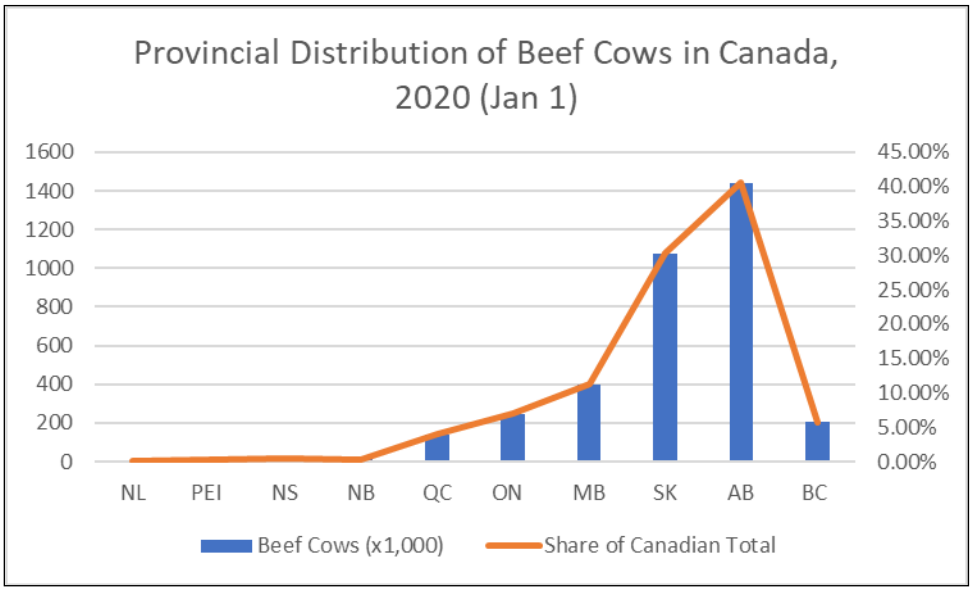
Rank in the World	Country	Percent of World Beef production
1	United States of America	20.54%
2	Brazil	16.74%
3	European Union	12.94%
4	China	10.87%
5	India	6.05%
6	Argentina	5.32%
7	Australia	3.51%
8	Mexico	3.47%
9	Pakistan	3.02%
10	Russia	2.29%
11	Canada	2.16%
12	South Africa	1.58%
13	Colombia	1.21%
14	New Zealand	1.18%
15	Paraguay	0.88%
	Rest of the World	8.27%

Source: Beef 2 Live (2020).



Source: Statistics Canada (2020a).

Figure 2.1: Farm Cash Receipt in Canada, by Agricultural Commodity, 2020



Source: Statistics Canada (2021a).

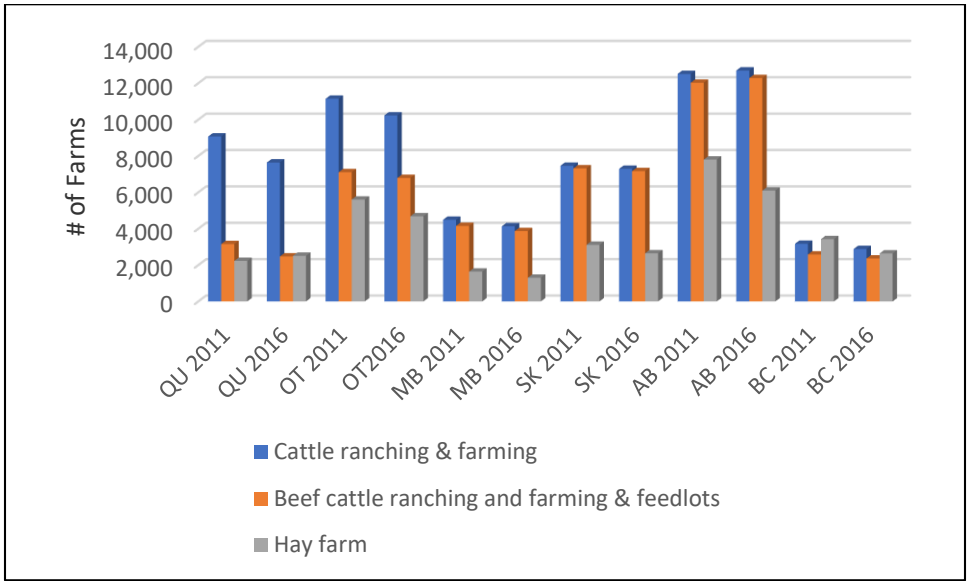
Figure 2.2: Provincial Distribution of Beef Cows in Canada, 2020 (Jan 1)

2.2 Farm Level Beef Cattle Production Sub-Sector

The latest numbers of beef cattle operations are from 2011 and 2016 Agricultural Census data (Figure 2.3) for the number of farms for the major producing provinces and Atlantic Canada (Figure 2.4). In Canada, the sector is concentrated in Ontario and Alberta. Within the Maritime provinces, there are higher number of cattle raised in Nova Scotia and New Brunswick.

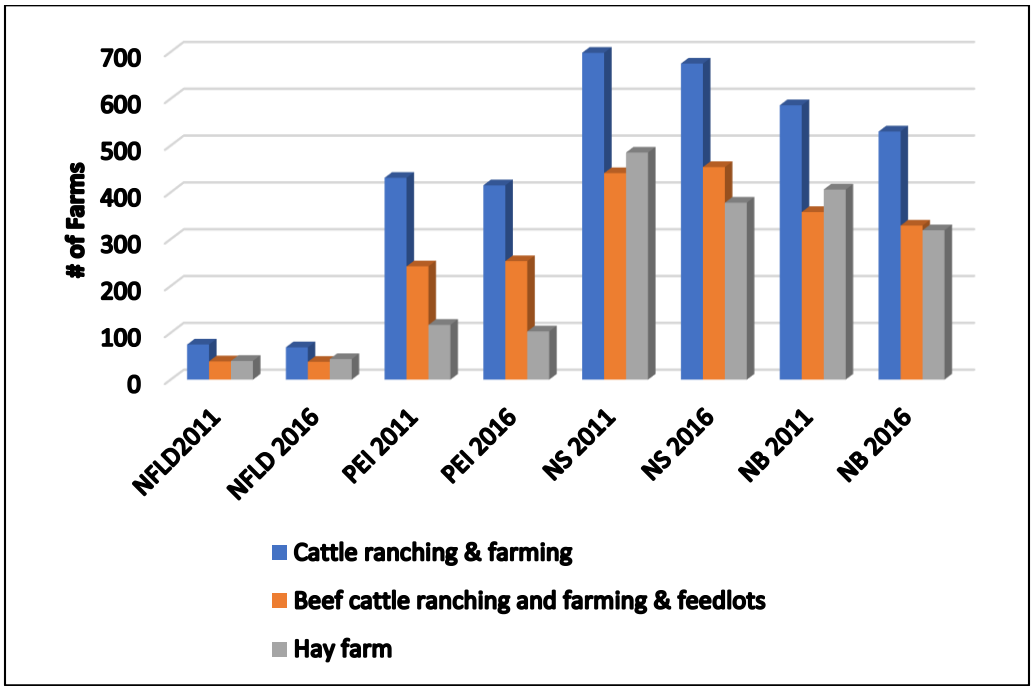
The general trend across provinces is for a decline in the number of farms which is consistent with other agriculture commodity sectors, such as dairy, hogs and grain farms. Alberta had an increase in Beef cattle ranching and farming & feedlots of 2.2% between 2011 and 2016 which runs counter to the trend. The decline in hay farms is likely due to consolidation, as this type of activity is related to fewer cattle, sheep, and dairy livestock in Canada over this period.

The beef industry is the third largest employer in the Canadian agricultural sector (AGRI-LMI 2020). In 2017 the beef sector employed 44,350 workers on cow-calf, background and feedlot operations representing 13% of the employment in agriculture. Almost two thirds of the beef sector workers are employed in the Prairie Provinces and 19% in Ontario. The age of beef cattle sector workers and managers is older than for other agriculture sectors with ¼ of the mangers 65 or older and with 2 in 5 workers expected to retire by 2029 (AGRI-LMI, 2020). Inter-generational transfer of the beef cattle operations and replacing retiring workers will be a challenge over the next decade.



Source: Statistics Canada (2021g)

Figure 2.3: Beef Farms in Major Producing Provinces (Census)



Source: Statistics Canada (2021g)

Figure 2.4: Beef Farms in Atlantic Canada (Census)

Most of the cow-calf operation takes place on pasture where calves are nursed to a weight of 450 to 600 lbs., when they are weaned and start backgrounding. The backgrounding operation primarily takes place on backgrounding operations however cow-calf and finishing operations also background a portion of the calves. Calves are fed a slow growth diet overwinter to gain about 1.5

lb. or less a day until spring when they are sold to finishing operations or put out to pasture then sold to finishers in the fall. Backgrounding goes on to about a weight of 900 lb., where the animals are taken to the final stage of the process, finishing. Backgrounding of cull cows primarily those under 5 years also occurs on backgrounding operations. On the finishing farms, the animals are fed a carefully formulated diet for fast weight gain. Diet begins with forages and progressively moves to about 90% grains.

Production of beef in Canada involves three primary sectors, beef cow-calf farms, backgrounders, and finishers. These three sectors are described for western and Eastern Canada in the following sections. Emphasis will be on Alberta and Saskatchewan where most of the beef cow herd is, most of the fed cattle are produced and where most of the slaughter and processing takes place. The farm level production sub-sector for cattle is a complex system with a significant amount of interregional and inter-firm dependencies. Another factor that adds complexity to the sub-sector is some overlapping in the numbers reported to produce calves between beef and dairy herds.

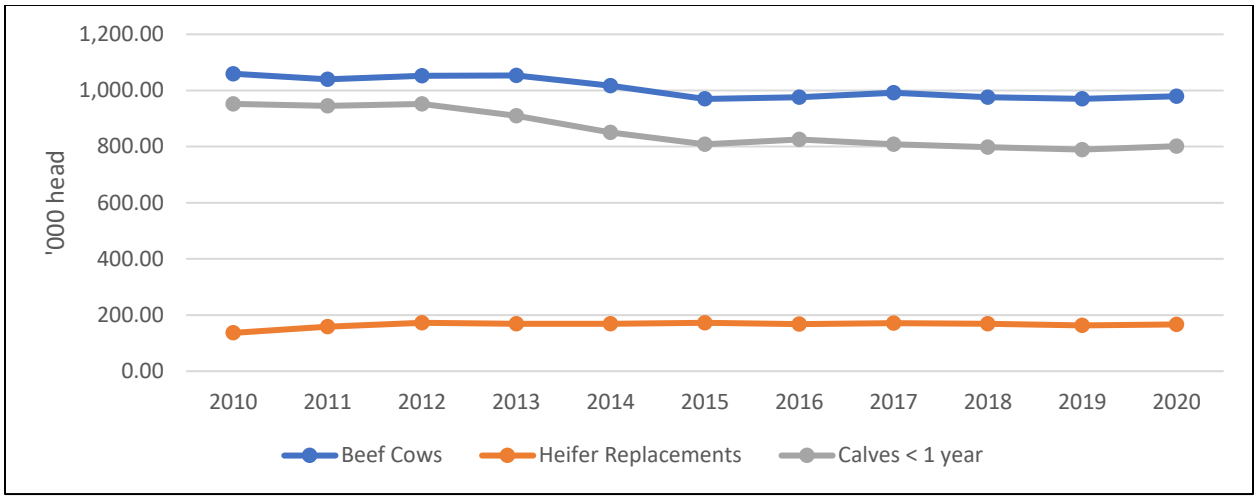
2.2.1 Cow-Calf Sector (Western Canada)

On July 1st, 2020 there were approximately 2.68 million beef cows on cow-calf operations in Western Canada (Statistics Canada, 2021a). This is a decline of 346,000 (-11.4%) head since 2010 with declines of -18.2% in Manitoba, -15.2% in Alberta, -7.5% in Saskatchewan, and an increase of 14.1% in British Columbia. In general, the decline has been partly attributed to fewer farms as farmers retire along with fewer mixed grain-livestock operations as farmers specialize in grain production. Also, poor pasture conditions, due to drought over 2013 to 2015 and 2018-19 in Alberta (AAFC 2021a), could likely have led to the culling of more beef cows than normal and thus partly explains the decline in the number of cattle. Low soil moisture in Saskatchewan and Manitoba 2017-2020 (AAFC 2021a) did not lead to the same level of decline in beef cow numbers in Saskatchewan compared to Alberta; however, it was more of a factor in Manitoba, which had a similar decline in beef cows compared to Alberta.

Most of the beef cows on cow-calf operations in Western Canada are in Alberta (51.3%) and Saskatchewan (39.4%). The number of beef cows in the cow calf sector in Saskatchewan over the 2010 to 2020 period is presented in Figure 2.5 with Alberta presented in Figure 2.6.

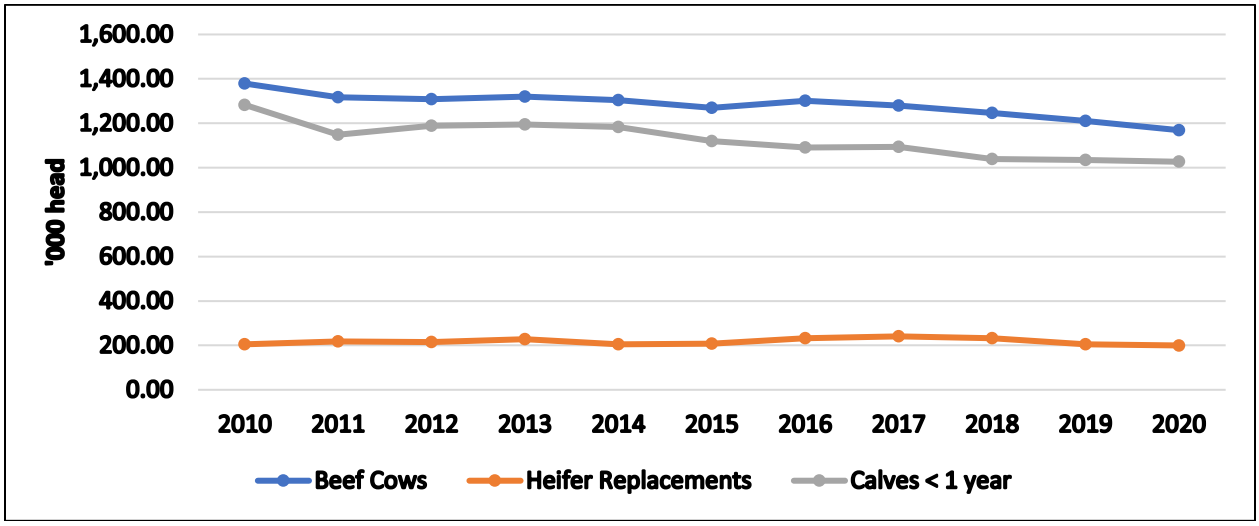
The number of beef cattle in Saskatchewan has fallen from an average of 1.044 million (2010-2014) to an average of 0.979 million (2016-2020), a decline of 6.2%. In Alberta, the decline was 7.5% from an average of 1.325 million to 1.276 million. Beef heifer replacement numbers have remained relatively constant in both Saskatchewan and Alberta even as the number of beef cows in the breeding herd has declined. As a percentage of the beef cow herd, beef heifer replacement

has averaged 16.9% in Alberta and 16.4% in Saskatchewan with the average for Western Canada at 18.7%.



Source: Statistics Canada (2021a).

Figure 2.5: Saskatchewan Cow-Calf Sector 2010 to 2020 on July 1st

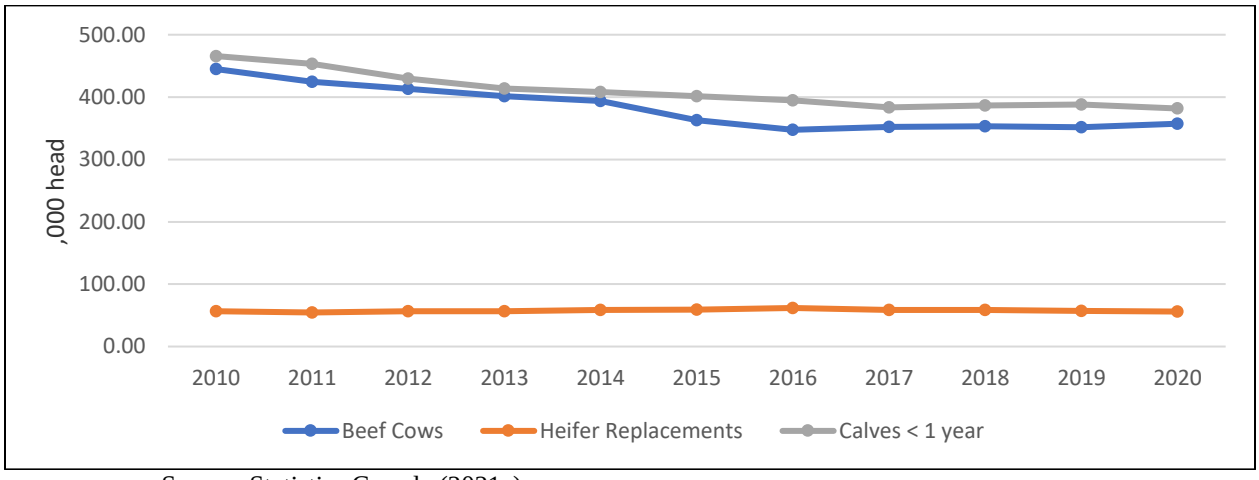


Source: Statistics Canada (2021a).

Figure 2.6: Alberta Cow-Calf Sector 2010 to 2020 on July 1st

2.2.2 Cow-Calf Sector (Eastern Canada)

Eastern Canada had 357,000 beef cows on cow calf operations on July 1st, 2020 which is 11.7% of the Canadian beef cows. Most of the beef cows on cow-calf operations in Eastern Canada are in Ontario (54%) and Quebec (38%). There was a steep decline in beef cow numbers in Eastern Canada of 22% from 2010 to 2016, since then the beef cow numbers has stabilized despite droughts in 2018 and 2020 in much of Eastern Canada (AAFC 2021b) (Figure 2.7). Even with the decline in beef cow numbers heifer replacement has remained on average 57,650 head per year which is 15.2% of the beef cow herd. The higher number of calves relative to beef cows reflects the higher rate of calves kept for backgrounding on cow calf farms in Eastern Canada compared to Western Canada.



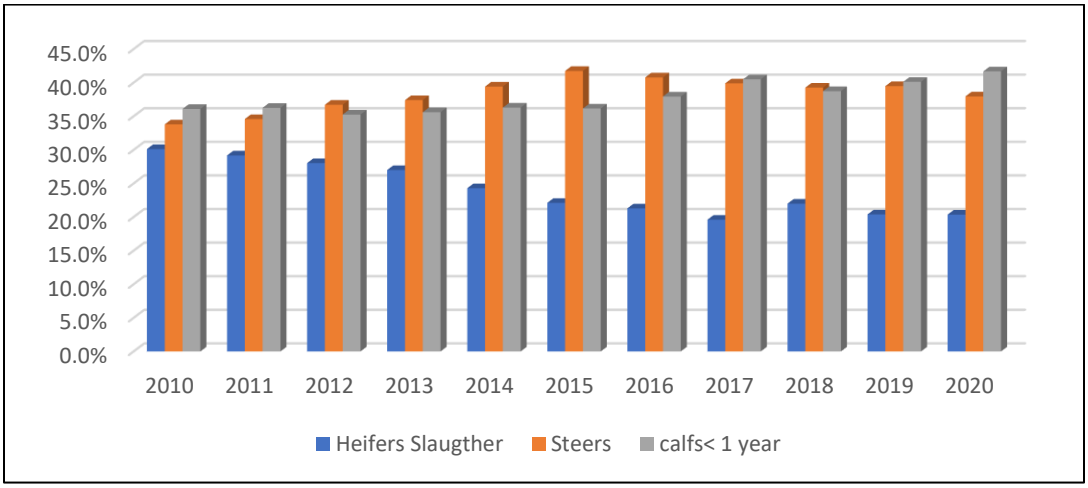
Source: Statistics Canada (2021a).

Figure 2.7: Eastern Canada Cow-Calf Sector 2010 to 2020 on July 1st

2.2.3 Backgrounding Sector (Western Canada)

In Western Canada, most placements in backgrounding operations are steers greater than 1 year old and calves less than 1 year old with a declining number of heifers from 2010 to 2020 (Figure 2.8).

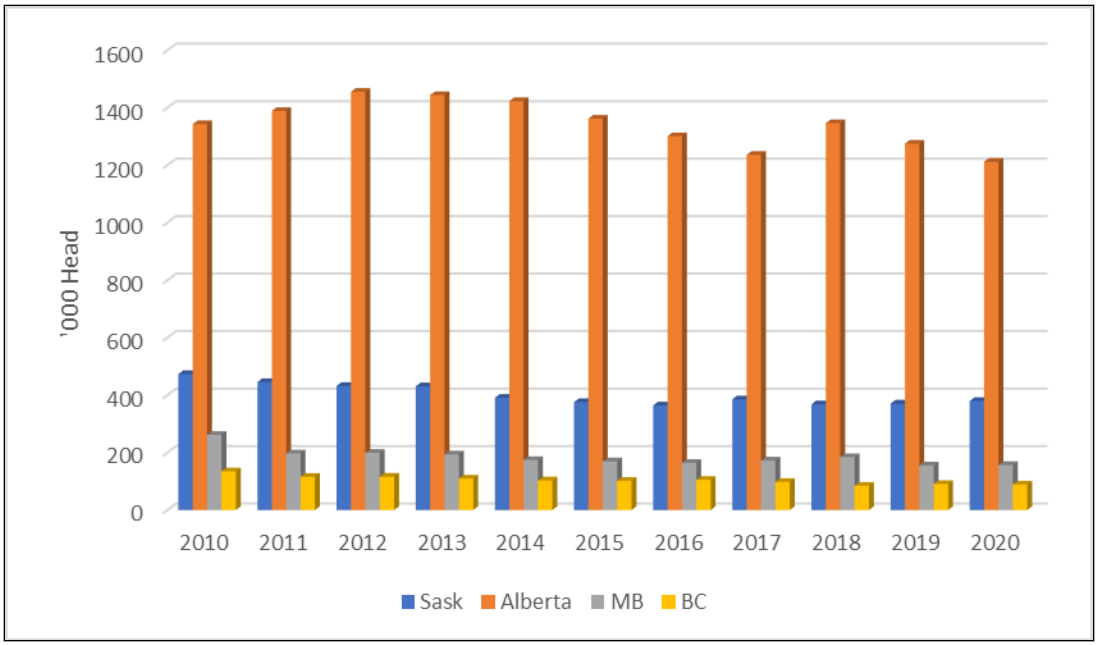
Steers have a higher rate of gain relative to heifers so given the production constraints of the backgrounder (i.e., pasture, stored pasture) and the price differential between steers and heifers have increasingly favoured steers over heifers. Calves < 1 year have increased in the share that backgrounders have placed over the 2010 to 2020 period. The calves maybe purchased in the Fall over wintered on a low gain ration for sale to finishers in the spring or set out to pasture over the summer for sale to finishers in the Fall. Backgrounders could also purchase yearlings (steers or heifers) in the spring to set out to pasture for sale to Finishers in the fall season.



Source: Statistics Canada (2021a).

Figure 2.8: Profile of the Animal type in Backgrounding Operations in Western Canada July 1st

On average most of the cattle on background operations in Western Canada are in Alberta (66%), then Saskatchewan (19.7%) and Manitoba (9%) (Figure 2.9). Alberta's share of backgrounding activity in Western Canada has increased over this period.

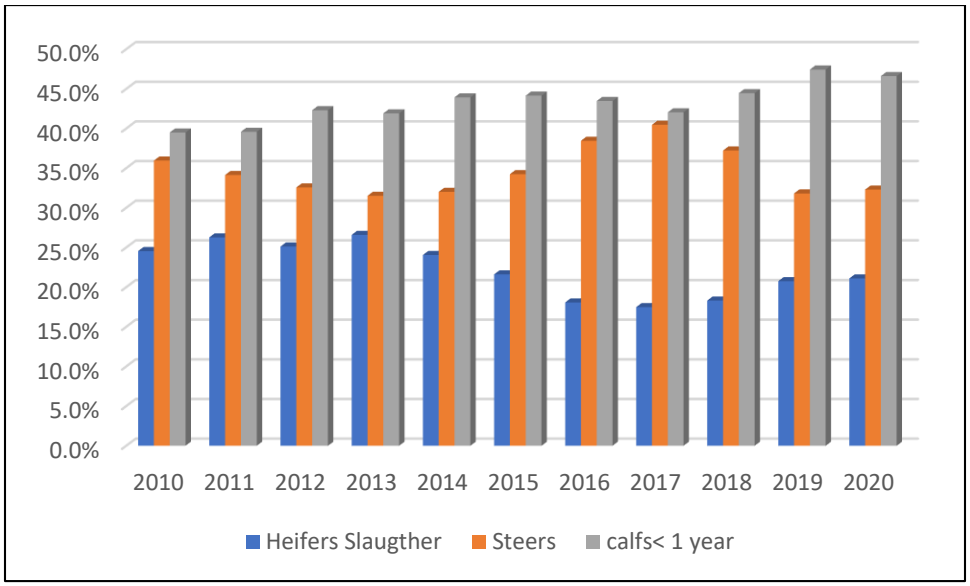


Source: Statistics Canada (2021a).

Figure 2.9: Cattle on Backgrounding Farms as of July 1st

2.2.4 Backgrounding Sector (Eastern Canada)

Calves < 1 year are the largest share of cattle in background operations in Eastern Canada and this share has increased over the 2010 to 2020 period (Figure 2.10). There has been a decline in the placement of heifers for slaughter with the number of steers falling to 2013 rising to 2017 then falling to 2020 in background operations.

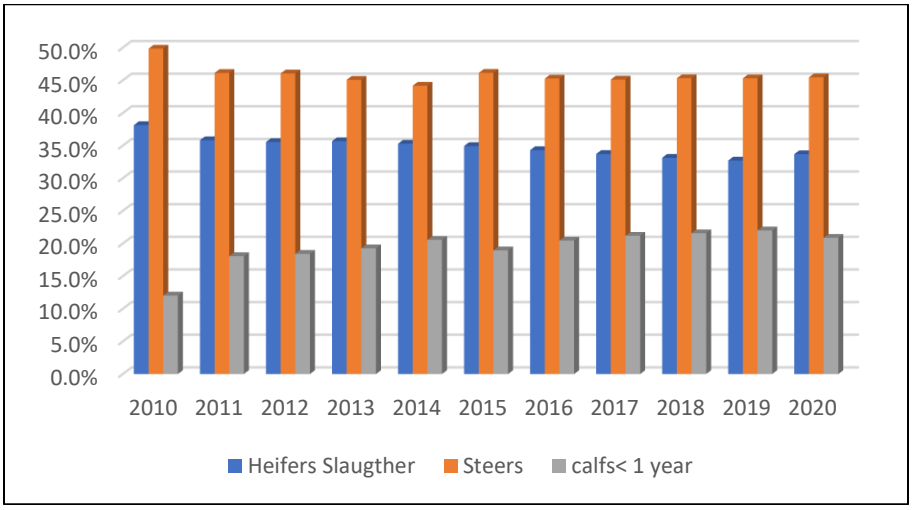


Source**:** Statistics Canada (2021a).

Figure 2.10: Profile of the Animal type in Backgrounding Operations, Eastern Canada July 1st

2.2.5 Finishing Sector (Western Canada)

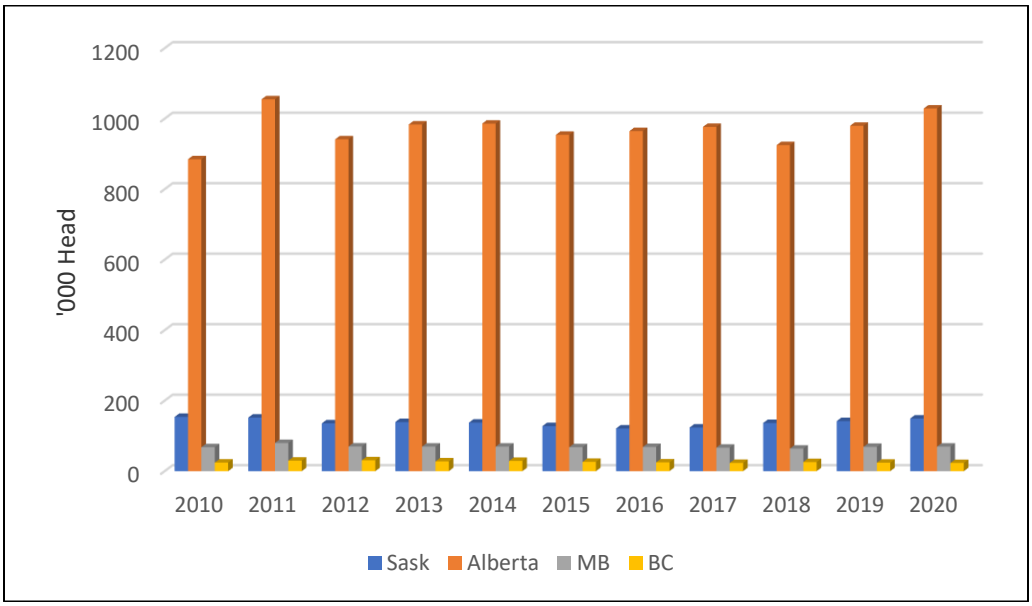
The profile of the type of animal in finishing lots in Western Canada has changed since 2010 as the percentage of steers and slaughter heifers has decreased with more calves less than 1 year old filling the gap (Figure 2.11). Also, the profile indicates a turnover of space that meets market demand. Since 2016 the profile of placements in finishing lots has been relatively constant which may indicate that the relative net returns to each class have remained constant. Alberta has 180 to 220 >= 1000 one-time bunk capacity feedlots (Alberta Cattle Feeders Association, 2021). The other western provinces have fewer feedlots in total with lower one-time capacity compared to Alberta. Saskatchewan has 10 feedlots >= 1000 one-time bunk capacity (CanFax, 2021) for a total of 100,000 one-time capacity. Manitoba has 3 feedlots >= 1000 one-time bunk capacity while British Columbia has several small feedlots.



Source**:** Statistics Canada (2021a).

Figure 2.11: Profile of the Animal type in Finishing Operations Western Canada on July 1st

Alberta has most of the cattle on feed operations with on average 80% of the placements in Western Canada over this period (Figure 2.12). Provincial slaughter capacity would be the major limiting factor on feedlot expansion in B.C., Manitoba and Saskatchewan as the net returns are reduced by transportation costs to Alberta slaughter plants.

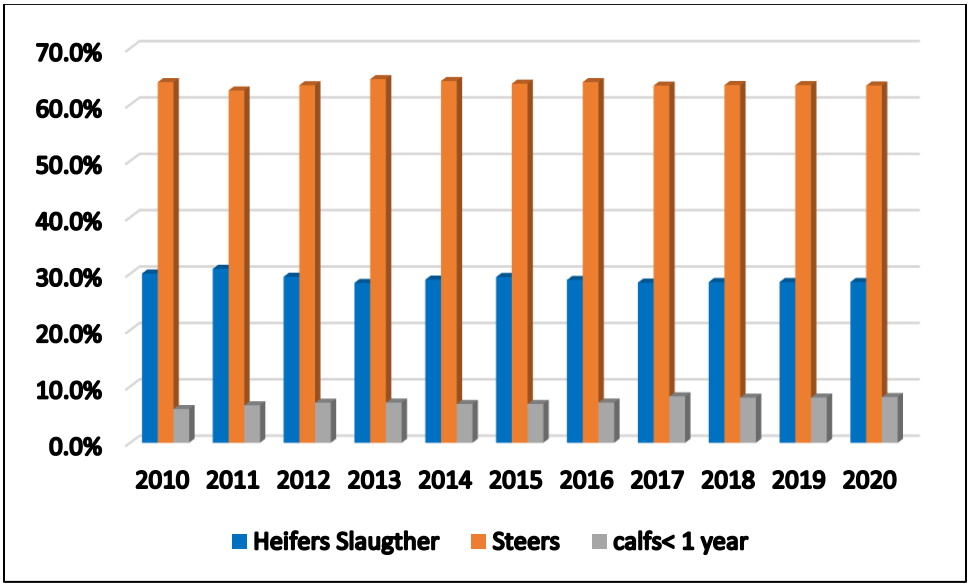


Source: Statistics Canada (2021a).

Figure 2.12: Feeder Operations Cattle by Province on July 1st

2.2.6 Finishing Sector (Eastern Canada)

The finishing sector in Eastern Canada relies heavily on steers, the overall profile of placements has not changed that much over the 2010 to 2020 period (Figure 2.13). The finishing sector in Eastern Canada relies more on the backgrounding sector as a source of placements than in Western Canada. Ontario feedlots have on average 76.9% of the placements of cattle on feed for Eastern Canada.



Source: Statistics Canada (2021a).

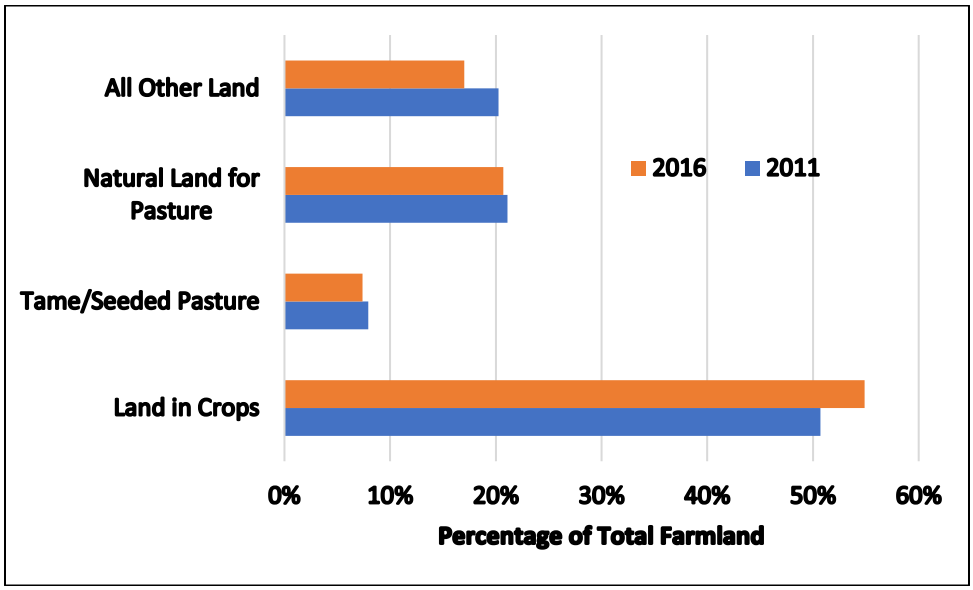
Figure 2.13: Profile of the Animal type in Finishing Operations Eastern Canada on July 1st

2.3 Feed Market

Cow-calf operations need for pasture is very critical in the production of beef in Canada. According to the 2016 agriculture census, of the total of 170.1 million acres of farmland, 36.2% was in natural pasture, and 12.6% seeded to tame hay (Figure 2.14). The sectors of the beef cattle industry vary in the type and use of purchased feeds and fodder as they vary in the amount and type of grains and fodder they produce on farm. Also, the type and use of feeds varies across Canada dependant on local production and availability. Rented pasture, purchased fodder (hay, silage, straw, greenfeed), feed grains (barley, corn, oats, wheat), distillers grains and prepared feeds are produced in Canada and used in the beef cattle sector.

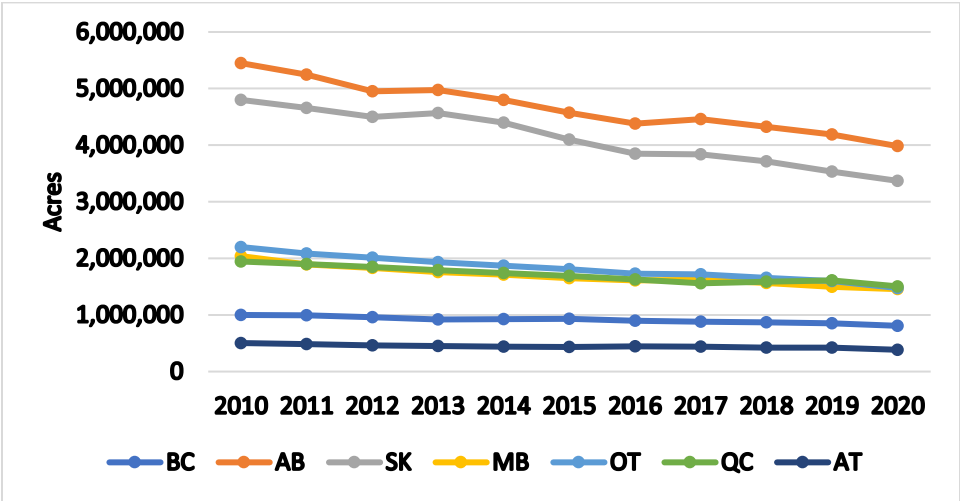
Pasture and production of feed for winter are the main operating costs for cow-calf operations across Canada. Cow-calf and backgrounders use own pasture, and may rent or lease pasture from other farmers, landowners, and/or governments. Area in tame hay has been declining in all

provinces as the size of the beef herd declines (Figure 2.15). The largest decline in area seeded to tame hay is in Alberta and Saskatchewan with approximately 1.4 million acres each. However, Ontario had the largest percentage decline at 32.9% followed by Saskatchewan 29.8%. The decline in tame hay area is greater than the decline in beef cattle numbers which would suggest that net returns to the land from other cropping options are being pursued.



Source: Statistics Canada (2020c).

Figure 2.14: Land Use in Canada, by Type of Use, 2011 and 2016 Census

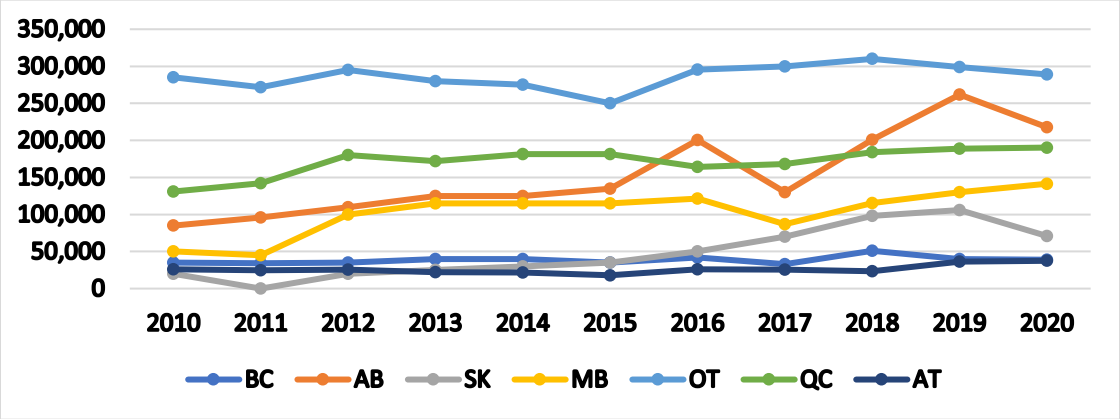


Source: Statistics Canada (2021c).

Figure 2.15: Tame Hay Acres by Province 2010-20120

One possible alternative use for tame hay area is corn for silage or corn for winter grazing. The area seeded to corn for silage has been increasing across Canada (Figure 2.16). The higher relative yields given the development of varieties of corn that are more suited to the Canadian growing

season is part of the reason for the shift. More cow-calf producers are seeding corn for winter grazing which has some cost advantages over tame hay in harvest/storage and manure handling. Imports of corn, soybean meal, and dried distillers grains from the USA are also used in the beef industry. The amount that is imported can vary quite widely depending on domestic supply of grains, exchange rate and relative price of the US substitute.



Source: Statistics Canada (2021c).

Figure 2.16: Silage Corn Acres by Province 2010-2020

There are 230 commercial Feed Mills in Canada as of January 1st, 2021 operated by 140 companies (Table 2.2), which is 5 mills and one company less than on January 1st, 2020 (ANAC, 2021). Like other sectors that supply services or goods to the agriculture sector there has been considerable consolidation of outlets and companies over the past 30 years. Not all the mills produce feed for the beef cattle sector or supply feed for the complete range of beef cattle types or feeding regimes. On farm milling or processing of feeds from own grown grain and fodder or purchased inputs is also undertaken especially for large feedlots.

2.4 Processing Sector

Most of the farm level cattle and calf production is destined for two major channels: (1) Exported out of the province (or outside Canada), without any further value-added within the Canadian economy, and (2) Agricultural products used as raw materials to be used for further processing by food processing operations within Canada. The latter leads to further value-added and generates additional employment and gross domestic product (GDP) at the regional or provincial levels. Total beef production in Canada was at 1.2 billion kilograms, of which 50% was sold to the international market (Statistics Canada, 2021b). Canadian meat processors produce a variety of meat products including fresh, frozen, processed, smoked, and canned meat.

Table 2.2: Number of Feed Mills and Companies by Province (01/01/2021)

Province	Mills	Companies
B.C.	12	12
AB	35	24
SK	33	14
MB	23	13
ON	62	37
QU	56	33
NB	3	3
PEI	0	0
NS	5	3
NFLD	1	1
Total	230	140

Source: ANAC (2021).

A total of 3.4 million cattle were slaughtered in Canadian slaughtering plants in 2020. In Canada to sell processed or slaughter beef across provincial borders or for export, the plant must be registered with and inspected by the Canadian Food Inspection Agency. The Federally inspected cattle slaughter plant sector in Canada and in the provinces is characterized by the top four plants holding a dominant market share (Table 2.3).

Table 2.3: Number of Federally Inspected Cattle Plants by Region/Top 4 Slaughter[1]

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Canada	26	22	20	19	21	21	20	21	20	20
Top 4 share[1]	95%	94%	95%	98%	98%	98%	98%	96%	95%	96%
Quebec	8	6	7	5	5	5	5	4	3	3
Top 4 share[1]	99%	99%	99%	100%	100%	99%	100%	100%	100%	100%
Ontario	8	9	7	7	7	6	6	6	6	6
Top 4 share[1]	97%	95%	99%	100%	100%	100%	100%	100%	100%	100%
MB/SK	1				1	2	1	2	2	2
Top 4 share[1]	100%				100%	100%	100%	100%	100%	100%
BC/AB	8	6	5	6	7	7	7	8	8	8
Top 4 share[1]	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Atlantic	1	1	1	1	1	1	1	1	1	1
Top 4 share[1]	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: Canadian Food Inspection Agency (2021); AAFC (2021b).
1. Percent of total federally inspected cattle slaughtered by the 4 largest establishments (companies) in that province/region.

The three plants in Alberta where most of the fed cattle are processed, account for 85% of Canada's cattle slaughter. The number of Federally inspected cattle slaughter plants in Canada have decreased from 26 in 2010 to 20 in 2020. Quebec has the largest decline in federally inspected slaughter plants which also affects Atlantic Canada as beef cattle can be shipped to Quebec and

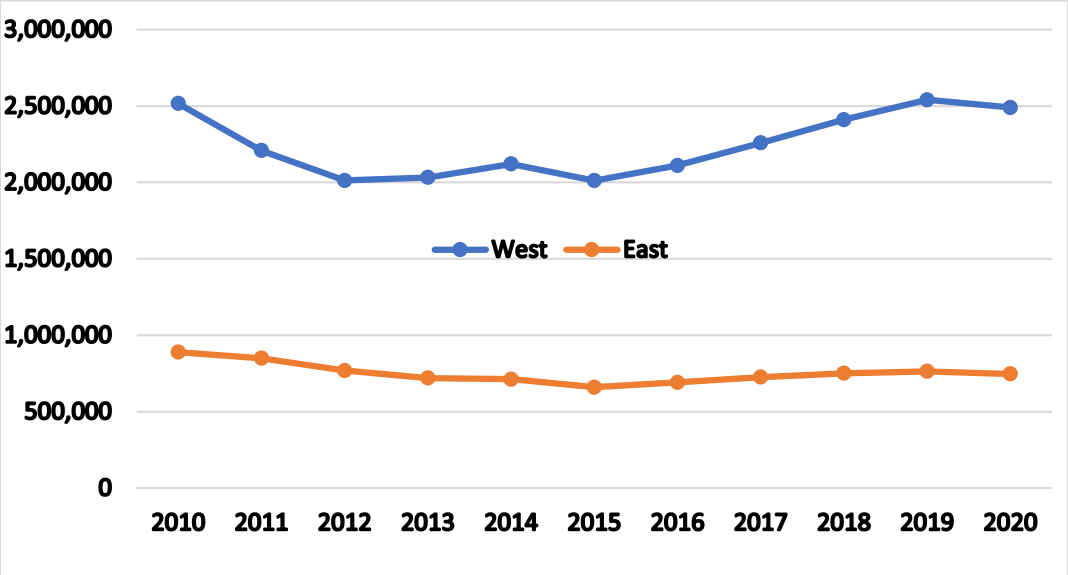
Ontario for slaughter. Manitoba and Saskatchewan have limited federal inspected slaughter capacity. Most fed steers and slaughter cattle in Saskatchewan and Manitoba are processed in Alberta with some shipments to the USA.

There are 456 registered establishments with the Canadian Food Inspection Agency that process red meat in Canada in 2020 (CFIA, 2021). Not all would use beef as an input in the processed products that they produce. These plants would be able to ship interprovincially and for export.

Provincially inspected slaughter and meat processing plants are smaller in capacity and generally process several animal species. Most provincially regulated meat processing plants would market several branded products in their regional markets. The number of provincially inspected plants by province is Ontario (86), Saskatchewan (76), British Columbia (58), Alberta (25), Manitoba (25), New Brunswick (29), PEI (5) and Nova Scotia (12) (Alberta Government, 2021; Manitoba Agriculture and Rural Development, 2020; New Brunswick Department of Health, 2019; Nova Scotia, 2021, OMAFRA, 2021; Saskatchewan Health Authority, 2021). Approximately 5% of the cattle slaughtered in Canada are processed at provincially regulated plants. Also, there is some uninspected slaughter which has been less than 1% of the total slaughter on a yearly basis.

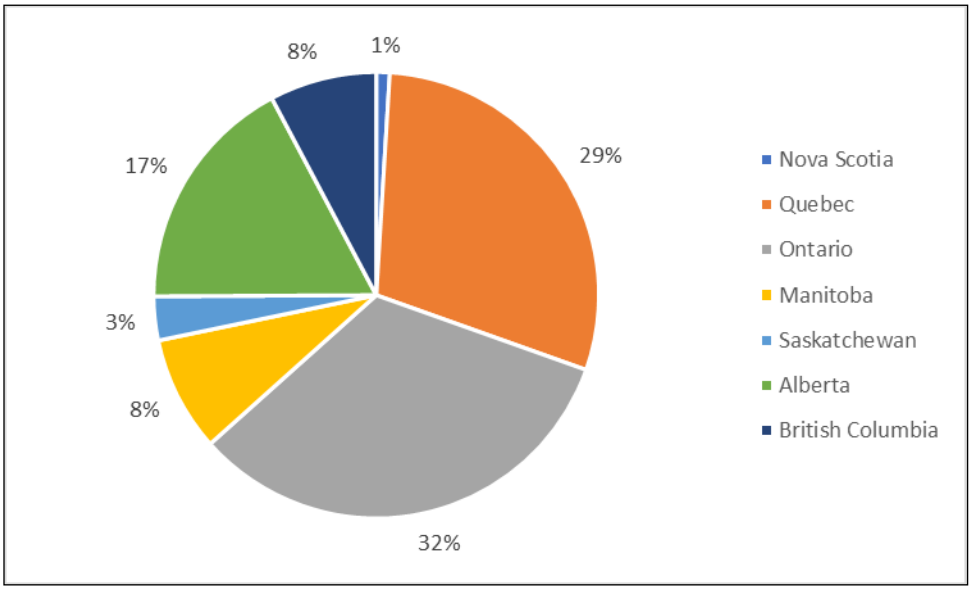
The number of cattle slaughtered in Canada is presented in Figure 2.17. Slaughter numbers have returned to 2010 levels after declining and hitting a low point in 2015. Even though the beef cattle herd has been in decline over this period higher slaughter numbers have been achieved because fewer fed cattle and slaughter cows are being exported to the USA for slaughter. Also, fewer calves and yearlings are being exported to be fed in the USA. And there has been increased imports of fed cattle and cows for slaughter from the USA. Most of the calves over this period were slaughtered in Quebec, > 85% (AAFC, 2020).

Despite having a smaller beef herd, processing of live animals and meats is located more in Eastern Canada, where, based on the number of employees, 61% of the capacity (as measured through employment) is present (Figure 2.18). Eastern Canada has a large poultry and pork sector which supports a large slaughter and processing sector. In Western Canada, much of the beef processing is in Alberta while the main pork slaughter plants are in Manitoba and Alberta while poultry processing is at a smaller scale than in Eastern Canada. Employment in meat processing in Western Canada has increased since 2016, after a period of consolation in the early part of the decade (Figure 2.19).



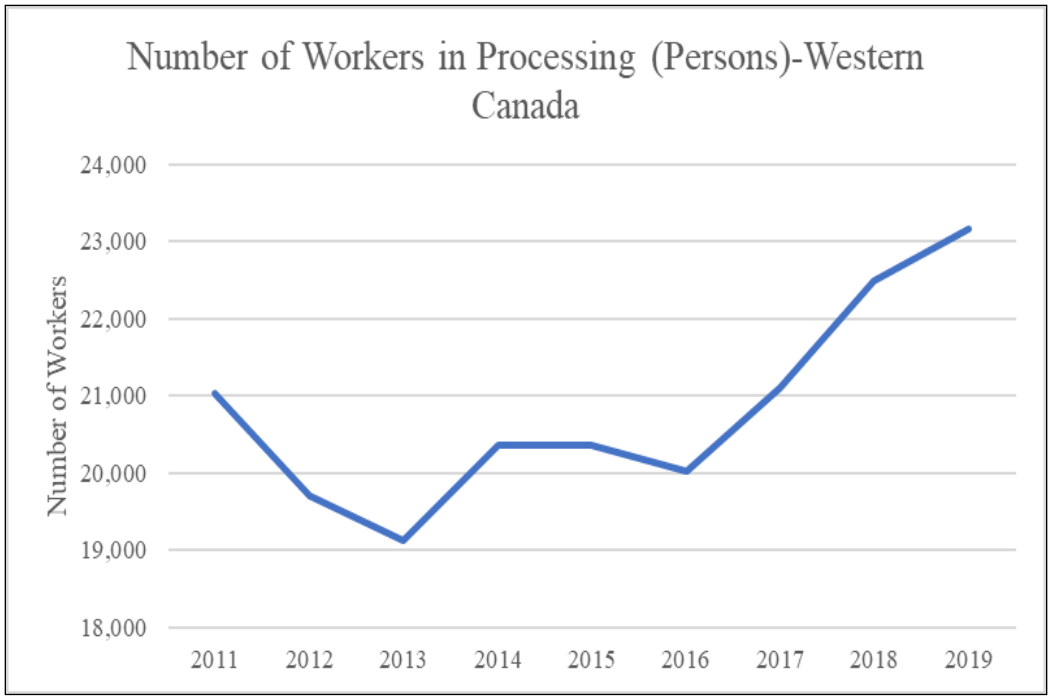
Source: Canada Beef Grading Agency (2021).

Figure 2.17: Number of Cattle Slaughtered in Eastern and Western Canada 2010-2020



Source: Statistics Canada (2019a)

Figure 2.18: Distribution of Employment in Meat Processing Canada by Regions, 2019



Source: Source: Statistics Canada (2019a)

Figure 2.19: Number of Workers in Meat Processing in Western Canada, 2011-2019

2.5 Marketing Channels

Canadian beef has two principal marketing channels (1) Feeder cattle markets and marketing, and (2) Finished (or fed) cattle markets and marketing (Grier, 2005). Feeder cattle follow the basic marketing pattern shown below:

Weaned calf → *Background lot/pasture* → *Feedlot.*

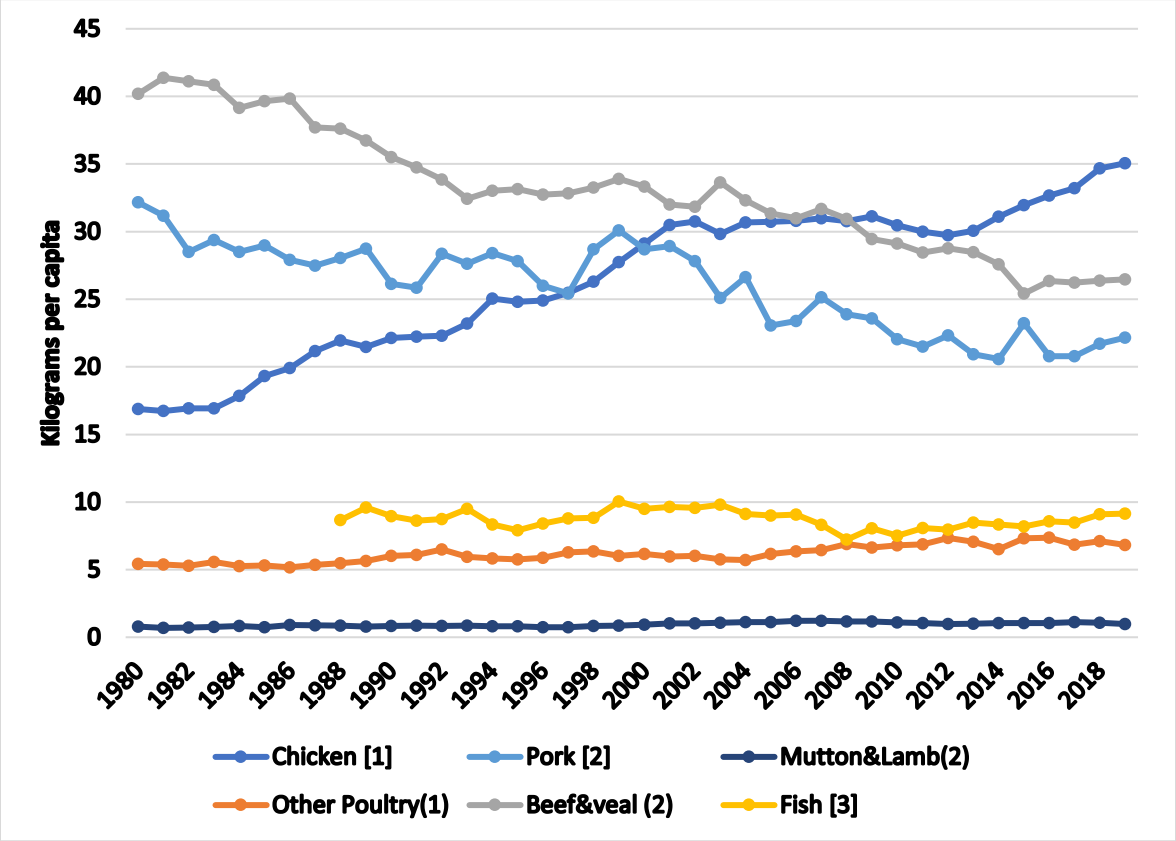
Feeder cattle marketing is largely a domestic endeavor, with relatively few exports/imports. The feedlots are concentrated in Alberta and Ontario, therefore the major flow of feeder cattle in Western Canada is to Alberta and in Eastern Canada into Ontario.

2.5.1 Domestic Beef and Veal Market

The Canadian per capita disappearance of meat products is presented in Figure 2.20 for the years 1980 to 2019. Beef and veal along with pork consumption has fallen over this period with total meat consumption in the range of 95.2 to 108.7 kg per year with an average of 101.2. Beef held

the top position in terms of consumption until 2004 when chicken caught and proceeded to overtake beef as the top choice. The decline in beef consumption per capita seems to have stabilized in 2016 through 2019 at 26-27 kg.

In 2020 due to COVID, consumption of meats and meat substitutes were affected. George-Cosh (2020) report a rise in the consumption of meat substitutes during the first wave of COVID in March-April of 2020 of 52% YoY for tofu and meat alternatives. Whether these changes are short term or will affect consumer preferences once the pandemic and life return to "normal" will be seen in 2021-2022.



Source: AAFC (2021c).

1. Eviscerated weight; 2. Carcass weight; 3. Edible weight

Figure 2.20: 1980 -2019 Canadian Per Capita Disappearance of Meat (KG)

The importance of the restaurant sector as an outlet for Canadian beef for the Food Service sector is demonstrated in Table 2.4. In 2020 with the closures and restricted capacity of restaurants due to COVID, consumption shifted to household preparation of meals which compensated for the reduced sales to restaurants.

Table 2.4: Food Service Distribution channels for Canadian Beef (2018)

Food Service	% of Volume
Accommodation	6.0%
Leisure	1.9%
Mobile operator	0.7%
Pub, club, and bar	0.9%
Restaurant	85.8%
Retail foodservice providers	1.7%
Travel	1.0%
Workplace	1.9%

Source: Global Data Intelligence Center: Consumer (2019; and Chauvin (2019).

2.5.2 Export Market for Beef and Veal

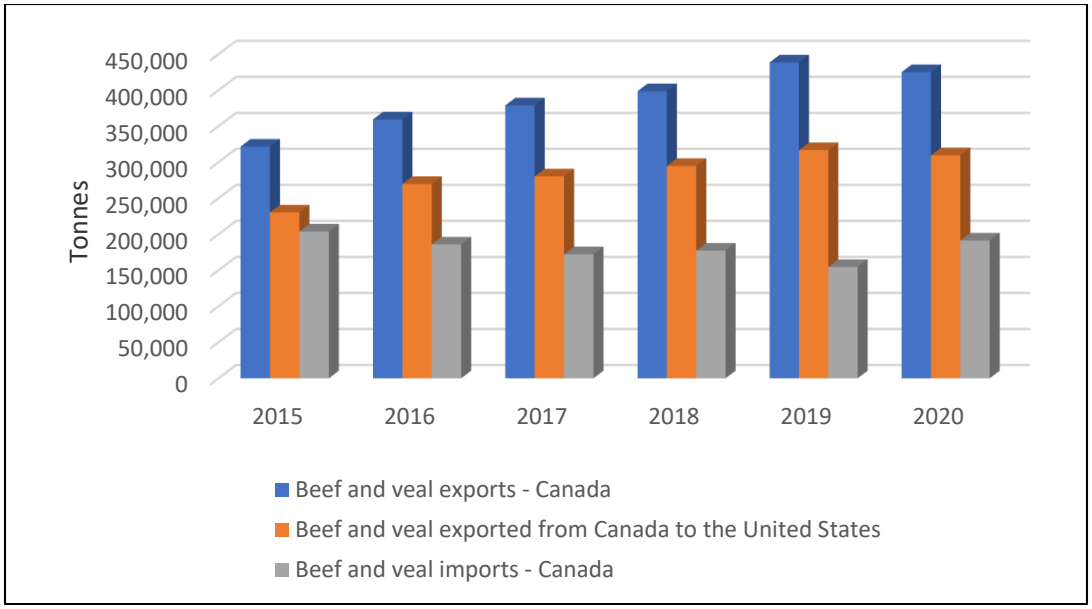
The United States is the primary export market for Canadian beef and veal at 72.8% of total exports in 2020 (Table 2.5). Japan is the second largest export market for Canadian beef and veal at 10.6% of exports in 2020. Sixty-two other countries imported Canadian beef and veal in 2020 accounting for 16.6% of exports. The Canada United States Mexico Agreement (CUSMA) and the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) will help keep Canadian beef trade growing in the United States and Japan (OCE, 2020). The Comprehensive Economic and Trade Agreement (CETA) with the European Union has yet to have any big impact on Canadian beef and veal exports (CBC News, 2019).

Table 2.5: Beef and veal exports by country % of Tonnes

Importing Country	**2020**	**2019**
United States of America	72.8%	72.2%
Japan	10.6%	11.2%
Mexico	3.6%	3.8%
Hong Kong	3.3%	3.8%
China	2.5%	2.7%
Korea, South	1.6%	1.3%
Viet Nam	1.7%	0.3%
Angola	0.6%	0.6%
Taiwan	0.5%	0.6%
Peru	0.5%	0.3%
Others	2.3%	3.0%
Total	100.0%	100.0%

Source: AAFC (2021d).

Canadian beef and veal exports have increased by 116,844 tonnes a 36% increase from 2015 to 2019 before falling in 2020 by 13,400 tonnes (-3%) due to COVID processing plant shutdowns (Figure 2.21). Most of the increase in beef & veal exports was to the USA in 2016 (100%) and in 2018 (73%) while in 2017 and 2019 only 55% of the increased beef & veal exports was to the USA. Also, fifty three percent of the decline in beef & veal exports in 2020 was to the USA. Approximately, 73% of Canadian beef & veal exports is to the USA while 66% of beef & veal imports are from the USA. The balance of trade in beef (quantity) is positive for Canada.



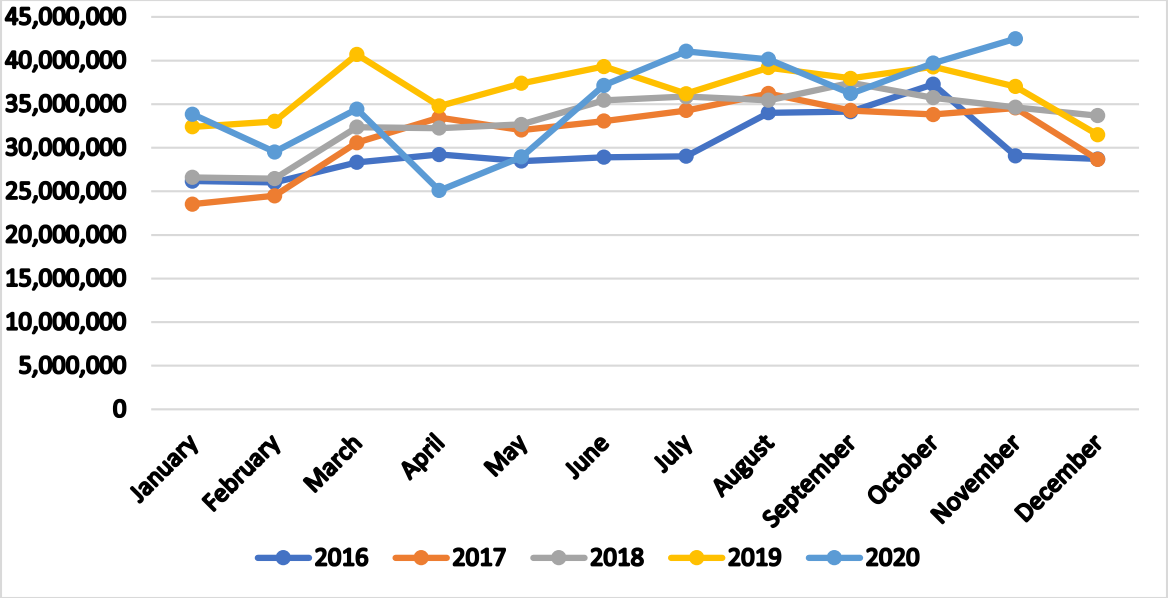
Source: Canadian Beef Grading Agency (2021).

Figure 2.21: Canadian Beef & Veal Exports Total and to USA; Beef & Veal Imports

The major export market for Canadian beef is the USA which tends to be seasonal with the December to March exports the lowest and the summer months being the high export months because of the barbecue season. The barbecue season has an affect on the supply chain of slaughter cattle since the beef sales are primarily fresh over the counter. The impact of COVID on the export of beef and veal is clearly visible in the 2020 data as exports fell in April and May due to plant closures (Figure 2.22). This created a backlog of fed animals in feedlots which seems to have been cleared through the system by 2021 (Statistics Canada, 2021d).

Because of the large two-way trade with the United States, Canadian cattle and calf prices are very closely related to the beef prices in the United States, subject to transport and local demand/supply situation. The exception to the functioning of these markets was in mid-2003 when the US closed its borders to Canadian beef after the breakout of bovine spongiform encephalopathy (BSE). This resulted in Canadian fed cattle prices declining 65 percent from $108/cwt. in April 2003 to

$38/cwt. in July 2003 (CanFax, 2009). Two factors that affect the relationship between the price in Canada and that in the US are: (1) The purchasing power of the Canadian dollar against the American dollar (FCC, 2011); and (2) Emergence of the biofuel industry, which affect the cost of producing beef through higher feed grains prices (FCC, 2011). With more emphasis on renewable energy and concerns for climate change, this situation may further exacerbate the feed grain market situation.



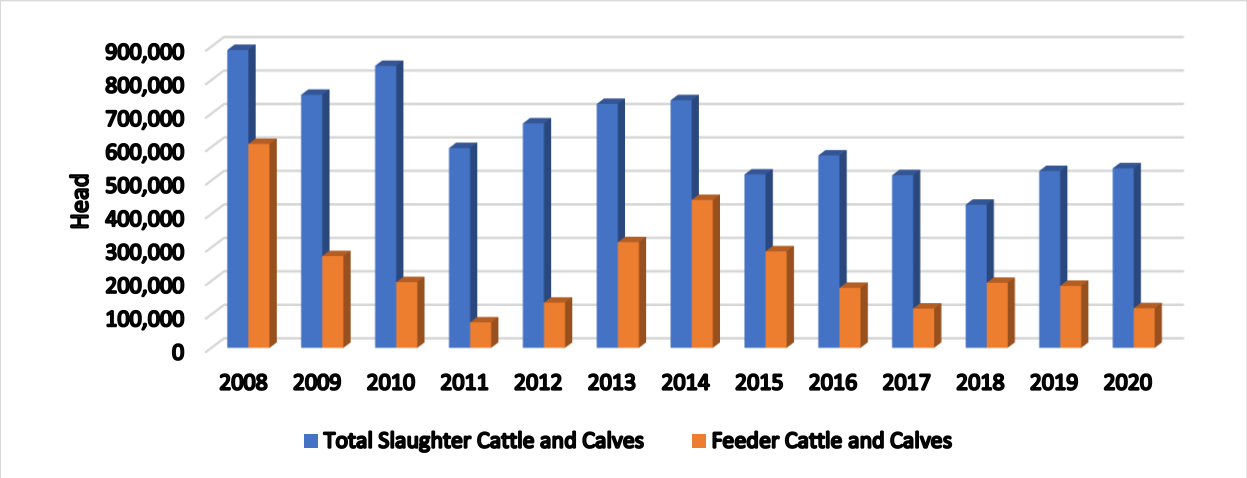
Source: AAFC (2021f).

Figure 2.5. Beef and Veal Exports by Month (Kilograms)

2.5.3 Export Market of Live Cattle

Exports of live cattle and calves to the United States for slaughter or as feeders is presented in Figure 2.23. Trade in Canadian live cattle exports recovered after the 2003 case of BSE but not to pre-BSE levels. Export of Canadian slaughter cattle and calves to the USA has been trending down as USA slaughter demand is dependant on feedlot capacity, exchange rates and price of slaughter animals in Canada.

The Canadian beef cattle sector, on account of its complexity and different regional distribution, would have a varying level of economic impact on the Canadian / regional economy. The procedure to estimate these impacts is described in the next few chapters.



Source: AAFC (2021e).
1. Includes Dairy Cattle and Calves.

Figure 2.23: Cattle and Calves Exported to the USA

Chapter 3

NATURE OF ECONOMIC LINKAGES BETWEEN CATTLE SECTOR AND REGIONAL / NATIONAL ECONOMY

In physics, the law of motion is based on an interaction between some action and reaction. Although this law may not apply directly in the economic world, it does have a parallel: For every change created by an economic agent, there are other changes that are created elsewhere. These changes are based on the rule that in a modern economy economic performance of a goods producing firm depends on other firms in the region. These types of changes are the core of economic impact assessment.

Economic impacts of a new project or set of activities are dependent on the complexity of the economic system where such activities occur. In a system where there is no production, and all goods and services are obtained from outside the region, the level of impact of any change on its economy would be zero. However, in a more mature economic system, an exogenous change would trigger an interrelated set of changes throughout the economy that require some formal method of modeling to determine the magnitude of these changes. One of the methods used is an input-output model-based analysis, which results in estimated total impact in the economy resulting from activities of a given sector. The description of the model is deferred to the next chapter, but the concept of economic impacts is discussed in this chapter.

3.1 Concept of Economic Impacts

Economic interdependencies among various economic good producing industries exist in all regions, and Canada is no exception to it. An exogenous change in a region can result in a variety of changes, each one of which, if economic in nature, can be monetized[4] to become economic impacts.

Major types of impacts associated with actions of a given economic sector (or a firm) include:

1. *Direct impacts*, to include any actions taken by the primary decision maker. These may be one of two types: (1A) New capital investment in expanding production capacity, a part of which could be in terms of purchases of goods and services, and another in terms of hiring additional workers for the job; and (1B) Additional level of production from

[4] This is not to suggest that all economic changes can be monetized, although the discipline is slowly improving in this respect.

the added capacity, resulting in higher input purchases, and higher workforce (additional employment).

2. *Backward linkage-based impacts*. These impacts are created in response to the increased input requirements under direct impacts that are supplied by other businesses. These inputs may be related to: (2A) Capital investment and (2B) Additional production-related expenditures. Like in the previous case, more workers could be needed.
3. *Forward linkage-based impacts*. Some of the output produced by the business could be sold in its raw form (such as exports of live animals), but in most other cases these products are sold to other firms (businesses) for further processing. These firms, depending on their current capacity, may be involved in (3A) Capacity expansion, and (3B) Expansion of production. It goes without saying that more workers are needed for both types of operations.
4. *Income generated impacts*: All the additional workers in any of the above sets of impacts would receive compensation either as wages and salaries or as profits (if they were self-employed in the unincorporated businesses). These higher incomes would have to be spent on needed goods for everyday living. These actions of the consumers would create another round of economic impacts called "induced impacts".
5. *Agglomeration impacts.* These impacts happen mostly in the long run. As one regional economy becomes stronger (higher level of output and peoples' paying capacity through higher incomes), other firms from other parts of the country or even the world) might be attracted to it. These firms could create a series economic impacts as listed above and contribute to the economic fortunes of a given region.

These economic impacts and their interrelationship are presented in Figure 3.1. They affect not only the region of study, but also other national regions, as well as rest of the world. The rest of the economy impacts depend on many factors, most important of these are trade patterns and trade agreements. By using a gravity model, it has been shown that countries located farther away have lower trade linkages. The effect on other regions of a country and rest of the world could be positive or negative. Increased trade between the region of study and these regions would be a positive effect on their economic growth. But if an industry moves to the region of study (as one would hypothesize under agglomeration economies), economic impacts could even be negative.

The nature of interdependencies that currently exist between a regional economy and the cattle sector could be illustrated by the experience with the outbreak of BSE in Canada. This incidence caused the U.S. to close the border to Canadian cattle over a certain age. This substantially reduced the demand for Canadian cattle since, the U.S. has been a major destination for Canadian feeder and slaughter animals. The lack of buyers affected many stockyards, trucking companies, and brokers. Reduced demand brought about more market pressures on price (particularly for the slaughter animals), which started falling soon after the announcement of the border closure. A lack

of sales of these animals meant that they were kept on farms longer than they would have been without BSE. This led to higher feed demand. Lack of markets, lower price, and higher feeding costs resulted in lower net income for cattle producers. The decreased family expenditures of these producers resulted in lower demand for consumer goods. This also resulted in less transportation, wholesaling, and retailing activities. Government coffers were also affected since the tax revenues generated were also reduced. Because of the reduced export demand and lower live cattle prices, packing plants were able to process these animals at a higher margin. Any excess capacity was used up subject to the level of market demand. Overall, various economic sectors in Canada were affected either directly or indirectly. This briefly illustrates the intricate relationships that exist in a mature and complex economic system.

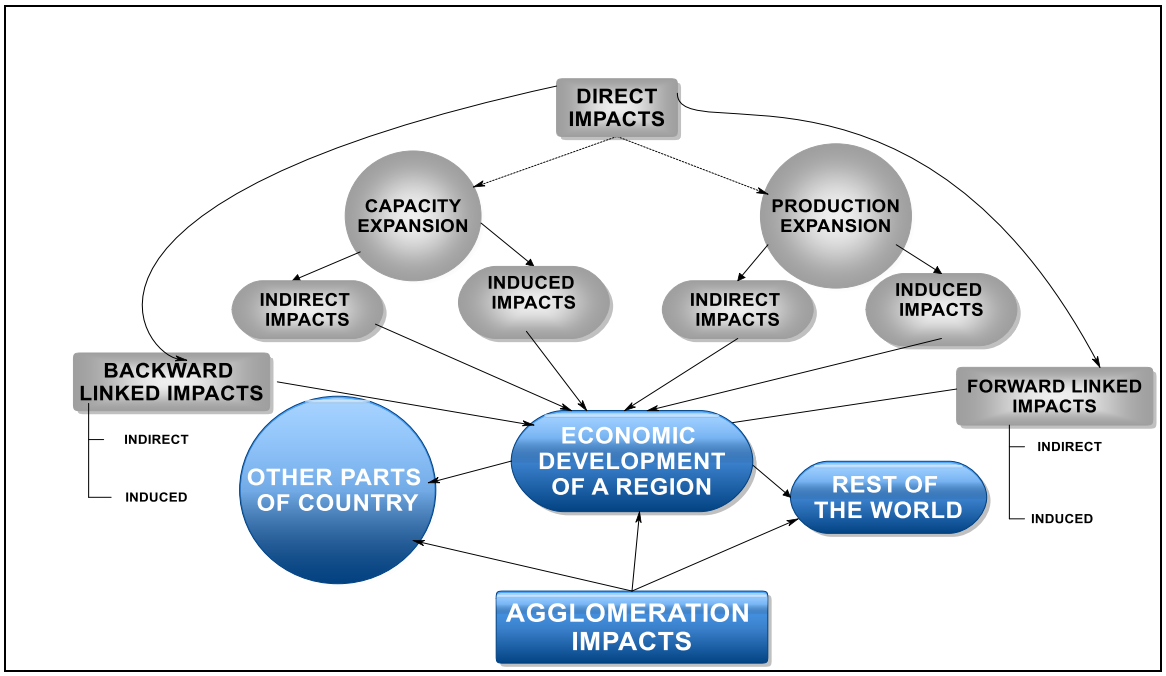


Figure 3.1: A Simple Model of an Economy Showing Various Types of Economic Impacts

3.1.1 Mechanism of Impact Generation

All the interdependencies shown in Figure 3.1 lead to economic impacts in a region. These impacts are generated by producers through their production decisions, or by the consumers, investors, and governments through changes in their expenditure patterns. Any action taken by producers or consumers (or other agencies, such as governments) in this context, when measured in monetary units, is called the 'direct impacts'. These direct impacts become the starting point for a series of other impacts within the economy, called 'secondary economic impacts'. They are created through two types of changes in the economy, resulting in two different types of economic impacts, as described below.

1. *Indirect impacts:* When a sector faces increased demand for its product, it must adjust its production to meet the new demand. These adjustments require purchases of commodities (non-human resources) produced by other industries. Although more workers are also needed, they are included separately. For example, the Canadian Cattle sector to produce its products must purchase inputs from other industries. Examples of these would include feed grains, processed feeds, forages, fuel, machinery and equipment, and other services. Each of the sectors producing these goods would increase their respective production and create economic change. Such indirect impacts are generated both through backward linkages, as well as through forward linkages.

2. *Induced impacts:* These impacts are generated by the actions of owners of human resources (such as workers and owners of unincorporated non-farm businesses) who receive compensation for their services. The compensation so received becomes a part of their total income, and a portion of that is spent on meeting household expenditures. This would create additional demand for commodities and the affected business would have to make adjustment in their production. Like above, these impacts are associated with both 'backward induced linkages' and 'forward induced linkages'.

3.1.2 Impact Identification for the Cattle Sector

Total impacts of the cattle sector are generated through a combination of direct cattle production and its backward and forward linkages, each with indirect and induced impacts. By applying the conceptual impact typology presented in Section 3.1.1, total economic impacts of the cattle sector can be represented as a sum of the following six impacts:

1. Direct impacts of farm level cattle production;
2. Indirect impacts from farm level beef cattle production (through backward-linked industries);
3. Induced impacts from farm level beef cattle production (through payments to workers and producers, and their re-spending within the economy);
4. Direct impacts of forward-linked industries with farm level beef cattle production;
5. Indirect impacts from forward-linked industries with farm level beef cattle production; and
6. Induced impacts from forward-linked industries with farm level beef cattle production.

Please note that consideration of agglomeration impacts requires knowledge of the future state of the industry, and the sectors that are more likely to move into the region. With the limited resources for the study, this task was considered out-of-scope.

Provided that due consideration is made for any double counting, a sum of the above six types of impacts would constitute the total economic impact of cattle production sector.

3.2 Source of Economic Impacts in a Regional Setting

If the region is an isolated one, and all economic activities are fuelled by local production, the above sum of economic impacts would apply to any decision leading to direct impacts. However, in Canada, like many other economies, regions trade with each other, as well as other countries. Thus, cattle producers' (as well as Canadian consumers) decisions have an economic impact not only on the economy of the region (where they are located), but also on other provinces in Canada that trade with the region, and other parts of the world as source of the imports. These impacts are called the 'Trade-related' impacts associated with a direct, backward linked, and/or forward linked sectors. Although these impacts can be estimated, they require development of individual economic impact models for each region. Given the limited resources for the project, this was considered out-of-scope.

3.3 Accounting for Total Economic Impacts of the Cattle Sector

The direct effects of any economic activity can be seen relatively easily. For the cattle production sector some of the contributions were shown in Chapter 2. However, direct contributions are not the same as total economic contribution of a sector. To estimate the total contribution, one needs a tool for estimating the spin-off effects of the sector.

There are several methods that can be used for such an assessment. These methods include the following: Export-Base Model, Income-Expenditures Model, and Input-Output Model. The first model is appropriate if one lives in a region with a single industry that is totally export oriented. Economic impact assessment for this economy will be rather simple, and for these situations, an Export-Base model is adequate. This model relates the total growth in the region to the export sales. The higher the export levels, the higher are the values of economic indicators for the region. Since the only driving force for the region is the export market (on which the region has no control), economic development of the region is decided by forces outside the region. However, this type of model would only be appropriate for a small town, mostly with a single industry. An example of this type of a region would be a mining town, where the ore is sent elsewhere for processing or processed alongside, or a town totally dependent on tourism. Unfortunately, in the

current age of development, number of such regions in Canada is rather small. This tool, therefore, cannot be applied to the Canadian cattle sector.

The assumption of a single export sector is removed by the application of the Income-Expenditures Model. The focus of the analysis here is on the income (regardless of how many sectors generate it) and the way it is spent. The impact of the direct income on the total income generated in the region can then be calculated. The region is assumed to contain a single homogenous set of consumers. Trade patterns are allowed but added together for the estimation of the total income generation. This method is highly aggregate in nature since all incomes are handled as a single entity.

The above two models do not offer a good basis for policy analysis since they are both very aggregate and their assumptions are somewhat restrictive. Most economic activities in a region are undertaken by several industries. These industries trade with each other. Each industry can produce several products. For this type of an economy, the best way to undertake economic impact assessment is using an input-output model.

An input-output model is a useful method of estimating secondary impacts of economic development projects. This model is preferred for impact analysis for the following reasons:

1. Every industry's impact is treated as unique, allowing its specific economic impacts to be estimated.
2. Different types of economic stimulus can be applied to undertake economic impact analysis. Thus, economic impacts of consumer spending, exports, or purchases by other firms, for example, could be estimated uniquely.
3. Development of the model can also be region specific, thereby allowing regional differences in the production processes, technology, and trade patterns.

Considering the above discussion, in this study, an input-output model was used in this study. More details on this model are presented in the next chapter.

Chapter 4

METHOD OF ECONOMIC IMPACTS ESTIMATION USING INPUT-OUTPUT MODEL

To undertake the estimation of economic impact an input-output model was constructed. This model is called the Canadian Regional Input-Output 2016 (CRIO-16) model since it is based on the transactions for Canada and regions for the year 2016. This chapter is devoted to a description of this model as used for economic impact analysis of the Canadian regional cattle production. The chapter is divided into six sections. Section 4.1 described a brief description of input-output analysis, followed by its basic framework in Section 4.2. Section 4.3 is a description of the study input-output model and steps taken to make it operational. Final model is described in Section 4.4, followed by a discussion on the term 'multiplier'. Distinction between gross impact and net impact of a given economic activity is drawn in Section 4.6.

4.1 Concept of Input-Output Analysis

The availability of high-speed computers made the input-output analysis a very useful, and more popular, method. Today, input-output analysis is routinely applied for national economic analysis including forecasting of regional and national economic performance, and by various provinces within Canada (although its use is highly variable from province to province). A national input-output model for Canada is published annually by Statistics Canada (2012a)[5]. It can also be appended to other economic and non-economic indicators, such as employment, greenhouse gas emissions, ozone depletion, water requirements and degradation, population, among others.

An input-output model can be constructed for any level of aggregation ranging from the world as a whole[6], for a specific nation, for a province/region within a nation, for several regions trading with each other, down to a specific firm. An input-output model has been used in many other areas besides economic impact analysis. Impact of new industries on a region has been investigated by Czamanski (1972) using Nova Scotia as the case study. Klassen (1967) has used it for selecting industries for depressed areas. Zuhdi (2015) has used this approach to estimate energy demand for Japan. Government of Canada has combined the input-output model along with an economic model for testing policies for simulating regional economic performance both in the short-run and long-run. More recent applications have included the development of physical flows, price input-output models, and physical and economic life cycle analysis models.

[5] In addition, Statistics Canada maintains an inter-provincial input-output model that is available for use on a user fee basis.

[6] It has not been attempted on account of differences in data collection methodology.

4.2 Basic Input-Output Framework

The basic input-output model is based on actual observations of sales and purchases by all economic agents in each regional economy. These actions are termed 'economic transactions' and presented as a transactions table. This table is the heart of the model as it denotes the interdependence (in terms of sales and purchases of goods and services) among three types of economic agents: producers of various goods and services (called economic sectors); owners of resources (land, labor and capital, and management); and final user agencies (to include consumers, governments, businesses, and trade agencies).

In the terminology developed for the input-output (I-O) models, firms/businesses are called sectors and the goods and services they purchase, or sell, are called "Commodities". The fundamental information contained in the model is the flow of commodities from one sector to the other. All firms that produce similar products are grouped under a single 'sector'.

In addition, in an economy there are economic agents called 'final demand agencies', where the goods sold leave the economy and not resold. Examples of these would include consumer demand, export sales, and government expenditures. These transactions are different from other sales (from one sector to the other) since they do not enter the production process for producing final demand goods and services.

Various goods and services that are used in the production process of economic sectors are divided into two types: Intermediate inputs/commodities, and Primary inputs/commodities. Intermediate inputs refer to those commodities that re-enter the production process for further value-added activities. These goods are traded between one economic sector and another. Primary inputs are those that refer to the owner of land, labor, capital, and management resources. These inputs receive compensation/payment, which can be aggregated to reflect the Gross Domestic Product (Income based) for a region.

Two types of accounting systems have been used in developing input-output models. These are square accounting systems, where every sector produces one and only one commodity, and the rectangular accounting system, where a sector can produce one or more of the commodities. Canadian input-output models are based on the rectangular accounting system.

In a rectangular accounting system, a transactions table is divided into three matrices: Use matrix, Make matrix, and Final Demand matrix. The Use Matrix displays the purchases of various economic sectors of intermediate and primary inputs. The Make Matrix is a display of various intermediate inputs produced by various economic sectors. The Final Demand matrix is the account of transactions among various economic sectors and final demand agencies.

The system of equations that are developed for impact analysis is linear in nature. Furthermore, non-linearities are not allowed in the system. In fact, the technology of production and consumption, as expressed in terms of the relationships, is assumed to be fixed in proportion. Similarly, in a rectangular system, the market share of each sector in producing a commodity cannot be altered and thus remains fixed.

The input-output analysis is a demand driven process. If the commodity is demanded, either by other sectors or by final demand agencies, its production will increase accordingly. It should be noted that capacity constraints are not considered to be a limiting factor in the model. It is, in fact, assumed that all sectors have excess capacity and would be able to adjust to the new increased level of production. However, in some situations this may be an unrealistic assumption. Here the methodology is modified to bring a new industry to the region and estimate the impacts with and without the new industry.

4.3 Study Input-Output Model

The study input-output model was based on the rectangular input-output model accounting system. It was based on the transactions tables for Canada and regions for the year 2016. In this section, an overview of this model and steps undertaken to develop the model are described.

1. Model contains a disaggregated account of the Canadian and regional economies.
2. Non-survey techniques were used to develop coefficients for the sectors in the two study regions (Western Canada and Eastern Canada).
3. The input-output model was appended with an employment module to estimate the effect on the number of jobs under a given study scenario[7]; and,
4. For estimation of induced impacts, average consumer behavior was incorporated.

Each of these features is described in more detail in the following sections.

4.3.1 Preparation of the Study Model

The starting point of the preparation of the CRIO-16 model was Statistics Canada's Canadian and provincial transactions table at aggregation large. These transactions tables included the following economic agents:

[7] Scenarios are described in Chapter 5 of this report.

Table 4.1: Number of sectors and commodities in the Statistics Canada Model and Study Model

Type of transactions	Statistics Canada Model	CRIO-16 Model
Sectors (Producing goods and services)	240	58
Commodities (Intermediate)	491	67
Primary Commodities	9	7
Final Demand sectors	273	2
Other Final Demand Sectors*	4	3

* Included change in inventories, exports, and imports.

The transactions table provided by Statistics Canada were for Canada and Alberta separately. There tables were very detailed due to a very high level of disaggregation used. Although this detailed description of the economy was very useful, it was also highly time consuming and required computer resources not readily available (on some laptops). To make a more manageable model, these sectors and commodities were aggregated. The 240 sectors of the original table were aggregated to 58 sectors for the present study. Similarly, the number of commodities were reduced from 491 in the original model to 67 in the study model. Since final demand agency structure and purchases were of no interest in the current study, there were all combined into two sectors.

In the study model CRIO-16, four separate input-output sub-models were developed: (1) Canadian economy; (2) Eastern Canadian economy; (3) Western Canadian economy; and (4) Province of Alberta. All these regions were programmed into a single computer program called Economic Impact Analyzer. Each sub-model has the same dimensions (number of sectors and commodities), but its own coefficients. A detailed list of sectors and commodities for this level of aggregation is shown in Appendix B (Table B.1 for sectors and Table B.2 for commodities). The combined final demand agencies included Consumers, Investment, Governments and Exports.
Construction of a regional (Eastern Canada or Western Canada) model can be done in one of two ways.

> Approach One involves obtaining transactions tables for all 10 provinces and for Canada as a whole. The ten provincial transactions tables had to be added together to yield the regional transactions table. Given the size of the Statistics Canada's transactions table (as shown in Table 4.1), this approach was very labor intensive and therefore considered not feasible within the resources available for the study.

Approach Two is based on a procedure called non-survey method. It only requires the use of a single transactions table – one for Canada. Input-output coefficients are estimated for each region using their location quotients for various commodities. This is the method adopted in this study for developing the regional models. More details are presented in Section 4.3.2.

To operationalize the model, the transaction table data were checked for any confidential entries. Such entries were not present in the Canadian transaction tables but were identified in the Alberta tables. These values were imputed and filled into a new commodity "using a neighbouring region". The next step was to check the balancing of the model. Each commodity's supply (total output) should be equal to its disposition (sales to other sectors or to final demand agencies). If the entries did not balance, values were imputed, and a new commodity "Residual Commodities" was created. In most sectors, this value was less than 2% of the total sales of that sector.

There were four major limitations of these transactions tables in the context of this study: One, there were no input-output coefficients available for aggregated regions (such as Western Canada and Eastern Canada), and therefore, had to be created; Two, there was no process for estimating employment for the regional (or national) economy as it gears up to produce more goods services to meet increased demand by the cattle sector; Three, in order to estimate induced impacts, consumer behaviour needed to be modelled; and Four, since various firms are allowed to import goods and services from other parts of Canada or from the rest of the world, these needed to be accounted in the model. To improve on these limitations, additional activity was required. The following steps were undertaken to complete the development of the CRIO-16 model:

One, Estimate aggregate regional input-output coefficients for various sectors;
Two, Develop employment coefficients for various regions;
Three, Estimate consumer behavior relationship; and,
Four, Estimate leakages from the regional economies.

Each of these is described further in the following sections.

4.3.2 Development of Regional Input-output Coefficients

As mentioned above, this study used the approach of non-survey method to create regional input-output coefficients. This approach provides a short-cut to the primary data collection. It is based on the knowledge of a location quotient (LQ). A LQ is a measure of a region's self-sufficiency in meeting its requirement for various goods and services. If a region is self-sufficient, it would first meet its own requirements and export the rest to other parts of Canada or rest of the world. It is calculated as follows:

$$LQ_{rc} = \text{Share of the commodity c in region r} \; / \; \text{Share of commodity c in Nation} \quad (4.1)$$

If the LQ ≥ 1, the region is a surplus region and can meet all its requirements for that commodity. Thus, its technical coefficients are like that for the nation. If LQ < 1, it a deficit region for that commodity and new set of coefficients are created. The estimation involves the use of the following equation:

$$A_{cr} = A_{cn} * LQ_{rc} \quad (4.2)$$

Where, A_{cr} is the technical coefficient for the commodity *c* in region *r*, and A_{cn} is the technical coefficient for that commodity for the nation.

This procedure was applied to both the regional models (Western Canadian and Eastern Canadian) of the CRIO-16.

4.3.3 Estimation of Employment Coefficients

To estimate employment coefficients for various sectors in the CRIO-16 model, Statistics Canada data on employment by major sectors were obtained. Corresponding levels of output were obtained from the output matrix of the transactions table for the model. Dividing the number of workers employed by a certain sector by its output in thousands of dollars provided the employment coefficient in terms of number of persons per $1,000 worth output (value of goods and services sold). Results are presented in Appendix Table B.3.

For some sectors, separate employment data were not available. In these cases, employment coefficient for the Canadian economy were assumed to be applicable.

4.3.4 Modeling Consumer Behavior

To estimate induced impacts under a given scenario, it is important to make assumptions regarding how consumers spend their earned income, a concept called propensity to consume. As income of consumers increases, a portion of this increase is spent on consumer goods and other personal expenditures. In the case of smaller changes, an appropriate indicator is the marginal propensity to consume (MPC). The MPC is the proportion of changed income being spent on personal

expenditures. These values are typically estimated using regression analysis. To estimate the MPC for various regions, a regression equation for personal expenditures (PEX) and income (INC) for Canada was estimated using 2004-2018 data. In the case of Western Canada, the MPC was greater than one, suggesting an impossible long-term situation (Table 4.2). Since it is a situation that cannot be sustained in the long-run, average propensity to consume were estimated. To maintain comparability, APC was used for other regions as well. The APC is simply a ratio of average personal expenditures to average income. According to past estimates, the APC for most regions was around one, and has been increasing in the recent time periods. In this model, this coefficient was set between 0.824 for Western Canada to a high of 0.871 for Canada as a whole (Table 4.2).

Table 4.2: Estimated value of Marginal and Average Propensity to Consume by Region, 2004-2018

Region	MPC	APC
Canada	0.997511	0.871352
Alberta	0.748756	0.830058
Western Canada	1.224919	0.823957
Eastern Canada	0.803603	0.894220

4.3.5 Inter-provincial and International Trade

As noted above, a part of the region's demand for goods and services (commodities) is met through imports from other regions. Similarly, a region's output of a sector can be exported. These imports/exports of various commodities take place within Canada (from other Canadian regions) as well as from outside the country. The former is called inter-regional imports/exports, and the latter one imports/exports. Both types of import/export activities were included in the model. In the CRIO-16 model, imports were treated as a source of supply for the commodity and not shown as explicit demand activity. In other words, imports were treated as negative demand. In addition, these imports are leakages and do not contribute to the local economic growth.

4.4 Estimation of Economic Impacts of a Change in Activity

As noted above, total economic impacts, based on an input-output model, are demand driven. The demand for the commodities could be through expansion of production of a sector, by enhanced exports, or purchases by investors or consumers. Each of these situations can be analyzed using the CRIO-16 model.

To estimate the above total impacts the inputs of various sectors are identified and assigned to various commodities per list in Tables B.1 and B.2. This is a very important step in economic impact analysis since the quality of the output (estimated economic impacts) is determined by the quality of these data. The result is an "Economic Impact Analyzer" that contains these steps and has the capability of presenting the total impacts under a given direct change. The direct change is called a 'scenario'. These scenarios are presented in Chapter 5.

The Analyzer presents matrices showing direct change under a scenario. These matrices are used to estimate direct plus indirect impacts, and total impacts (direct, indirect, and induced impacts) resulting from the scenario. The first type of changes (direct and indirect) is called Type I impacts, whereas second type (direct, indirect, and induced) are called Type II impacts.

In the model, Impacts are presented in two formats: (1) Long format, which contains all individual items of GDP and two types of trade (interprovincial and international), along with employment generated; (2) Short format provides impacts in terms of the following indicators: Output (or sales of goods and services by various sectors), GDP at factor cost, GDP at market prices, Labor income (excluding transfer payments), Total imports, and Employment. In this study the short format results were used.

4.5 Concept of an Economic Multiplier

A multiplier is simply a ratio of total impacts to a selected direct impact for a given scenario. Mainly these multipliers are either Type I (total impacts include direct and indirect impacts only) or Type II (where total impacts include induced impacts in addition to Type I impacts). Depending on the choice of direct impact, one can calculate three types of multipliers: Final demand multipliers, Pseudo multipliers, and Ratio-form multipliers.

4.5.1 Pseudo Multiplier

If a decision maker is interested in the total change in the economy, and only has information on the direct change associated with a scenario, the multiplier that is appropriate is called a Pseudo Multiplier. It is estimated as a ratio of total change in the economy divided for a given economic indicator, and level of direct production of that sector.

Let us take an example. if a pseudo-output multiplier for the manufacturing sector is 1.35, this suggests that if the production of this sector increases by one dollar, output of all goods and services (including manufacturing) in the regional economy would increase by $1.35.

4.5.2 Ratio-Form Multiplier

The ratio-multiplier takes a different form than the above two types of multipliers. It is estimated as a ratio of total change in an economic indicator and direct change in the same indicator for a given scenario.

Let us take an example of income in cattle production. Let us further assume that the ratio-form income multiplier for the cattle sector is estimated at 2.25. This suggests that for every dollar of income earned by cattle producers, the rest of the economy makes an additional $1.25 dollars, making it a total income change in the region of $2.25 dollars.

4.6 Gross Multiplier Effects vs. Net Multiplier Effect

Estimation of economic impacts of a change in final demand for a commodity or production of a sector requires one caution. If the change involves a final demand, and since that commodity transaction does not enter the regional economic system, estimation of economic impacts does not require any change in the calculation of multipliers.

If the change involves the level of production, and if the sector has forward linkages, estimation of these impacts, if done for each of the individual sub-sectors, would overstate the total economic impact of the sector. This is called the gross impacts of the sector and any multipliers based on such estimates would be gross multipliers. These multipliers would overstate the impact of the sector. For this reason, they are of limited use for policy making.

The degree of overstatement in the total economic impacts arises from the double counting of inputs in the direct impact for economic impact analysis. This occurs from the fact that some of the inputs purchased by the forward linked sub-sectors are already produced by the selling sector. Since economic impacts of the selling sector have already been included, and if the purchases of these commodities are not removed from the purchases of the forward-linked sector, the sum of the economic impacts of these two sectors would give rise to a serious overestimation of the total economic impacts.

Let us take the example of the cattle sector. Initial stage of farm production is cow-calf operations where the final product is calves (with a weight of 600 ponds) for sale to other producers (backgrounders) for further value added (through bringing them to higher weights, say 900 pounds). By this time, these animals are moved to a feedlot (or feeder operations) for adding more weight to them (say to 1350 to 1400 pounds). These animals are then sold to the slaughtering and meat processing sector.

If all the economic impacts of each of the four sectors (Cow-calf operations, Backgrounding operation, Feedlot or feeder operations, and Slaughtering and meat processing) are estimated individually and then together, there will be serious double (or even triple) counting. To add them together, this double counting must be avoided, as shown in Table 4.3. Although the calves produced on a cow-calf farm is the start of the production of beef cycle. This value has no double counting. But the calves bought by backgrounding farms and mature animals purchased by feeders and finishing operations are adding more value the animals received, but not the production inputs for their production. This double counting extends to S&MP sub-sector since all the animals being processed have already been produced.

Table 4.3: Source of Double-Counting in the Cattle and Calves Sector in Canada

Producing Sector	**Purchasing Sector**	**Input**
Cow-calf Operations	Backgrounding Operations	Calves
	Animal Slaughtering and Meat Production Sector	Calves
Backgrounding Operations	Feeder Operations / Feedlots	Feeder Animals
Feeder Operations / Feedlots	Animal Slaughtering and Meat Production Sector	Finished Animals
Animal slaughtering and meat production sector	Final demand sectors (consumers and exports)	Calves, feeder animals, finished animals

If the above set of inputs is removed from subsequent (sequential) economic impact analyses, and if all these impacts are added together, the result would be net total economic impacts of the sector. This is the approach used in this study.

Chapter 5

STUDY SCENARIOS

The total economic impacts of the cattle sector on the Canadian and regional economies (including provincial economy of Alberta) were estimated by using two approaches:

One, each of the sub-sectors was assumed to be an independent source of change (scenario) and total impacts were estimated using their respective expenditures. These included the three types of farm level production firms plus the processing sub-sector. In total, there were four individual scenarios. These impacts, as noted in Chapter 4, should be interpreted as gross impacts.

Two, aggregate scenario, where all sub-sectors were combined but using a lack of duplication approach. This was based on following a net direct impact approach, where commodities already produced by the selling sectors were excluded. This approach showed the net total impact of the cattle sector.

Economic impacts of a given scenario were estimated using a 'with' and 'without' situation. In other words, the situation depicts the changes in the Canadian or regional economy if that production sub-sector included in the scenario did not exist. Thus, estimated impacts show the marginal contribution of that sector to a given economy. Please note that without a given sub-sector, the economic impacts would be zero.

The economic impacts were estimated for four individual scenarios plus the aggregate scenario. The four-study scenario included: three scenarios for farm level production of cattle, namely cow-calf production, backgrounding, and feeding/feedlots operations. The fourth scenario was that of S&MP. Each of these were estimated for three regions (Eastern Canada, Western Canada, and Alberta) and Canada as a whole.

5.1 Farm Level Cattle Production Scenarios

In this study, impacts of each of these scenarios were estimated as an independent set of activities. All the inputs purchased by that production unit were included in impact analysis. The results of these scenarios reflect a situation as if these were the only changes that have occurred in the economy. No effort was made here to avoid the possible double counting.

Each scenario was estimated as the value of production as measured by total farm cash income from the sale of cattle. Since, Statistics Canada reports this income as a total for the beef cattle sector, a method to divide the income among the three scenarios was developed. The number of beef steers and heifers for slaughter in each region on the three types of production sub-sectors as well as cull cows sold directly to slaughter (50%) from cow calf or put on feed then sold to slaughter (50%) from Backgrounding is used to allocate the income. In all cases, a one-to-one relationship between slaughter cattle numbers and the final product being sold by that sub-sector in each region/province was assumed. The estimates for the value of production for the yearly slaughter and meat processing sector are calculated using the following formula.

$$\text{Total Dressed weight (kg)} * \text{average \$ per kg wholesale price} \quad (5.1)$$

Where

Total Dressed weight (kg) = Cows * average dressed weight + calves * average dressed weight;

Cows = number of slaughter steers, heifers, cows, and bulls in a region/province;

average $ per kg wholesale price = (average retail price) *50%; and

average retail price = cuts as a percentage of carcass * average retail price of cut.

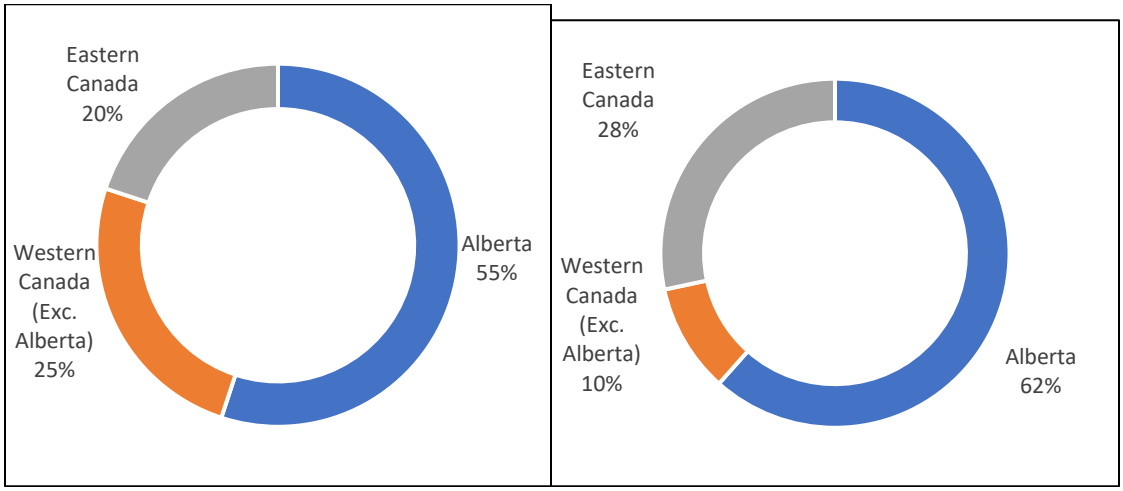
Resulting value of production for the three scenario and four spatial regions are shown in 5.1.

Table 5.1: Direct Demand (Change) Associated with Study Scenarios

2018-2020 Average	**Value of Production in Thousand Dollars**			
Scenario	**Canada**	**Eastern Canada**	**Western Canada**	**Alberta**
Cow-calf Operations	1,049,387	165,600	885,163	483,083
Backgrounding Operations	3,507,444	370,935	3,144,869	2,194,776
Feeding Operations including feedlots	4,702,364	1,309,844	3,382,783	2,419,856
Total Farm Cash Income	9,259,194	1,846,379	7,412,815	5,097,715
Slaughtering and Meat processing	10,306,640	2,920,857	7,385,783	6,346,598
Total Direct Value of Production	19,565,834	4,767,236	14,798,598	11,444,313

Source: Author's estimates using Statistics Canada (2020d); Statistics Canada (2021a; b; c; d; e) AHDB (2020).

Average yearly total farm cash income in Canada for 2018-20 period was reported at $9.3 billion. Its distribution by Eastern and Western Canada suggests that Western Canada has a slightly higher proportion of the total than Eastern Canada. Similarly, the Alberta share of the Canadian cash farm income from cattle production was almost half. In fact, as shown in Figure 5.1 (Left Panel), farm level production is more concentrated in Western Canada than in Eastern Canada, like the concentration of S&MP sector.



Farm Value of Production **Slaughtering and Meat Processing**

Figure 5.1: Regional Distribution of Canadian Beef Cattle Sector

Farm level beef cattle production, as noted in Chapter 2, is destined either for the live export market or purchased by other local buyers for further processing. One could argue that in a narrow sense, forward linkages do exist between farm level sub-sectors. This is since as calves raised by the cow-calf operations are purchased by the backgrounding operations, whose products are purchased by finishing (feedlots), and feedlot output is purchased for further value-added activities by the slaughter and meat processing sector.

5.2 Beef Cattle S&MP Scenario

The forward linkages of farm level cattle production are the animal S&MP sector. This increases further value added to the regional economy. Unfortunately, all the data reported for this industry is for all live animals slaughtered for meat production (to include beef, veal, pork, chicken meat, turkey meat, mutton and lamb, and other meats). To estimate the value of beef and veal and other related products, some imputation was required.

To estimate the Canadian beef and veal output, Statistics Canada's 2016 data for the Canadian Animal S&MP sector was obtained from their input-output model. Using the proportion of the value of cattle and other live animals/birds used as input, total output for beef and veal[8] production was estimated. This assumes that processing of beef cattle required similar inputs as other live animal/birds.

[8] It is recognized that some of the veal may have been produced from dairy calves. However, the distribution of total calves by beef or dairy was not available.

If one assumes that the processing of these cattle is totally dependent on local supply[9] of cattle, the sector could be defined as inclusive of farm level and agri-processing level economic activities. Using this extended sector definition, the cattle sector in Canada is almost a $20 billion industry[10]. One should note that this is the gross value of their output and does include some double counting.

5.3 Aggregate Scenario

The aggregate scenario created in this study was based on the premise that the sum of individual scenarios would overestimate total impact of the cattle sector due to double counting. This is because at each stage of production and processing, purchases are made from another sector whose impacts have already been included. To avoid this double counting, a method of triangulation was followed. Animals purchased by the backgrounding, feeding operations / feedlots, and processing firms were excluded in the estimation of total economic impacts.

5.4 Data Sources

The starting point in economic impact analysis is the direct inputs purchased by a given sector from other goods producing sectors. For example, a cow-calf producer would need, among other items, bedding, feed, fencing, as inputs. The quality of estimated economic impacts is governed by the quality of this information.

Unfortunately, comparable regional data for various stages of production in the sector were not available. Data for Alberta and some activities in Western Canada were provided by Canfax Research Services (CRS)[11]. Available data pertained to different time periods or used a different accounting system (in terms of items reported or detailed). In some cases, estimates were provided for the cost of production but not on the revenue side. Despite these limitations, a best set of cost of production were selected from those available. However, quality of these estimates can be improved significantly. This aspect needs to be considered while interpreting the multipliers reported later in this study.

Farm level cost of production data were obtained from Canfax Research Services (Personal Communications), plus Alberta Agriculture and Forestry (2019). Some data were also available

[9] In reality, a firm processing a product has two options: One, use local goods, or Two import them from other regions of Canada or the world. The second option is viable in the short-run. However, in the long run for the firm to continue in the region, local inputs must be available. Lack of meeting this condition would indicate closure of the firm's business.

[10] Another approximation that was not taken into account was the regional variability in type of animal slaughtered.

[11] We are highly indebted to Ms. Brenna Grant for this assistance.

for Manitoba. Budgets for the past few years of farm level production costs. In most of these cases, data on the return to producer was either not provided or the value was negative at current prices. In such cases, the price was adjusted to show a moderate net return. Farm level data for Ontario were provide by the Canfax Research Services and used for Eastern Canada. Data on slaughtering and meat processors were obtained from the transactions table provided by Statistics Canada.

5.5 Estimation of Economic Impacts

The procedure for the estimation of economic impacts involved four steps:

One, Collection of direct requirements for the production activity being analyzed;
Two, Classification of above set of data by input-output model commodity system. A list of these commodities is provided in Table B.2 (Appendix B).
Three, Estimation of Type I and Type II economic impact of the selected activity using the CRIO-16 model; and,
Four, Estimation of various types of multipliers using the results in Step 3 above.

This study reports both gross and net impacts of cattle sector in three regions of Canada. As already noted, net impacts were estimated by excluding the goods already produced by other types of farms or sub-sector.

5.6 Reporting of Results

The economic impact results and multipliers are reported in the next four chapters. They are arranged as: Canada (in Chapter 6); Western Canada (in Chapter 7), Eastern Canada (in Chapter 8), and Alberta (in Chapter 9). In all regions, both gross and net impacts of the sector are presented. Also, each chapter includes details on each of the sub-sectors, including direct impacts of the sector, secondary impacts, and multipliers. In addition, the beef cattle sector was projected to 2030. These results are presented in Chapter 10.

Chapter 6

ECONOMIC IMPACTS OF CANADIAN CATTLE SECTOR ON THE CANADIAN ECONOMY

As noted earlier, in this study, the Canadian cattle sector was divided into two sub-sectors – (1) Farm level cattle production sub-sector, and (2) S&MP of cattle sub-sector. This chapter presents the total impact of these two sub-sectors, first individually and then combined. No regional distribution is presented here since it is presented in the following chapters. All farms associated with cattle production are included[12]. The farm level production sub-sector included three types of operations; Cow-calf, Backgrounder, and Feeder and/or feedlots. Since Canada is modeled as a whole, no interregional trade was permitted; however, international trade is possible and was included.

The chapter is divided into four sections: Section 6.1 described the multiplier effect of the three farm level cattle production, individually. This is followed for the processing sector in Section 6.2. Since there is double counting among the farm level producing units and between farm level and processing level, in Section 6.3 net economic impacts (and multipliers) for the entire cattle sector are provided. The last section provides a summary.

6.1 Economic Impacts of Farm Level Cattle Production Sub-Sector

6.1.1 Direct Impact of the Sub-Sector

Direct impacts of an economic activity are traditionally measured through five indicators: (1) Level of sales, also called output of a sector; (2) Contributions to the income of workers and other members of the society associated with that activity, called Labor Income; (3) Contributions to the gross domestic product for the region in market prices; (4) Contributions to employment generating activities; and (5) Imports from other regions within Canada and from rest of the world. Since the last indicator provides little information on the contribution to the Canadian (or regional) economy, this study presents results only for the first four indicators.

Direct impacts of the farm level sub-sector of the Canadian cattle sector are shown in Table 6.1. These farms, as already noted above, sell $9.3 billion worth of cattle[13]. This total value of production was estimated for the three types of farms using the value of output and number of beef

[12] Readers should note that some of the income may have been derived from the sale of dairy calves. From the Statistics Canada estimates, it is not clear whether this income was included in these estimates. Therefore, further investigation of this issue is needed.

[13] The value of inventory of cattle and calves on farms is not included in this estimate. This is simply the value of sales at the farm level.

cows, as explained in section 5.4. The total cash farm income from the sale of calves was attributed to the cow-calf operations. These enterprises contribute $1.2 billion to Canada's gross domestic product (GDP), which includes the personal income of almost one billion[14]. Using employment coefficients (per description in Appendix E), the farm level sub-sector is estimated to have employed 43,737 workers (on a full-time equivalent basis)[15].

Table 6.1:Direct Impacts of the Canadian Farm Level Sub-Sector, 2018-20

Indicator	Unit	Value			
		Cow-Calf	Back-grounding	Feeder / Feedlots	Total
Sales of Goods and Services*	Million Dollars	$1,051	$3,516	$4,693	$9,260
GDP at Market Prices	Million Dollars	$357	$357	$534	$1,248
Labor Income	Million Dollars	$288	$288	$490	$1,066
Employment**	Person-Years	22,415	5,419	15,903	43,737

* Total farm cash receipts for the region were obtained from Statistics Canada (2020a). Total farm cash income for each of the three sub-sectors was imputed.

** More details on the estimation of employment are provided in Appendix E.

The farm level production is a significant generator of employment in the region. Of this total, the cow-calf operations and feedlots produce a higher level of employment [16].

6.1.2 Total Economic Impact of the Farm-Level Cattle Sub-Sector

Although most people can easily recognize the direct impacts (contributions) of a sector, total impacts need to be estimated. These impacts include indirect and induced impacts in addition to direct impact (contributions made) of a given sector. As explained previously, indirect impacts are created through the purchase of various inputs that are required for the production in each sector

[14] One of the reasons for the close values of GDP and labor income is that some of the budgets used for the analysis did not include depreciation and taxes.

[15] It should be noted that this is an estimate and is not based on actual employment numbers since these data are not reported by Statistics Canada at this level of disaggregation.

[16] Please note that these employment estimates are based on sales. If sales do not relate to employment, these estimates could be over or under-estimated for each of the three types of cattle and calves farm level production farms. For details of the methodology, see Appendix E.

(or sub-sector). Similarly, the induced impacts are a result of spending of the income received by owners of these resources, thereby creating more demand for various commodities and thus increase production[17].

For the farm-level Canadian cattle sub-sector, inputs required for production were obtained from the cost of production budgets. This information reflected the type of goods and services that are required for the production in the sector some of which are purchased from other goods producing sectors. These actions were aggregated into four economic indicators: Output (level of sales of all sectors affected; Gross Domestic Product at market Prices (GDP-MP); Labor Income (income of the people to spend at their own discretion); and Employment (number of additional full-time equivalent jobs). Results are shown in Table 6.2 (Top panel).

The level of direct output of these sectors is different and therefore, each sector imparts a different secondary (indirect and induced) impact on the economy. For all three types of farm level activities (estimated at $9.3 billion), through indirect impacts (called Type I impacts), the economy increases output of all sectors by $22.6 billion, created additional GDP-MP of a little over $6 billion, which includes $4 billion as income to people (owner of resources). If the re-spending of the income earned by various members of the labor force are considered (Type II impacts), value of total goods and services would increase to $29.5 billion (bottom panel of Table 6.2).

Contributions to the GDP at market prices[18] were estimated at $10 billion though both indirect and induced impacts, which includes labor income of almost $7 billion. In total, some 216,758 person-years of employment are generated either directly or indirectly from the farm level cattle production in Canada.

Table 6.2: Total Economic Impacts of the Canadian Farm Level Sub-Sector, 2018-20

Indicator	Unit	Value			
		Cow-Calf	Back-grounding	Feeder / Feedlots	Total*
		Type I Impacts (Direct and Indirect)			

[17] It is recognized that a small increase in demand faced by a sector could be met through inventory, but larger changes would inevitably require an increase in production.

[18] GDP at market prices includes indirect taxes and subsidies in addition to labor income and other operating surplus (which includes depreciation). If these items are excluded, the GDP is measured at factor cost.

Sales of Goods and Services	Million Dollars	$1,934	$9,056	$11,624	$22,614
GDP at Market Prices	Million Dollars	$781	$2,249	$3,081	$6,111
Labor Income	Million Dollars	$538	$1,425	$2,060	$4,023
Employment	Person-Years	31,462	34,606	52,835	$118,903
Type II Impacts (Direct, Indirect, and Induced)					
Sales of Goods and Services	Million Dollars	$2,869	$11,398	$15,184	29,451
GDP at Market Prices	Million Dollars	$1,340	$3,649	$5,203	10,192
Labor Income	Million Dollars	$926	$2,399	$3,534	6,859
Employment	Person-Years	44,776	67,997	103,985	216,758

* As noted above, the total of the three production types should be interpreted with caution. Because of double counting this total is an overestimate.

6.1.3 Economic Multipliers for the Sub-Sector

The results of the total economic impacts can be translated into multipliers for the sub-sector. As noted earlier, two types of multipliers are commonly used for sectoral analysis. They are: Pseudo Multipliers and Ratio-form Multipliers.

The Pseudo multiplier provides the magnitude of change per dollar of the output of that sector (or sub-sector), whereas the Ratio-Form multiplier is the multiples of time the increase in the economy is for each unit of direct impact. These multipliers can be of Type I (include only direct and indirect economic impacts) or of Type II (include direct, indirect, and induced impacts). For the fam-level production sub-sector, multiplier estimates are shown in Table 6.3.

Table 6.3: Pseudo Multipliers for the Canadian Cattle Farm Level Production Sector Type I and Type II, 2018-20

Indicator	Unit	Value		
		Cow-Calf	Back-grounding	Feeder / Feedlots
		Type I Impacts (Direct and Indirect)		

Value of output (Sales of goods and services)	Dollars	1.841	2.576	2.477
GDP at Market Prices	Dollars	0.774	0.640	0.657
Labor Income	Dollars	0.512	0.405	0.439
Employment	Person-Years	29.942	9.844	11.270
	Type II Impacts (Direct, Indirect, and Induced)			
Value of output (Sales of goods and services)	Dollars	2.731	3.342	3.236
GDP at Market Prices	Dollars	1.276	1.038	1.109
Labor Income	Dollars	0.882	0.682	0.753
Employment	Person-Years	42.612	19.342	21.946

If both indirect and induced impacts are included, results indicate that for every dollar of output generated, the total GDP-MP would increase by 77 cents for the cow-calf operations, 64 cents for the backgrounding operations and by 66 cents for feeders / feedlot operations. Employment per million-dollar worth of output generated by the sub-sector is estimated to be 10 (for backgrounders) and 30 person-years (for cow-calf operations)[19] in the Canadian economy.

One should keep in mind that these impacts and multipliers reflect gross changes in the economy and are slightly over-estimated. This is because both backgrounding and feedlot operations purchase cattle from other farms. Since we are counting them twice, economic impact for these two types of farm level cattle production is an overestimate.

A ratio-form multiplier relates the activity of the sub-sector to the level of changes in the entire economy. In other words, these multipliers indicate the change in the entire economy (for a given criterion) per unit of change in the sub-sector. These multipliers are shown in Table 6.4.

Table 6.4 :Economic Ratio-form Multipliers for the Canadian Cattle Farm Level Sub-Sector, Type I and Type II, 2018-20

Indicator	**Value**		
	Cow-Calf	**Back-grounding**	**Feeder / Feedlots**

[19] Estimated as a ratio of direct impact of farm sector ($9.26 billion) and Type II employment of 202,542 person-years.

	Type I Impacts (Direct and Indirect)		
Sales of Goods and Services	1.841	2.576	2.477
GDP at Market Prices	2.212	8.838*	5.574
Labor Income	1.997	7.740*	4.205
Employment	1.404	6.386	3.325
	Type II Impacts (Direct, Indirect, and Induced)		
Sales of Goods and Services	2.731	3.342	3.236
GDP at Market Prices	3.794	14.388*	9.410
Labor Income	3.442	13.028*	7.216
Employment	1.948	12.548	6.476

* Lower direct income in these sub-sectors is responsible for these large multipliers.

A perusal of estimates in Table 6.4 suggests that for one unit of change in the income of cow-calf producers (plus hired workers), there is slightly more than one total impact on the economy. The ratio-form multiplier (Type I) for these farms is 1.84, suggesting that these farms add another 84 cents worth of income in the hands of workers in other sectors. When all impacts are considered, the multiplier increases to 3.44, suggesting an increase in the income of workers in other sectors of 2.44.

Some multipliers in the table are somewhat large. This is in part due to the type of data used for direct impact in this analysis. For example, the GDP multiplier for backgrounding operations is 14.39. This is a result of very small part of the total expenditures were recorded for depreciation, land taxes, and personal incomes. Given the small denominator, the ratio-form multiplier would be rather large[20]. However, caution is advised in interpreting and use of these estimates.

6.2 Canadian Beef Cattle S&MP Sub-Sector

Some of the cattle on various types of farms are destined for exports while others are purchased by local S&MP establishments. These establishments, through their own activities, would add further value to the economy and result in further economic growth. In this section, economic impacts of these forward links of the Canadian cattle (farm level) sub-sector are reported, first with the direct economic impacts, then total economic impacts, and the finally in terms of multipliers.

[20] This issue is a result of type of cost of production budgets that were available at the time of conducting this study. Further investigation is required.

6.2.1 Direct Impact of the S&MP Sub-Sector

As noted above, actual data for Canadian cattle S&MP in various regions of Canada were obtained from Statistics Canada for Canada and Alberta. Alberta was used as a proxy for Western Canada, and the net Canadian (Canada as whole less Alberta) was used as a proxy for Western Canada. Direct sales for these regions were reported in Table 5.1. Input data for these sectors were based on transactions tables for Canada and Alberta. In terms of direct contribution, S&MP produced about $10.3 billion worth of goods, which resulted in $2.7 billion to Canada's GDP (which is the contribution made by the sub-sector itself), including $0.36 billion as wages and salaries and profits of unincorporated non-farm businesses. It is estimated to have employed 27,716 workers during 2018-2020 period (Table 6.5).

Table 6.5: Direct Economic Impacts of Canadian Cattle S&MP Sub-Sector, 2018-20

Particulars	Unit	Value
Production of Goods and Services	Mill. $	$10,307
Gross Domestic Product at Market Prices	Mill. $	$2,699
Labor Income	Mill. $	$357
Employment	Person-Years	27,716

6.2.2 Total Economic Impacts of the S&MP Sub-Sector

Using the direct economic impacts of the beef cattle S&MP in Table 5.1, total (Type I and Type II) impacts were estimated. These results are presented in Table 6.6. In terms of increasing the production of goods and services, the sub-sector contributed a total of $23 billion through direct and indirect impacts, and almost $28 billion through all impacts. Similarly, additions to the Canada's GDP were estimated at $11 billion, including $6 billion through direct labor income (wages of workers and profits of unincorporated non-farm businesses). In addition, approximately 171,000 jobs in Canada are directly or indirectly related to the Canadian cattle S&MP sub-sector. One must note that since this sub-sector purchases some raw materials from the farm level sub-sector, these estimates are larger than those of the sub-sector by itself[21].

Table 6.6: Total Economic Impacts of Canadian Cattle S&MP Sub-Sector, 2018-20

Particulars	Unit	Type I Impact Level	Type II Impact Level
Production of Goods and Services	Mill. $	$22,714	$28,256

[21] These impacts, called net impacts, are presented in Section 6.3.

Gross Domestic Product at Market Prices	Mill. $	$7,434	$10,738
Labor Income	Mill. $	$3,284	$5,581
Employment	Person-Years	93,034	171,190

6.2.3 Economic Multipliers for the S&MP Sub-Sector

Like farm level estimates. total impacts of the Canadian cattle S&MP sub-sector were converted into two types of multipliers – Pseudo multipliers and Ratio-form multipliers. In terms of pseudo multipliers, as shown in Table 6.7, for every dollar worth of goods produced by this sub-sector, Canadian GDP increases by 72 cents, including personal income of 32 cents, based on direct and indirect impacts. This contribution increases to 1.04 if all impacts are to be included. For each million-dollars worth of output of the sub-sector, nine workers are employed in Canada. Type II multipliers, as expected, are even larger, as shown in Table 6.7. One should also remember that this sector is also counting impacts for the farm level production of beef cattle.

Table 6.7: Pseudo Economic Multipliers for the Canadian Cattle S&MP Sub-Sector, 2018-20

Particulars	Unit	Pseudo Multipliers		Ratio-Form Multipliers	
		Type I Impact Level	Type II Impact Level	Type I Impact Level	Type II Impact Level
Gross Domestic Product at Market Prices	$	0.721	1.042	2.644	3.819
Labor Income	$	0.319	0.542	9.203	15.640
Employment	Person-Years	9.027	16.610	3.357	6.177

Interpretation of ratio-form multipliers can also be done in a similar manner as for the farm production sub-sector. These are also shown in Table 6.7. For every dollar of GDP-MP produced by the Canadian cattle S&MP sub-sector, another 1.64 is generated by other sectors, making a multiplier of 2.64. Similarly, every worker employed by the sub-sector four workers are employed in Canada (counting only direct and indirect impacts) and almost ten workers are employed if all impacts are included.

6.3 Net Impacts of Canadian Cattle Sector

The above impacts are accurate if each sector's contribution is considered in isolation (just by itself with no trading with any other sub-sector of the farm level cattle sub-sector). The reality is

that such is not the case. In fact, the S&MP sub-sector purchases cattle from farms. Similarly, within the farm production sub-sector for cattle, feeder operations purchase animals from backgrounding farms or cow-calf farms. This, if one were to add all these sectors together, would create a large degree of double counting. To obtain the total impact of the Canadian cattle sector, all double counting must be removed. This was done to estimate the net impacts of the sector, called aggregate sector. Using the net direct impacts, each of the farm level and processing level sub-sectors were combined, and economic impacts of all activities (farm level units and processing activities) were estimated. These results are presented in this section.

6.3.1 Net Direct Impacts of the Canadian Cattle Sector

Since there is no double counting in the direct impact estimates, total direct impact of the sector is sum of individual sub-sectors. As shown in Table 6.8, the sector produced a total of $20 billion dollar worth of goods, contributed $4 billion to the Canadian GDP (including approximately $1.4 billion to personal income). It employed a total of 71,500 workers (on a full-time equivalent basis), almost 60% of these were through farm level operations.

Table 6.8: Net Direct Economic Impacts of Canadian Cattle (Farm Level and S&MP) Sector 2018-20

Particulars	Unit	Value		
		Farm Level	Processing Level	Total
Production of Goods and Services	Mill. $	$9,260	$10,307	$19,567
Gross Domestic Product at Market Prices	Mill. $	$1,248	$2,699	$3,947
Labor Income	Mill. $	$1,066	$357	$1,423
Employment	Person-years	43,737	27,716	71,453

6.3.2 Total Net Economic Impacts of Canadian Cattle Sector

Using the total direct purchases of the combined farm level and processing level sub-sectors, economic impacts were estimated. These results are presented in Table 6.9. If only direct and indirect impacts are included (Type I impacts), the sector contributed $40 billion to the Canadian level of sales of goods and services, $15 billion to the Canadian GDP at market prices, including $7 billion to personal income. A total of 181,800 jobs were related to this sector either directly or indirectly. When induced impacts are added to these values, employment generation increases to 347,400 jobs (on a full-time equivalent basis).

Table 6.9: Total Net Economic Impacts of Canadian Cattle Sector

Particulars	Unit	Total Impacts

		Type I Impacts
Production of Goods and Services	Mill. $	$39,918
Gross Domestic Product at Market Prices	Mill. $	$14,816
Labor Income	Mill. $	$6,854
Employment	Person-Years	181,833
	Unit	**Type II Impacts**
Production of Goods and Services	Mill. $	$51,628
Gross Domestic Product at Market Prices	Mill. $	$21,802
Labor Income	Mill. $	$11,715
Employment	Person-Years	347,352

6.3.3 Net Economic Multipliers for Canadian Cattle Sector

Results of total impacts were translated into multipliers. These results are shown in Table 6.10. These multipliers can be used to answer various types of questions. For example, one question might be "How much contribution does the cattle sector make to the Canadian GDP for every dollar contributed by it directly? Or it may be: How many jobs in total are created by the farm level production of cattle in Canada? The first question can be answered using the net aggregate ratio-form employment multiplier. In this case, the answer would be 2.54 (if only indirect impacts are included), which increases to 4.86 if all economic impacts are included. Thus, in the final analysis, the sector contributes another $1.99 through supporting production in other sectors in the Canadian economy, or for every dollar contributed by the sector, almost another dollar is generated in some part of Canada. The second question can also be answered using these ratio-form multipliers. For every worker employed in the sector, another 2.5 (based on indirect impacts) to 4.9 (based on indirect and induced impacts) workers are employed elsewhere in the economy.

Table 6.10: Net Pseudo and Ratio-form Economic Multipliers for the Canadian Cattle Sector

Particulars	**Unit**	**Net Pseudo Aggregate Multiplier**	
		Type I	**Type II**
Production of Goods and Services	$	1.992	2.576
Gross Domestic Product at Market Prices	$	0.739	1.088
Labor Income	$	0.342	0.584
Employment	Person-Years	9.074*	17.334*

		Ratio-Form Net Aggregate Multiplier	
Production of Goods and Services	$	1.992	2.576
Gross Domestic Product at Market Prices	$	2.280	3.355
Labor Income	$	4.230	7.227
Employment	Person-Years	2.545	4.861

* Since the farm level direct impacts are low during the study period, these multipliers are somewhat larger. Caution is advised in their interpretation and use.

6.4 Summary

From the results presented in this chapter, Canadian cattle sector is an important economic driver in Canada. Though its own actions and support of other sectors, it is responsible for $51 billion worth of sales of goods and services in Canada. Through these sales, the sector contributes $22 billion to the country's GDP, which includes $12 billion through personal incomes. Directly or indirectly through induced income effects, the sector generates 347,352 jobs in the country.

Chapter 7

ECONOMIC IMPACTS OF WESTERN CANADIAN CATTLE SECTOR

In this chapter, the estimated economic impacts of the cattle sector in Western Canada are reported. As noted earlier in this report, this sector was defined to include two major sub-sectors of economic activities: Farm level beef cattle production sub-sector, and cattle S&MP sub-sector. The chapter is divided into four sections, starting with, Section 7.1, direct economic impacts of farm level production are presented, followed by the same for the processing sub-sector in Section 7.2. Net impacts of the sector are presented in Section 7.3, with a summary of the whole sector in Section 7.4.

7.1 Farm Level Production of the Western Canadian Cattle Sector

7.1.1 *Direct Impact of the Farm Level Production*

As described in Chapter 2, farm production in Western Canada takes place in three types of production units: Cow-calf operations, Backgrounding operations, and Feeding operations and/ or feedlots. Like that for Canada, direct impacts were measured in terms of gross value of goods and services sold (called output), gross domestic product (in market prices), labor income, and employment.

For the farm level western Canadian cattle sub-sector, results are presented for all three types individually and combined. These impacts are shown in Table 7.1. These farms sell $7.4 billion worth of live animals. Some of these are destined for exports and others are purchased by other local industries (by S&MP sub-sector for further processing). Combined they contribute $891 million to the regional GDP, including $654 million to the labor income in the region. It is estimated to employ some 34,292 workers estimated on a full-time equivalent basis.

7.1.2 Total Economic Impact of Farm Level Production

All expenditures incurred by a goods producing sector generate secondary impacts, which include indirect impacts (which are created through the purchase of various inputs that are required to produce various commodities) and induced impacts (which are created through consumer demand generated by additional income in the hands of consumers). These impacts are shown in Table 7.2.

Through purchases of goods and services for the farm level cattle sub-sector production, there is additional expansion in the level of goods produced by other sectors. These sectors then require

more inputs for meeting this additional demand. The result is a larger level of economic activity in Western Canada.

Table 7.1 : Direct Impacts of the Western Canadian Farm Level Cattle Sub-Sector, Average 2018-20

Indicator	Unit	Value			
		Cow-Calf	Back-grounding	Feeder / Feedlots	Total*
Sales of Goods and Services	Million $	$885	$3,143	$3,383	$7,411
GDP at Market Prices	Million $	$368	$237	$286	$891
Labor Income	Million $	$244	$170	$240	$654
Employment	Person-Years	19,753	3,681	10,858	34,292

* Total farm cash receipts for the region were obtained from Statistics Canada (2020a). Total farm cash income for each of the three sub-sectors was imputed.

Table 7.2: Total Economic Impacts of the Western Canadian Farm Level Cattle Production, 2020

Indicator	Unit	Value			
		Cow-Calf	Back-grounding	Feeder / Feedlots	Total*
		Type I Impacts (Direct and Indirect)			
Sales of Goods and Services	Million $	$1,607	$8,064	$8,639	$18,310
GDP at Market Prices	Million $	$665	$2,014	$2,185	$4,864
Labor Income	Million $	$462	$1,274	$1,419	$3,155
Employment	Person-Years	27,868	29,546	38,845	96,259
		Type II Impacts (Direct, Indirect, and Induced)			
Sales of Goods and Services	Million $	$2,397	$10,120	$10,941	$23,458
GDP at Market Prices	Million $	$1,138	$3,246	$3,564	$7,948
Labor Income	Million $	$791	$2,131	$2,378	$5,300
Employment	Person-Years	39,201	59,082	71,901	170,184

* As noted above, the total of the three production types should be interpreted with caution. Because of double counting this total is an overestimate.

By producing $7.4 billion of sales to other economic agents, the sub-sector generates a total economic activity of $18.3 billion by all economic sectors of Western Canada. This level of total sales contributes to the regional GDP in the tune of $4.9 billion, which includes $3.2 billion worth

of income to people (called labor income). An estimated 96,259 jobs in Western Canada depend on the activities of the sub-sector either directly or indirectly.

7.1.3 Economic Multipliers for Farm Level Production

Direct impact of cattle production and its total impacts are used to calculate the multiplier effect of the sub-sector. These results are shown in Table 7.3 for the pseudo multipliers and in Table 7.4 for the ratio-form multipliers.

Table 7.3: Pseudo Multipliers for the Farm Level Production of Cattle Sector, Western Canada, Type I and Type II

Indicator	Unit	Value		
		Cow-Calf	Back-grounding	Feeder / Feedlots
		Type I Impacts (Direct and Indirect)		
GDP at Market Prices	Dollars	0.752	0.640	0.646
Labor Income	Dollars	0.522	0.405	0.419
Employment	Person-Years	31.483	9.396	11.482
		Type II Impacts (Direct, Indirect, and Induced) *		
GDP at Market Prices	Dollars	1.285	1.032	1.054
Labor Income	Dollars	0.894	0.618	0.703
Employment	Person-Years	44.286	18.789	21.255

* Since the farm level direct impacts are low during the study period, these multipliers are somewhat larger. Caution is advised in their interpretation and use.

For every dollar worth of cattle produced by a cow-calf farm, almost 75 cents are added to the GDP (including 52 cents to labor income) by other non-cattle and/or non-agricultural sectors. The Type II impacts suggest a change of $1.29 per dollar value of farm output. Every million dollars worth of cattle produced in Western Canada generates up to 44 jobs[22]. Of course, different types of farms differ in terms of their impact on the region.

Table 7.4: Ratio-form Multipliers for the Farm Level Production of Cattle Western Canada, Type I and Type II

Indicator	Value

[22] Due to lower cattle and calves prices, value of sales is low. Since the employment coefficient is based on sales of a sector, this resulted in lower level of employment.

	Cow-Calf	Back-grounding	Feeder / Feedlots
	Type I Impacts (Direct and Indirect)		
Sales of Goods and Services	1.816	2.564	2.554
GDP at Market Prices	2.099	8.498	7.653
Labor Income	1.897	4.476	5.917
Employment	1.411	8.027	3.577
	Type II Impacts (Direct, Indirect, and Induced)		
Sales of Goods and Services	2.708	3.218	3.234
GDP at Market Prices	3.573*	13.696*	12.481*
Labor Income	3.246*	12.505*	9.919*
Employment	1.985	16.051*	6.622

* Lower direct income in these sub-sectors is responsible for these somewhat. larger multipliers.

In terms of the interpretation for the ratio-form multiplier, it is like that provided in Chapter 6. Every dollar of GDP generated by the sub-sector cow calf farms results in an increase in the regional GDP level by 2.7 (Type II) and 2.56 times. Some of these multipliers (GDP and labor income) are rather large, in part due to a smaller level of direct impact of these types of farms.

7.2 Western Canadian Cattle S&MP Sub-Sector

A portion of the farm level output of the farm level sub-sector is sold for further processing. The processing industries add further value to the goods and create economic growth in the region. These results are described in this Section.

7.2.1 Direct Impact of Western Canadian S&MP Sub-Sector

The S&MP sub-sector in Western Canada included all four provinces, including the province of Alberta. This sector produced (and sold) a total of $7 billion worth of goods to other economic agents in Canada and in the rest of the world (Table 7.5). This generated almost two billion dollars worth of GDP in Western Canada (including slightly over a quarter of a billion dollars in terms of labor income). Employment in this sub-sector was estimated at 17,631 workers on a full-time equivalent basis.

Table 7.5: Direct Economic Impacts of Western Canadian Cattle

S&MP Sub-Sector, 2020

Particulars	Unit	Value
Production of Goods and Services	Mill. $	$7,386
Gross Domestic Product at Market Prices	Mill. $	$2,015
Labor Income	Mill. $	$256
Employment	Person-years	17,631

7.2.2 Total Economic Impacts of S&MP Sub-Sector

The direct economic activity by the S&MP sub-sector in Western Canada resulted in more economic activities. Combining all direct, indirect, and induced impacts, it contributed $7.6 billion to the regional GDP and employed 118,591 workers (Table 7.6).

Table 7.6: Total Economic Impacts of Western Canadian Cattle S&MP Sub-Sector

Particulars	Unit	Type I Impact Level	Type II Impact Level
Production of Goods and Services	Mill. $	$16,266	$20,041
Gross Domestic Product at Market Prices	Mill. $	$5,325	$7,586
Labor Income	Mill. $	$2,347	$3,920
Employment	Person-years	64,381	118,591

7.2.3 Economic Multipliers for S&MP Sub-Sector

Converting the total economic impacts on a per dollar worth of output results in the estimate of pseudo multipliers. These multipliers are shown in Table 7.7. Based on including only direct and indirect impacts (Type I impacts), one dollar of goods sold by the sub-sector results in $0.72 in terms of GDP in the region. This also generates almost 9 person-years of employment per million dollars of sales of goods. If all impacts (Type II) are considered, the total employment increases to 16 workers per million dollars of sales.

Table 7.7: Pseudo Economic Multipliers for the Western Canadian Cattle S&MP Sub-Sector

Particulars	Unit	Type I Impact Level	Type II Impact Level
Gross Domestic Product at Market Prices	$	0.721	1.027
Labor Income	$	0.318	0.531
Employment*	Person-Years	8.717	16.057

* Please note that on account of smaller direct impacts, some of these multipliers are high.

Ratio-form multipliers for the S&MP sub-sector are shown in Table 7.8. The sub-sector has a high multiplier activity. If all impacts are included, output of the western Canadian region increases 2.7 times the level of output of the sub-sector. The GDP of the region increases by almost four times, and employment by a little under four-times. One should note that since the sub-sector is purchasing inputs from the farm level production sub-sector, these multipliers reflect more than processing level impacts.

Table 7.8: Ratio-form Economic Impacts Multipliers for the Western Canadian Cattle S&MP Sub-Sector

Particulars	Type I Impact Level	Type II Impact Level
Production of Goods and Services	2.202	2.714
Gross Domestic Product at Market Prices	2.643	3.765
Labor Income*	9.176	15.328
Employment	3.625	6.726

* Please note that on account of smaller direct impacts, some of these multipliers are high.

7.3 Net Impacts of Aggregate Western Canadian Cattle Sector

To avoid the double counting through the purchases of inputs from other sectors whose impacts are already accounted for, impacts were re-estimated on a net purchases basis. The sector is now called ‘net aggregate cattle sector’ or simply ‘aggregate sector’. These results are described in this section.

7.3.1 Net Direct Impacts of the Aggregate Western Cattle Sector

Direct impacts of the aggregate sector are presented in Table 7.9. The sector produces $14.8 billion worth of goods and services, contributes $4.7 billion to the regional GDP (including $1.2 billion as labor income), and employs 51,923 workers at both farm level production and off-farm S&MP sub-sectors.

Table 7.9: Net Direct Economic Impacts of Aggregate

Western Canadian Cattle Sector

Particulars	Unit	Value		
		Farm Level	Processing Level	Total
Production of Goods and Services	Mill. $	$7,413	$7,386	$14,798
Gross Domestic Product at Market Prices	Mill. $	$799	$3,875	$4,675
Labor Income	Mill. $	$654	$512	$1,166
Employment	Person-Years	34,292	17,631	51,923

7.3.2 Total Net Economic Impacts of Aggregate Western Cattle Sector

The direct expenditures by the aggregate sector generate several rounds of secondary impacts. The aggregate sector generates goods and services worth $30.4 billion in Western Canada though direct and indirect impacts and $38.8 billion though direct, indirect, and induced impacts (Table 7.10). It generates $11 billion worth of GDP including $5.2 billion as labor income, which increased to $16.2 and $9 billion when induced impacts were included. Directly and indirectly. it is responsible for employment of 258,130 workers (full-time equivalent basis).

Table 7.10: Total Net Economic Impacts of Aggregate Western Canadian Cattle Sector

Particulars	Unit	Total
		Type I Impacts
Production of Goods and Services	Mill. $	$30,383
Gross Domestic Product at Market Prices	Mill. $	$11,228
Labor Income	Mill. $	$5,156
Employment	Person-years	136,986
		Type II Impacts
Production of Goods and Services	Mill. $	$38,820
Gross Domestic Product at Market Prices	Mill. $	$16,280
Labor Income	Mill. $	$8,672
Employment	Person-years	258,130

7.3.3 Net Economic Multipliers for Western Cattle Sector

Total impacts of the aggregate sector were converted into per unit change, called multipliers. Using the production level related changes, for every dollar worth of production of the aggregate sector, the rest of the economy produces 74 cents through direct and indirect changes, and 107 cents

through indirect and induced changes (Table 7.11). Similarly, for every dollar of goods sold by the aggregate sector, 57 cents are generated as labor income in the western Canadian economy. The aggregate sector creates employment of 9 or 17 person-years through Type I changes or Type II changes, respectively.

Relative multiple activity of changes in the economy (called ratio-multipliers) were also estimated and shown in Table 7.11. Every dollar worth of GDP by the cattle sector activities, creates 2.3 dollars to the regional GDP. For every worker employed by the sector, employment of an additional 4.9 workers through economic activities of the regional cattle sector are created.

Table 7.11: Pseudo and Ratio-form Net Economic Multipliers for the Aggregate Western Canadian Cattle Sector

Particulars	Unit	Pseudo Net Aggregate Multiplier	
		Type I	Type II
Production of Goods and Services	$	1.995	2.549
Gross Domestic Product at Market Prices	$	0.737	1.069
Labor Income	$	0.339	0.569
Employment	Person-Years	8.893	16.947
		Ratio-Form Net Aggregate Multiplier	
Production of Goods and Services	$	1.995	2.549
Gross Domestic Product at Market Prices	$	2.302	3.338
Labor Income	$	4.421	7.435
Employment	Person-Years	2.638	4.971

* These multipliers are high perhaps because of lower value of production and other direct impacts of the farm level cattle production.

7.4 Summary of Impacts

The farm level activities related to cattle sector in Western Canada and its subsequent processing activities make a significant contribution to the western Canadian regional economy. A total of $38 billion dollar worth of goods sold, and a net contribution of the regional GDP of $16 billion are indicative of this importance. Directly or indirectly employment of over 258 thousand workers is related to the farm level production and processing activities in this region.

Chapter 8

ECONOMIC IMPACTS OF EASTERN CANADIAN CATTLE SECTOR

In this chapter, economic impacts of the cattle sector in Eastern Canada are presented. The method of analysis and presentation follows the same line as used for Canada and the western Canadian cattle sector. Both farm level as well as processing sub-sector activities are described.

8.1 Farm Level Production of Cattle

8.1.1 Direct Economic Impacts of the Farm Level Cattle Production

In Eastern Canada, the cattle sector is comprised of beef herds and dairy herds. Although data for beef cows is separated from dairy cows, such is not the case with sales of calves. Slaughtered or exported calves may be a product of either type of farm. However, in this study, it is assumed that all calves reported by Statistics Canada can be divided into those from beef or dairy herds in proportion to the number of cows of each category[23]. Like Western Canada, farm production in Eastern Canada takes place in three types of production units: Cow-calf operations, Backgrounding operations, and Feeding operations. However, cow-calf operations are relatively small compared to the other two types of operations (Table 8.1). Their economic impacts were measured through four economic indicators: Level of sales (also called output of a sector); Labor Income; Gross Domestic Product in market prices; and Employment generating activities.

Table 8.1: Direct Impacts of the Eastern Canadian Farm Level Cattle Production, 2020

Indicator	Unit	Value			
		Cow-Calf	Back-grounding	Feeder	Total*
Sales of Goods and Services	Mill. $	$166	$371	$1,310	$1,846
GDP at Market Prices	Mill. $	$33	$16	$262	$312
Labor Income	Mill. $	$25	$14	$250	$289
Employment	Person-years	2,662	1,738	5,045	9,445

* Total farm cash receipts for the region were obtained from Statistics Canada (2020a). Total farm cash income for each of the three sub-sectors was imputed.

[23] In Eastern Canada, the proportion of beef cows is 36% of the total number of cows in the region. Dairy cows in Eastern Canada were reported at 735,900 and beef cows at 429,500 on July 1st 2020 (Statistics Canada, 2021a).

Direct impacts of the three type of beef cattle operations suggest it is almost a 2-billion-dollar industry employing almost 9,000 workers. Over half of this employment was through feeders/feedlot operations in the region (Table 8.1). In addition, these activities contributed to the regional gross domestic product (GDP). Together they contributed a total of $312 million worth of GDP to the region, including $289 million dollars as income to the people engaged in these operations.

8.1.2 Total Economic Impact of Farm Level Production

Total impacts of a production activity include in addition to direct impacts, secondary impacts. The secondary impacts are generated through purchases of inputs (called indirect impacts) and through re-spending of income earned by workers and profits of unincorporated non-farm businesses. For the farm level beef cattle production sub-sector in Eastern Canada, total economic impacts for various selected indicators are presented in Table 8.2.

Table 8.2: Total Economic Impacts of the Eastern Canadian Farm Level Cattle Production, 2020

Indicator	Unit	Value			
		Cow-Calf	Back-grounding	Feeder	Total*
		Type I Impacts (Direct and Indirect)			
Sales of Goods and Services	Mill. $	$327	$993	$2,985	$4,305
GDP at Market Prices	Mill. $	$116	$236	$896	$1,248
Labor Income	Mill. $	$75	$151	$641	$867
Employment	Person-years	3,594	5,060	14,042	22,696
Type II Impacts (Direct, Indirect, and Induced)					
Sales of Goods and Services	Mill. $	$473	$1,277	$4,242	$5,992
GDP at Market Prices	Mill. $	$203	$404	$1,639	$2,246
Labor Income	Mill. $	$135	$268	$1,156	$1,559
Employment	Person-years	5,575	8,915	31,085	45,575

* As noted above, the total of the three production types should be interpreted with caution. Because of double counting this total is an overestimate.

All the three types of cattle farms combined are related either directly or indirectly to $6 billion worth of goods and services in the region, which included indirect and induced impacts. In terms of net contribution, these farms are responsible for $2.2 billion in terms of regional GDP, including $1.6 billion as labor income. If all indirect and induced impacts are counted, total employment

related to these farms is estimated at 45,575 person-years. If induced impacts are excluded, total impacts are slightly lower.

8.1.3 Economic Multipliers for Farm Level Production

Total economic impacts of the farm sub-sector were converted into multipliers. Both pseudo and ratio-form multipliers for eastern Canadian farm level cattle sub-sector are shown in Table 8.3 and 8.4, respectively.

Table 8.3: Pseudo Multipliers (Type I and Type II) for the Farm Level Production of Cattle Sub-Sector, Eastern Canada

Indicator	Unit	Value		
		Cow-Calf	Back-grounding	Feeder / Feedlots
		Type I Impacts (Direct and Indirect)		
GDP at Market Prices	Dollars	0.702	0.635	0.684
Labor Income	Dollars	0.453	0.408	0.489
Employment	Person-Years	21.704	13.640	10.720
	Type II Impacts (Direct, Indirect, and Induced)			
GDP at Market Prices	Dollars	1.223	1.088	1.251
Labor Income	Dollars	0.815	0.722	0.883
Employment	Person-Years	33.665	24.033	23.731

According to the level of pseudo multipliers, every dollar of production of these farms yields a regional GDP between 64 cents (Backgrounding farms) and 70 cents (cow-calf farms) cents with only indirect impacts included, or $1.09 (backgrounding farms) to $1.25 (feeders/feedlots) if all impacts are included. In terms of employment generation, sales of one-million-dollar worth of cattle in the region results in employment of 10 to 21 person-years through indirect linkages, and 24 to 34 person-years through all (direct, indirect, and induced) impacts.

Table 8.4: Ratio-form Multipliers (Type I and Type II) for the

Farm Level Production of Cattle Eastern Canada

Indicator	Value		
	Cow-Calf	**Back-grounding**	**Feeder / Feedlots**
	Type I Impacts (Direct and Indirect)		
Sales of Goods and Services	1.973	2.677	2.779
GDP at Market Prices*	3.334	13.429	3.352
Labor Income*	2.961	11.028	2.563
Employment	1.350	2.911	2.783
	Type II Impacts (Direct, Indirect, and Induced)		
Sales of Goods and Services	2.853	3.444	3.239
GDP at Market Prices*	5.810	23.001	6.130
Labor Income*	5.324	19.523	4.624
Employment	2.094	5.129	6.162

* Lower direct income in these sub-sectors is responsible for these large multipliers.

The ratio-form multipliers in Table 8.4 indicate how many times one unit of a given indicator for a sub-sector turns over to create total economic change of that sub-sector. Let us take an example of a Type II multiplier. For GDP, one unit of GDP generated by, say a feeder/feedlot operation, results in a total GDP in the region of 13.4. This number is unusually large because the farms have not had a good return over the past few years, and some of the budget data did not account for some GDP items. Caution is advised in their use.

8.2 Eastern Canadian Beef Cattle S&MP Sub-Sector

Eastern Canada has a larger S&MP sector than Western Canada, but the slaughter of beef cattle sector is larger in Western Canada. Since data are reported for all live animals processing, it is somewhat unclear whether the value estimated in this study is net of other types of animals. Several assumptions were made in this estimation, including:

1. Identical labor productivity across Canada, and

2. Number of employees in a region reflects the gross output of the plant.

The estimation involved total output of the Canadian slaughtering and meat processing industry and the use of the above assumption. This yielded the total output of the sub-sector in Eastern Canada. Given the nature of assumptions made, however, the accuracy of this number requires further scrutiny.

8.2.1 Direct Impact of S&MP Sub-Sector

The Eastern Canadian's S&MP sub-sector produced a total value of goods and services worth $2.9 billion, which generated a regional GDP of $765 million, including $101 million dollars as labor income. It is estimated to have employed 10,085 workers on a full-time basis, as shown in Table 8.5.

Table 8.5: Direct Economic Impacts of Eastern Canadian Cattle S&MP Sector, 2020

Particulars	Unit	Value
Production of Goods and Services	Mill. $	$2,921
Gross Domestic Product at Market Prices	Mill. $	$765
Labor Income	Mill. $	$101
Employment	Person-years	10,085

8.2.2 Total Economic Impacts of the S&MP Sub-Sector

Total economic impacts of the processing sub-sector in Eastern Canada were estimated and are presented in Table 8.6. Through direct, indirect, and induced changes in the regional economy, the sub-sector generated a total GDP of $3.2 billion, which included $1.7 billion as labor income. The sub-sector was also responsible directly or indirectly for creating 52,600 person-years of employment.

Table 8.6: Total Economic Impacts of Eastern Canadian Cattle S&MP Sector 2020

Particulars	Unit	Type I Impact Level	Type II Impact Level
Production of Goods and Services	Mill. $	$6,448	$8,214
Gross Domestic Product at Market Prices	Mill. $	$2,109	$3,152
Labor Income	Mill. $	$0.938	$1,662
Employment	Person-Years	28,653	52,599

8.2.3 Economic Multipliers for S&MP Sub-Sector

The total impacts as reported above were converted into multipliers – pseudo and ratio-form. They are shown in Tables 8.7 and 8.8, respectively.

Table 8.7: Pseudo Multipliers (Type I and II) for the Eastern Canadian Cattle S&MP Sector

Particulars	Unit	Type I Impact Level	Type II Impact Level
Production of Goods and Services	$	2.207	2.812
Gross Domestic Product at Market Prices	$	0.722	1.079
Labor Income	$	0.321	0.569
Employment	Person-Years	9.810	18.008

Table 8.8: Ratio-form Multipliers (Type I and II) for Eastern Canadian Cattle S&MP Sub-Sector

Particulars	Unit	Type I Impact Level	Type II Impact Level
Gross Domestic Product at Market Prices	$	2.647	3.956
Labor Income	$	9.271	16.430
Employment	Person-Years	2.841	5.216

In terms of the level of production of goods of the sub-sector, one dollar worth of production of Eastern Canada's S&MP sub-sector leads to a total regional level production of 2.21 dollars with both indirect and induced changes included. The GDP increase is 72 cents including 32 cents as labor income. Every one-million-dollar worth of goods sold by the sub-sector generates 10 person-years of employment through direct and indirect impacts, and 18 person-years through all impacts.

Ratio-form GDP multiplier of this sub-sector suggest that every dollar of direct GDP generated result in a total GDP creation of 4 dollars if all impacts are considered. Similarly, every worker employed by this sub-sector results in total employment of 5.2 person-years in Canada through trade linkages with other regions. It should be noted that since part of the inputs for this sub-sector are procured from the farm level production, these multipliers are an over-estimate and should be used with caution. To remove this bias, estimation of net impacts is needed, which is shown in Section 8.3.

8.3 Net Impacts of Aggregate Eastern Canadian Cattle Sector

8.3.1 Net Direct Impacts of the Eastern Cattle Sector

In the previous analyses, the cattle sector had four types of activities – three at the farm level and the fourth one at the processing level. Obviously, there is double counting if these sectors are added together. For example, for S&MP, cattle are required but they have already been produced by the farms ad their impact would be double counted. Similarly, under the assumption that feedlots purchase cattle from backgrounding farms, and these farms purchase them from cow-calf operations, again a significant amount of double counting would be present. The true economic

impacts of a sector should not have such double counting. If these double counting are excluded, one can develop a real impact of the cattle sector. This was attempted for the eastern Canadian cattle sector. The sector was called "Aggregate" cattle sector.

Since there is no double-counting in the direct contributions, these values remain the same as for each of the sub-sectors. Details are shown in Table 8.9. Because of the lower return in the industry, the regional farm level sub-sector values are low. Total production of the sector is estimated at $4.8 billion with a total labor force of 19,530 workers on a full-time equivalent basis.

Table 8.9: Net Direct Economic Impacts of Aggregate Eastern Canadian Cattle Sector

Particulars	Unit	Value		
		Farm Level	Processing Level	Total
Production of Goods and Services	Mill. $	$1,896	$2,921	$4,767
Gross Domestic Product at Market Prices	Mill. $	$312	$1,248	$1,560
Labor Income	Mill. $	$289	$165	$454
Employment	Person-years	9,445	10,085	19,530

8.3.2 Total Net Economic Impacts of Eastern Canadian Cattle Sector

The direct expenditures of the sector create several rounds of impacts, some through purchase of input from other sectors (industries) while others through household (families of workers and self-employed members of labor force) spending the money received as wages or profits within the region. In total, the sector produced goods and services worth $13 billion (counting all direct, indirect, and induced impacts), which translates into generation of $5.5 billion GDP (including $1.7 billion labor income). About 89,222 person-years of employment was also associated with the sector through its direct and secondary economic impacts (Table 8.10).

8.3.3 Net Economic Multipliers for the Aggregate Eastern Canadian Cattle Sector

As shown in Table 8.11, the sector was responsible for sales of almost $2 for every dollar of output sold directly. These sales created a GDP of 74 cents per dollar of output sold, including 34 cents as labor income. For every million-dollar output sold, the sector created nine person-years of employment.

Ratio-form Type II multipliers indicate that the magnitude of unit direct expenditures of the sector creating total economic impacts. Thus, for the labor income, one dollar of income generated by

the sector would result in another $0.98 generated elsewhere for a total multiplier of 1.98. Similar interpretation can be attached to other multipliers.

Table 8.10: Total Net Economic Impacts of Aggregate Eastern Canadian Cattle Sector

Particulars	Unit	Total
	Type I Impacts	
Production of Goods and Services	Mill. $	$9,535
Gross Domestic Product at Market Prices	Mill. $	$3,588
Labor Income	Mill. $	$1,698
Employment	Person-years	44,647
	Type II Impacts	
Production of Goods and Services	Mill. $	$12,808
Gross Domestic Product at Market Prices	Mill. $	$5,521
Labor Income	Mill. $	$3,040
Employment	Person-years	89,222

If one is interested in estimating the impact of the farm level production sub-sector on the total economy, one can use the multipliers in Table 8.11. Taking the example of employment multiplier (Type II), estimated value is 4.57. Thus, for every job created by the aggregate cattle sector, another 3.6 person-years of employment is generated elsewhere in the economy.

8.4 Summary

Eastern Canadian farm and processing level cattle sector produces a total value of output of $13 billion, including $5.5 billion in the regional GDP (including $3 billion in labor income). Directly or through secondary economic impacts, it creates total employment of 89,222 person-years either as paid workers or owners of unincorporated non-farm businesses.

Table 8.11: Pseudo and Ratio-form Net Economic Multipliers for the Aggregate Eastern Canadian Cattle Sector

Particulars	Unit	Pseudo Net Aggregate Multiplier	
		Type I	Type II
Production of Goods and Services	$	1.983	2.664
Gross Domestic Product at Market Prices	$	0.746	1.149
Labor Income	$	0.353	0.632
Employment	Person-years	9.329	18.560
		Ratio-Form Net Aggregate Multiplier	
Production of Goods and Services	$	1.983	2.664
Gross Domestic Product at Market Prices	$	2.215	3.408
Labor Income	$	3.739	6.693
Employment	Person-Years	2.296	4.568

Chapter 9

ECONOMIC IMPACTS OF ALBERTA CATTLE SECTOR ON ALBERTA ECONOMY

This chapter is a summary of the results of the impact of the Alberta cattle sector on the Alberta economy. It includes farm level impacts as well as the processing sub-sector. Economic impacts are presented in terms of direct and secondary impacts of these activities. As noted in Chapter 2, in Western Canada and for that in Canada as a whole, Alberta has the highest number of beef cattle operations, as well as processing activities.

9.1 Alberta Beef Cattle Sector

Alberta is the golden province of beef production in Canada, boasting the largest beef processing capacity. This allows for fed cattle from other provinces to be slaughtered and processed in Alberta. In the 2018-20 period, Alberta had a value of S&MP production of $5.7 billion, which was 85% of Western Canada, and 60% of the total Canadian value. At the farm level, the cattle sub-sector is equally important, providing $6 billion worth of farm cash income, constituting 44% of the total.

According to Statistics Canada (2020c), Alberta's cattle sector is supported by the vast availability of pastures. The overall land use of the 52.2 million acres of farmland in the province includes 30 percent under natural pasture and another 10 percent under tame or seeded pasture.

Because of the slaughtering capacity of the province, most cows are fed to finish in the province. Alberta exports both live beef cattle, and beef to the United States, Mexico, Hong Kong, Japan, Russia, and other countries. Majority of the exports are destined to the United States.

9.2 Alberta Farm Level Cattle Sub-Sector

9.2.1 Direct Impact of the Farm Level Production

As described in Chapter 2, farm production in Western Canada takes place in three types of production units: Cow-calf operations, Backgrounding operations, and Feeding operations and/ or feedlots. Since sales of goods and services by various types of farms are not reported, imputations were made using value of products and number of beef cows on various types of beef farms in the province. More details on this estimation were provided in Chapter 5. Like other regions reported in previous chapters, economic impacts were measured through four indicators: (1) Level of sales (output of a sector); (2) Labor Income; (3) Gross domestic product in market prices; and (4) Employment.

For the farm sub-sector of cattle feedlots (and raising feeder cattle) is the most important activity, contributing $3.4 billion to the total sales of $6 billion for the entire sub-sector (Table 9.1). Some of these cattle are destined for exports however most are purchased by S&MP firms for processing. The farm level sub-sector generated a $694 million as the GDP (including $492 million as labor income). The total employment in the sub-sector was estimated at 20,683 full-time workers (person-years).

Table 9.1: Direct Impacts of the Alberta Farm Level Cattle Production, 2020

Indicator	Unit	Value			
		Cow-Calf	Back-grounding	Feeder / Feedlots	Total*
Sales of Goods and Services	Million Dollars	$483	$2,196	$3,383	$6,062
GDP at Market Prices	Million Dollars	$168	$154	$322	$694
Labor Income	Million Dollars	$134	$119	$240	$492
Employment	Person-Years	10,780	2,570	7,333	20,683

* Total farm cash receipts for the region were obtained from Statistics Canada (2021a). Total farm cash income for each of the three sub-sectors was imputed.

It should be noted that the provincial cattle sector has been under financial stress over the last decade. Profit margins have been low, in part due to intermittent drought and high Canada-U.S. exchange rate (2011-13). Although the industry is slowly recovering, the labor income and GDP values are lower than under normal production and trade conditions.

9.2.2 Total Economic Impact of Farm Level Cattle Sub-Sector

Indirect impacts are created through the purchase of various inputs that are required to produce livestock commodities. For the Alberta cattle farm level sub-sector, as noted earlier, input requirements create a series of repercussions in the economy. When added together these reflect the total economic impacts of the production activity in question. Although it is realized that various economic sectors in the province would be affected differently, indicators presented in this chapter are more aggregate in nature.

Through direct, indirect, and induced impacts, Alberta's cattle farm level production sub-sector contributed $13.6 billion to the sales of various goods and services. This level of output contributed $4 billion to the provincial GDP. The sub-sector was directly or indirectly responsible for

employment of 55,100 full-time equivalent workers (paid workers and owners of unincorporated non-farm businesses), as shown in Table 9.2.

Table 9.2: Total Economic Impacts of the Alberta Farm Level Cattle Production, 2020

Indicator	Unit	Value			
		Cow-Calf	Back-grounding	Feeder / Feedlots	Total*
		Type I Impacts (Direct and Indirect)			
Sales of Goods and Services	Million Dollars	$824	$4,934	$5,422	$11,180
GDP at Market Prices	Million Dollars	$331	$1,066	$1,183	$2,580
Labor Income	Million Dollars	$230	$690	$794	$1,714
Employment	Person-Years	9,345	13,265	19,090	41,700
		Type II Impacts (Direct, Indirect, and Induced)			
Sales of Goods and Services	Million Dollars	$1,174	$5,905	$6,550	$13,629
GDP at Market Prices	Million Dollars	$544	$1,656	$1,869	$4,069
Labor Income	Million Dollars	$376	$1,095	$1,264	$2,735
Employment	Person-Years	11,264	18,589	25,272	55,125

* As noted above, the total of the three production types should be interpreted with caution. Because of double counting this total is an overestimate.

9.2.3 Economic Multipliers for Farm Level Production

Conversion of the total impact to unit impacts resulted in two types of multipliers for the sub-sector: Impact per unit of production, called pseudo multiplier, and Impact per unit of direct contribution of the sub-sector, called a ratio-form multiplier. These multipliers are shown in Table 9.3 for the pseudo multipliers and in Table 9.4 for the ratio-form multipliers.

Table 9.3: Pseudo Multipliers for the Farm Level Production of Cattle, Alberta, Type I and Type II

Indicator	Unit	Value

		Cow-Calf	Back-grounding	Feeder / Feedlots
		Type I Impacts (Direct and Indirect)		
GDP at Market Prices	Dollars	0.686	0.486	0.489
Labor Income	Dollars	0.476	0.314	0.328
Employment	Person-Years	19.345	6.044	7.889
		Type II Impacts (Direct, Indirect, and Induced)		
GDP at Market Prices	Dollars	1.126	0.755	0.772
Labor Income	Dollars	0.778	0.499	0.523
Employment	Person-Years	23.317	8.470	10.443

Table 9.4: Ratio-form Multipliers for the Farm Level Production of Cattle Alberta, Type I and Type II

Indicator	Unit	Value		
		Cow-Calf	Back-grounding	Feeder / Feedlots
		Type I Impacts (Direct and Indirect)		
Sales of Goods and Services	Dollars	1.707	2.248	2.251
GDP at Market Prices	Dollars	1.934	6.715	5.900
Labor Income	Dollars	1.722	5.800	4.633
Employment	Person-Years	1.243	5.161	2.603
		Type II Impacts (Direct, Indirect, and Induced)		
Sales of Goods and Services	Dollars	2.931	2.691	2.707
GDP at Market Prices	Dollars	3.175	10.431*	9.347
Labor Income	Dollars	2.814	9.205*	7.370
Employment	Person-Years	1.498	7.233*	3.446

* Lower direct income in these sub-sectors is responsible for these large multipliers.

Considering total impact (direct, indirect, and induced) pseudo multiplier, on a per dollar basis of output, this sub-sector is responsible for generating 69 cents of additional GDP in the province. For employment, on a one-thousand-dollar worth of sales, the sub-sector provided 8 to 23 workers, depending on the type of beef farm.

The ratio-form (Type II) output multiplier is between 2.7 to 2.9, for each dollar of production more than twice the value of provincial goods and services are sold. For every job in the sub-sector, 1.5 to 7 jobs[24] are created in the economy.

9.3 Alberta Beef Cattle S&MP Sub-Sector

9.3.1 Direct Impact of S&MP Sub-Sector

The processing of provincially produced beef cattle through the S&MP sub-sector results in another round of economic impact on the provincial economy. It is estimated that the value of processed products sold was $6.3 billion, generating $2.3 billion as GDP, and creating additional employment of 7,926 workers (Table 9.5).

Table 9.5: Direct Economic Impacts of Alberta S&MP Sector

Particulars	Unit	Value
Production of Goods and Services	Mill. $	$6,347
Gross Domestic Product at Market Prices	Mill. $	$2,256
Labor Income	Mill. $	$712
Employment	Person-years	7,926

9.3.2 Total Economic Impacts S&MP Sub-Sector

The processing sector through the purchase of inputs and providing income to workers creates another round of economic impacts on the Alberta economy. These results are shown in Table 9.6. Total (Type II) impacts of the processing sub-sector on the Alberta economy is estimated at $14 billion in terms of goods and services produced, $5 billion as GDP, and employment of 44,200 workers in the province.

Table 9.6: Total Economic Impacts of Alberta S&MP Sector

Particulars	Unit	Type I Impact Level	Type II Impact Level
Production of Goods and Services	Mill. $	$12,340	$14,446
Gross Domestic Product at Market Prices	Mill. $	$3,673	$4,953
Labor Income	Mill. $	$1,504	$2,383
Employment	Person-years	32,633	44,182

[24] Interpretation of these values should be done with caution. These values are higher as a result of lower value of farm level direct contribution.

9.3.3 Economic Multipliers for S&MP Sub-Sector

The Alberta S&MP sub-sector produces a high rate of multiplier activity, in part since it includes part[25] of the farm level sub-sector impacts. Every dollar of output of this sector generates $0.58 as GDP. About five workers are associated directly or indirectly with the production of every million dollars (Table 9.7). In terms of ratio-form multipliers, a GDP multiplier (Type II) of 2.91 suggests that for every dollar of GDP contributed by the processing sub-sector another $1.91 are generated elsewhere (Table 9.8).

Table 9.7: Pseudo Economic Multipliers for the Alberta Cattle S&MP Sector, 2020

Particulars	Unit	Type I Impact Level	Type II Impact Level
Gross Domestic Product at Market Prices	$	0.579	0.780
Labor Income	$	0.237	0.375
Employment	Person-Years	5.142	6.962

Table 9.8: Ratio-form Economic Impacts Multipliers for Alberta Cattle S&MP Sector, 2020

Particulars	Unit	Type I Impact Level	Type II Impact Level
Production of Goods and Services	$	1.944	2.276
Gross Domestic Product at Market Prices	$	2.155	2.906
Labor Income	$	6.846	10.844
Employment	Person- Years	4.117	5.574

9.4 Net Impacts of Alberta Cattle Sector

As noted previously, since part of the input requirements of the processing sub-sector is met through the farm level production sub-sector, and furthermore since there is some double counting among the farm level production activities, impacts were re-estimated by excluding these transactions. The result was a net aggregate cattle sector, which was further subjected to economic impact analysis.

9.4.1 Direct Impacts of the Aggregate Alberta Cattle Sector

[25] This part includes those cattle and calves that are not destined for export.

The aggregate Alberta cattle sector produced a total of $8.8 billion goods and services, which results in a contribution to the provincial GDP of $2.3 billion, Some 28,609 person-years of employment is associated with these activities (Table 9.9).

Table 9.9: Net Direct Economic Impacts of Alberta Cattle Sector

Particulars	Unit	Total
Production of Goods and Services	Mill. $	$8,843
Gross Domestic Product at Market Prices	Mill. $	$2,312
Labor Income	Mill. $	$712
Employment	Person-years	28,609

9.4.2 Total Economic Impacts of Net Aggregate Alberta Cattle Sector

Through direct expenditures via links with other economic sectors, the aggregate Alberta cattle sector generates a total value of production of $16.8 billion (Type I). This resulted in a provincial level GDP of almost $5.3 billion, including $2.6 billion in labor income. Through direct, indirect, and induced effects, the sector is responsible for generating 60,600 jobs on a full-time equivalent basis (Table 9.10).

9.4.3 Economic Multipliers for Net Aggregate Alberta Cattle Sector

Interpretation of multipliers for the aggregate Alberta cattle sector are like those provided for other regions. Results are shown in Table 9.11. In terms of total activity, the effect on the provincial economy is high. Every dollar of output from the sector generates 85 cents to the provincial GDP (Type II pseudo multiplier). This is also associated with employment of nine person-years in the province. Using the ratio-form multipliers, one can interpret that every dollar of GDP contributed by the sector results in a total provincial GDP of $3.26. Similarly, every job in the sector yields another 1.8 jobs elsewhere in the economy, resulting in an employment multiplier of 2.8 person-years.

Table 9.10: Total Net Economic Impacts of Alberta Cattle Sector

Particulars	Unit	Total Impacts
		Type I
Production of Goods and Services	Mill. $	$16,797
Gross Domestic Product at Market Prices	Mill. $	$5,304
Labor Income	Mill. $	$2,554
Employment	Person-Years	60,600

		Type II
Production of Goods and Services	Mill. $	$20,467
Gross Domestic Product at Market Prices	Mill. $	$7,534
Labor Income	Mill. $	$4,085
Employment	Person-Years	80,724

Table 9.11: Pseudo and Ratio-form Net Economic Multipliers for the Alberta Cattle Sector

Particulars	Unit	Pseudo Net Aggregate Multiplier	
		Type I	Type II
Production of Goods and Services	Mill. $	1.900	2.135
Gross Domestic Product at Market Prices	Mill. $	0.600	0.852
Labor Income	Mill. $	0.289	0.462
Employment	Person-Years	6.853	9.129
		Ratio-Form Net Aggregate Multiplier	
Production of Goods and Services	Mill. $	1.900	2.315
Gross Domestic Product at Market Prices	Mill. $	2.294	3.258
Labor Income	Mill. $	3.587	5.737
Employment	Person-Years	2.118	2.822

* These values are higher on account of lower direct impact of the farm level production. of cattle sub-sector.

9.5 Summary

In summary, the Alberta cattle sector is a major part of the Alberta economy. It is responsible for the production of $16to $20 billion worth of goods and services directly but in total, it adds $$5 to $8 billion to the provincial gross domestic product. This is associated with directly or indirectly; some it is responsible for employment of 81 thousand person-years of employment.

Chapter 10

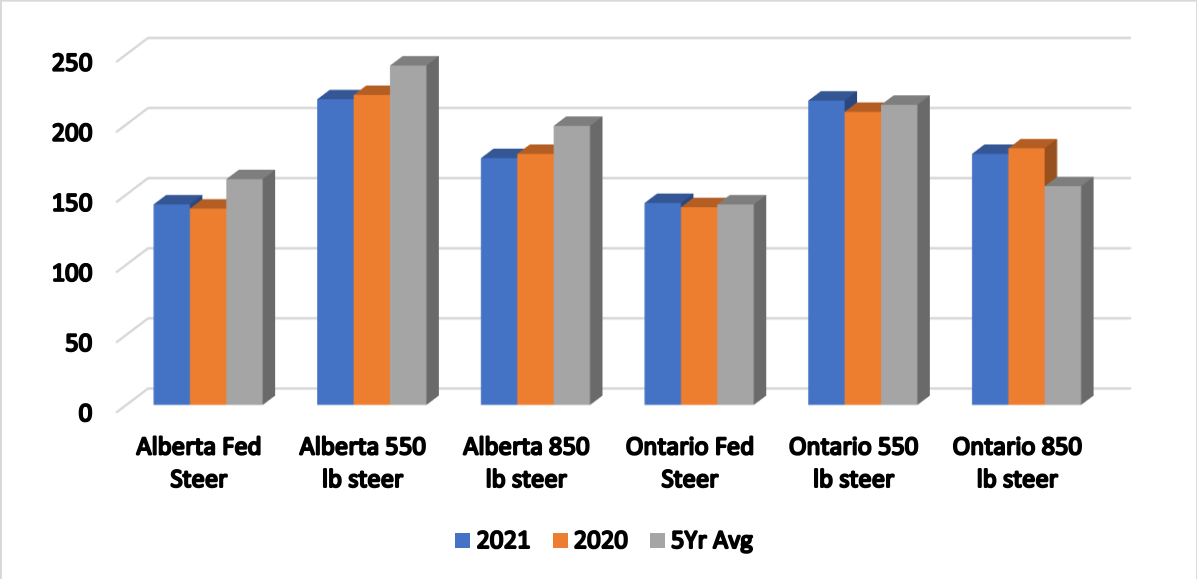
BEEF CATTLE SECTOR IN 2030

A forecast of Canadian beef production activities to 2030 involves analyzing the trends in the consumption of beef and veal in the domestic and export markets. Canadian domestic beef demand to 2030 will be determined by per capita consumption, population growth and growth in household income. Canada, USA, and Japan currently account for most of Canadian beef and veal sales which is likely to continue for this decade. Trade deals are a means to access the growing middle class in developing countries which could be accessed by Canada.

Drought especially in Western Canada where most of the beef cow calf operations are located is the biggest negative factor affecting herd expansion. Carrying capacity of native and tame pastures is affected by intermittent and prolonged drought. It is likely with climate change that the frequency and duration of climate extremes will increase **(**Sauchyn et al. (2020). This is likely the case for much of the Great Plains in North America where most of the beef cattle herd is located and where feedlot and slaughter expansion has occurred. Higher climate variability could result in a more volatile North American beef market.

10.1 Near Term Canadian Cattle Sector

Farm Credit Canada (FCC, 2020; Roberts, 2021) outlines the near-term prospects for the beef sector given the impact of COVID in 2020. Due to COVID restrictions there was a shift in domestic demand away from Food Services as restaurants were closed or offered reduced service (FCC, 2020). Due to the second/third wave of COVID and the availability of vaccines for a full recovery of the demand for beef is not expected until 2022. Also, there was reduced processing of live animals as slaughtering plants were shutdown due to COVID which created a backlog of cattle, which has been mostly cleared up (FCC, 2021a). This affected the export market as sales fell 11.8% in April YoY (FCC, 2020). Livestock prices are projected to be below the 5-year average through 2021 in Western Canada (FCC, 2020) (Figure 10.1). However, in Eastern Canada fed steer and 550 lb steer prices are likely to be around the 5-year average and for 850 lb steers above the 5-year average price. Recovery of pastures that have been affected by drought in Western Canada would be positive for increasing the beef cow herd in 2021 (USDA, 2020a). However, current soil moisture is Dry to Very Dry in most of the Prairie provinces (Henry, 2021). Pasture recovery in 2021 is dependant on spring rains and timely growing season precipitation to reverse the trend in beef cow-calf sector population decline in Western Canada.

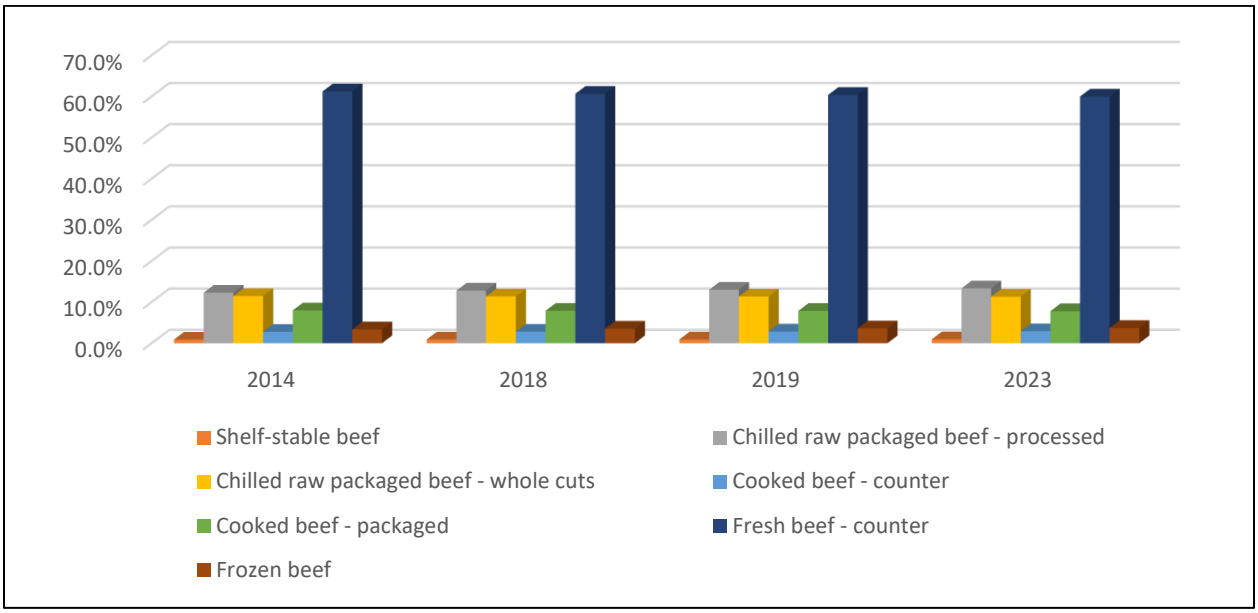


Sources: Statistics Canada (2021i), AAFC (2021e), USDA (2020a) and FCC (2020).

Figure 10.1: Alberta & Ontario Steer Prices Forecast 2021, 2020 Average & 5 Yr. Average

Restrictions due to COVID have changed food consumption patterns of consumers as restaurants were closed or restricted capacity resulting in more home meal preparation and take out. A pre-COVID forecast of the Canadian retail beef meat sector for 2019-2023 is presented in Figure 10.2. Fresh beef was the dominant meat product for 2016 to 2018 and is very likely to continue beyond 2023. These are over the counter sales primarily at grocery stores. In 2020 during the pandemic with more at home meal preparation fresh beef sales shifted from restaurant to home purchase. It is likely that a return to "normal" after the pandemic for the restaurant sector will be in 2022 so that the projection for 2023 is still valid. The unanswered question is "will consumers revert to pre-COVID behaviour or will there be a new normal?". The effect on household income during the pandemic was not even as some sectors of the economy had greater job loss. It may take until 2023 to get the employment rate back to pre-COVID levels and any return to pre-COVID household income levels and consumption.

Live cattle exports are expected to increase in 2021 after a sharp decline in 2020 fed cattle for slaughter and feeder cattle. Exports of cattle will increase over 2020 but not expected to return to 2019 levels (USDA, 2020a). Imports of feeder cattle are likely to decline in 2021 after a decline in 2020 from 2019.



Source: Data from GlobalData Intelligence Center: Consumer (2019).

Figure 10.2: Canadian Retail Meat Sector Actual 2014&2018, Forecast 2019 & 2023

Recovery of slaughter plant capacity to pre-COVID levels in 2021 is dependant on minimal disruptions due to COVID (USDA, 2020a). Also, the increased operating costs due to COVID related safety protocols will continue through 2021 and it remains to be seen what protocols will be maintained post-COVID. This has cost implications for new entrants into the slaughter or processing sector and for those companies expanding operations regardless of whether it is under Federal or Provincial regulation.

The cattle slaughter sector is dominated by large plants which offers economies of scale and scope giving cost and efficiency advantages when competing in the North American market (Hobbs, 2021). However, this comes at a cost when events like the pandemic occur where plant closures reduced returns to cattle producers as there is no excess capacity. The cost of feeding animals longer than expected was one of the results.

Medium Term Outlook (MTO) by Agriculture and Agri-Food Canada (2018) for the 2017-2027 period forecast a 6% increase in beef production on a 1.4% increase in total cattle marketing. The beef herd is expected to grow by 5% to 2027 as beef heifer retention for breeding increases. Feed prices are forecast to increase by 9% by 2027 which would put pressure on the fed cattle sector. Growth in beef consumption in Canadian export markets should result in an 1.7% annual increase in beef exports. For the foreseeable future most of Canadian beef will continue to be sold in the North American market regardless of expanding export markets. Agriculture Canada's Medium-Term Outlook for Canadian beef consumption forecast it to fall to 21.4 kg per capita by 2027. Growth in Canadian population is the main source for increased domestic sales. Developed countries generally

have lower population growth (Japan is negative), declining or stagnant per capita consumption of meat, no real income growth for a declining middle class, health concerns and an aging population. The Canadian beef sector is dependant on Developed countries (Canada, USA, Japan) for most of its sales which has limited upside growth (FCC, 2021b).

The Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) should result in improved access to the Japanese beef market along with other Asian beef markets. The Comprehensive Economic and Trade Agreement (CETA) with the European Union to date has not resulted in any increase in exports to fill the annual duty-free tariff-rate-quotas. Obstacles to ship certified Canadian beef into the European market need to be overcome before this market is fully accessed (CBC 2019).

10.2 Projection of the Canadian Cattle Sector to 2030

Alternative proteins that are/may take market share away from livestock meat protein is a threat to Canadian beef production. These alternatives are meat substitutes, emerging alternatives and lab grown meat products. The alternative proteins can be used to make products or used as an ingredient either directly consumed or fed to livestock (Boumeester, 2018).

Santo et al. (2020) claim that it is uncertain how consumers will include plant based and cell-based meat alternatives into their diet because of a lack of products and limited consumer studies have been done. Will these meat alternatives be a substitute for farm raised meat or added to a household's basket of food products consumed? Plant based meat substitutes are highly processed so the market segment that they would likely compete against is the processed meats like sausages, hot dogs, salami, and burgers. Also, Santo et el. (2020) outline areas where research or information on plant based or cell-based meat substitutes is lacking. These include life cycle analysis in terms of environment, greenhouse gas (GHG) emissions, and health claims. This is because information on production processes is evolving or proprietary.

Are plant-based meats competing with less processed plant-based products that vegetarians already consume? There are two groups of consumers of plant-based products 1) those who adopt vegan or vegetarian diets 2) those who are concerned about sustainability with respect to food consumption and are looking to change their diets the so-called Flexitarians (Gebhardt and Hadwiger, 2020). Vegan/vegetarians tend to be young while Flexitarians tend to be older people concerned with "healthy" diet choices. In their survey of European consumers Gebbhardt and Hadwiger (2020) cite cost and range of products as limiting market growth in these two market segments. Their survey of experts in plant-based products expect that improvements in the range of products offered as well as sensory/taste

attributes of the plant-based products will occur. Concerns about the highly processed nature of plant-based foods and the number of additives used were expressed by the survey participants and experts.

Lemken et al. (2018) in their survey of consumers from Germany and New Zealand on the consumer preferences to legume alternatives to meat consumption found three basic segments "Only Meat" "Meat First" and "Pioneers". The basis for these segments is to reflect the consumers' willingness to change their diet.

The assessment of the market segments in these studies is relevant when estimating beef and veal demand in developed countries where most of Canadian beef and veal are marketed (Canada, USA, Japan). Developed country protein market is characterized by an older generation 55+ that primarily consume animal protein and who have healthy eating concerns, and a younger generation who eat less animal protein per capita than the older generation.

Tubb and Seba (2019) forecast that by 2030 the cost of manufactured proteins will be 5 times cheaper than animal proteins and that by 2035 these manufactured proteins will 10x cheaper. They claim that this would result in a 50% reduction in the beef cattle herd by 2030 in the USA. Their model uses the S-curve adoption theory to determine the rate of change in the production technologies used to manufacture proteins. However, the study is based on limited data of the cost of current processes, and lack of assessment of known and unknown hurdles which would restrict adoption. Assumptions are also made about how society and individuals would react in the face of these new products. Consumer's acceptance of these manufactured protein products is unknown. The first bio-printed steak from cow cells was made in 2020 (Martin, 2021). This is a major step in the manufacturing process of manufactured proteins.

USDA (2020b) forecast for domestic beef cattle prices to 2030 predicts a rise in prices as the economy recovers over 2021-22 however as the cow herd rebuilds and projected sluggish demand for beef, prices will fall by 2030. This forecast is based on "normal" weather since like Canada most of the beef cattle herd in the USA is on the Great Plains, which with climate change maybe subjected to more drought.

10.3 Labour as a constraining Factor

Labour could be a limiting factor in the growth of the beef cattle sector, although the industry is making attempt to alleviate of this problem in the future. The number of workers that are expected to retire by 2029 combined with any growth in the beef sector could result

in a 14,000 jobs deficit as the domestic labour supply will not be able to fill this gap (AGRI-LMI, 2020). Also, there could be shortages of labour in other sectors that provide services to the beef cattle sector such as veterinarians, trucking, and feed. This could affect expansion plans for all sectors of the beef industry. Technology developments and adoption thereof over the next 10 years could increase the productivity of labour used in the beef cattle sector. AGRI-LMI (2020) forecast that labour productivity in the beef cattle sector will increase from 0.9% to 1.2% average annual percentage change. This in part could reduce the need for labour as the current stock of labour becomes more productive.

10.4 Projection of Canadian Beef Cattle Numbers to 2030

The near-term growth of the beef cattle sector will largely depend upon pasture conditions in Western Canada. Growth to 2030 will depend on building resilience to extreme weather events, adopting new technologies, next generation transition and attracting labour to this sector. Canada's National Beef Strategy (2019) Phase 1 2020-2024 and Phase II to 2030 set targets/benchmarks for the Canadian beef industry involving increased efficiency, carbon sequestration, and improved grazing systems. Also, marketing initiatives such as the Canadian Beef Advantage (CBA) brand strategy that focus "on full carcass optimization – or finding the highest value customers for every cut and product from every animal produced" will deliver higher value through the supply chain. Canadian Roundtable on Sustainable Beef (CRSB, 2020) have made progress in implementing environmental, social, and economic programs to address the challenges facing the beef industry. Widespread adoption of new technologies and processes will hopefully flow from these initiatives.

Long term competitiveness in the protein sector is a concern as animal protein faces competition from alternative sources of protein. How much market share will these alternative sources of protein get and over what time frame is the question? All protein products will have to be competitive on several fronts, price being one, along with environment, net GHG and health.

Agriculture Canada's Medium-Term Outlook forecast Canadian beef cattle herd to be 5% larger than in 2020 by 2027. USDA (2020b) forecast that beef prices will rise to 2025-2027 then fall to 2030 as the US beef herd rebuilds. These forecasts are based on "normal" weather or at least no prolonged droughts over the 2020s. Major disruptions to the animal protein sector from alternative proteins are not expected in this decade.

The Canadian beef herd is likely to peak in 2026-27 then decline to 2030. Fed cattle slaughter will peak around 2027-28 with total slaughter not falling till after increased cull cows and bulls are marketed over the 2028 to 2030 period.

With increasing free trade in beef for Canada, internal shocks (+/-) to the cattle sector will be moderated by exports/imports subject to any TRQs that remain. The World Price of beef at port minus transportation and handling to interior points will be the market signal that drives production decisions for cow calf, backgrounders, and finishers. This moderation of shocks to the Canadian beef cattle market should level the rise and fall in the Canadian beef cycle. There has been some evidence for this with increased market weights for fed cattle as a response to higher market demand for beef when the number of cattle available for slaughter is limited.

The estimates for the 2030 beef cattle population in Canada is presented in Table 10.1. The forecast is generated by taking the current population of beef cattle by class and increasing it by 5% to obtain 2027 estimates. The assumptions are that the current rates for calving percentage, cows per bull and heifer replacement do not change. These estimates are then reduced by 2% to arrive at 2030 cattle population.

Table 10.1: Forecast of Beef Cattle in 2030

Type of Animal	West	East	Ontario	Sask.	Alberta	Canada
Bulls	171.1	21.9	12.7	57.1	82.6	193.04
Cows	2,987.9	387.5	222.8	1,082.5	1,351.7	3,375.43
Heifer Rep	464.5	56.5	38.7	161.5	206.4	520.98
Calves Born	2,943.1	356.8	201.0	1,106.5	1,333.3	3,299.90
Slaughter*	2,562.2	768.5	625.3	183.0	2,256.8	3,330.65

*Includes fed steers and heifers, cull cows and bulls and imports.
Source**:** Author's estimates

Statistics Canada (2021f) projects Canada's population using several scenarios where birth rates, life expectancy and immigration are variables in estimating population. The domestic demand for beef and veal in Canada is estimated for three scenarios of population growth for Canada by using the per capita estimate for beef and veal demand in Agriculture Canada's Medium-Term Outlook (Table 10.2). Currently, Canada's population was estimated at 38 million on July 1st, 2020 so the range of growth to 2030 is between 2 and 5.5 million. Beef and veal consumption in Canada was estimated at 1 million tonnes for 2020, so depending on population estimates and per capita consumption there would be a decline in domestic consumption from 140 to 70 tonnes.

Table 10.2: Canadian Population Estimates and Beef Demand in 2030

Scenario*	Population	Beef Demand**
	millions	'000 tonnes
2030 Low	40.3	862.4
2030 Med	41.8	894.5
2030 High	43.5	930.9

*Three Scenarios for population growth to 2030 (1) low growth low immigration; (2) medium growth business as usual; (3) high growth high immigration.
**Beef and veal demand forecast to be 21.4 kg per capita from Agriculture Canada's Medium-Term Outlook
Source: Statistics Canada (2021f) for population estimate.

Canadian domestic beef and veal production estimates for 2030 uses 2019 estimates of the average carcass weight for Canada (Table 10.3). Since 2020 is an outlier because of plant shutdowns and resulting heavier weight of animals that were slaughtered, 2019 averages are used. Also, the trend in carcass weights across Canada is for heavier weights for Steers, heifers, and cull cows (Figure 10.3).

Table 10.3: Dressed Average Carcass weights for 2019 Federally Inspected Plants

Type of Animal	Canada	West	Ontario
	Kilograms per carcass		
Steers	412.4	406.5	432.8
Heifers	379.3	378.9	384.3
Cows	329.4	336.7	300.4
Bulls	434.2	434.2	379.8
Average	389.7	386.6	402.9

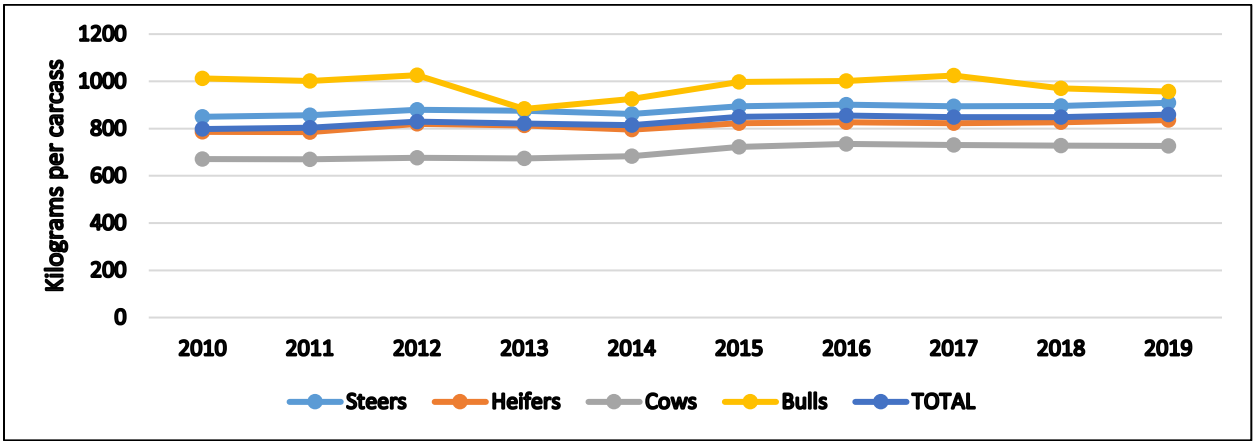
Source**:** Canadian Beef Grading Agency (2021).

The estimates for the supply and disposition of beef and veal in 2030 are presented in Table 10.4. Imports of beef and veal are expected to increase by 2%, domestic consumption will fall from 2020 levels while exports to the USA and rest of the world will increase over 2020.

10.4.1 Current Trends Based Scenario

Agriculture Canada's "Medium Term Outlook" along with the USDA's "USDA Agricultural Projections to 2030" (USDA, 200b) were used to estimate the value of production in Canada to 2030. The expansion of the cattle herd in the USA is expected to put pressure on Canadian domestic beef prices resulting in a decline in wholesale prices of 9% by 2030. The Canadian beef cattle herd is expected to expand by 5% to 2027 then decline by 2% to 2030 in response to lower beef prices. Table 10.5 presents the estimate for 2030 from applying the increase in herd size and decline in prices to Statistics Canada data for 2020. The estimated level of 2030 herd were converted into value form and are

presented in Table 10.5. A comparison of these forecast values with the 2018-2020 values is shown in Table 10.6. The highest reduction is noted for the cow-calf operations, followed by backgrounding farms. In fact, feedlots, and S&MP subsectors show a relatively less decline by 2030.



Source: Canadian Beef Grading Agency (2021).

Figure 10.3: Trend in Canadian Average Carcass weights by Type

Table 10.4: Estimate of 2030 Beef & Veal Supply and Disposition

Particulars	Source	Value in Kilograms
Supply	Domestic Production	1,298,109,128
	Imports	195,119,278
	Total supply	1,493,228,406
Demand	Domestic Consumption	894,520,000
	Exports to USA	431,070,052
	Exports to World	167,638,354

Source: Authors' estimates.

Table 10.5: Estimated Value of Production for the Canadian Cattle Sector by Region, and Sub-Sector in 2030

2030	Value of Production in Thousand Dollars			
Scenario	Canada	Eastern Canada	Western Canada	Alberta
Cow-calf Operations	887,474	142,321	745,409	406,412
Backgrounding Operations	3,088,478	334,304	2,756,216	1,922,394
Feeding Operations including feedlots	4,547,489	1,231,557	3,313,636	2,402,642
Total Farm Cash Income	8,523,441	1,708,181	6,815,260	4,731,447
Slaughtering and Meat processing	9,703,104	2,684,150	7,018,954	6,091,555
Total Direct Value of Production	18,226,545	4,392,332	13,834,213	10,823,002

Source: Author's estimates using AAFC (2018) applied to Statistics Canada data for 2020.

Table 10.6: Comparison of 2030 Forecast Values to 2018-2020 Values by Region and Sub-Sectors

Particulars	Canada	Eastern Canada	Western Canada	Alberta
Cow-calf Operations	84.57%	85.94%	84.21%	84.13%
Backgrounding Operations	88.05%	90.12%	87.64%	87.59%
Feeding Operations including feedlots	96.71%	94.02%	97.96%	99.29%
Total Farm Cash Income	92.05%	92.52%	91.94%	92.82%
Slaughtering and Meat processing	94.14%	91.90%	95.03%	95.98%
Total Direct Value of Production	93.15%	92.14%	93.48%	94.57%

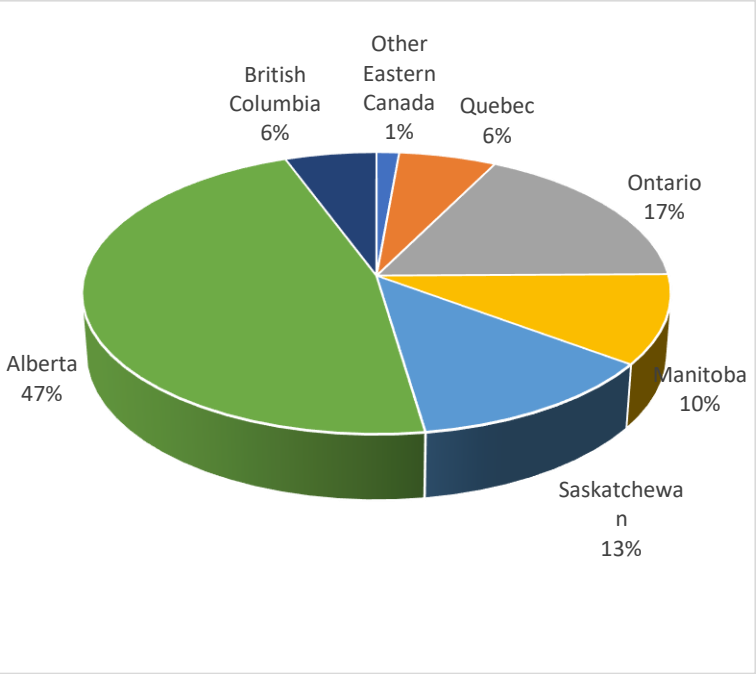
10.4.2 Growth Based Scenario

Although current trends may suggest a relatively lack of growth in the Canadian cattle sector, an alternative scenario was developed using the assumption that the sector is going to face some growth in the future. A moderate rate of 10% growth in various regions was assumed. However, a recent study by Acera (2021) has predicted a growth of 36% in feeder animals on irrigated farms. Assuming a growth rate of 10% for the dryland farms, composite growth rate was estimated using irrigated area as a proportion of the total cultivated area (Table 10.7). It was assumed that the growth rates shown in Table 10.6 would apply to all three sub-sectors – cow-calf, backgrounding, and feeders.

Table 10.7: Expected Growth Rate for the Canadian Cattle Sector by Regions

Region	Irrigated	Dryland	Composite (Weighted Average)
Alberta	36%	10%	11.14%
Western Canada Excluding Alberta	30%	10%	10.20%
Eastern Canada	5%	10%	9.95%

To estimate the total value of economic activity in 2030, consideration of live cattle exports was considered. It was assumed that an increase in the live cattle exports would dampen the S&MP activity in the region. Data for live exports of cattle from various regions showed that most of these exports are from western Canada, notably from Alberta (Figure (Figure 10.4) In 2020, Canada exported a total of 673,200 head of cattle. The value of these animals was estimated using data from Feeder Associations of Alberta Ltd., n.d.). The above set of estimation resulted in value of direct impact of the cattle sector in 2030 and are shown in Table 10.8.



Source: Based on Statistics Canada (2021j)

Figure 10.4: Distribution of Live Cattle Exports to U.S.A. from Canada by Regions, 2020

Table 10.8: Canadian Cattle Sector Level of Output in 2030 (Growth Based Scenario)

Sector	Value of Production in Thousand Dollars			
	Canada	Eastern Canada	Western Canada	Alberta
Cow-calf Operations	$1,164,707	$182,077	$982,630	$536,918
Backgrounding Operations	$3,898,999	$407,843	$3,491,156	$2,439,362
Feeding Operations including feedlots	$5,195,441	$1,440,173	$3,755,267	$2,689,525
Total Farm Cash Income	$10,259,147	$2,030,094	$8,229,053	$5,665,804
Slaughtering and Meat processing	$10,594,352	$3,008,772	$7,585,580	$6,672,812
Aggregate Cattle Sector	$20,853,500	$5,038,866	$15,814,634	$12,338,616

10.5 Economic Impacts of the Canadian Cattle Sector in 2030

10.5.1 Current Trends Based Scenario

The forecast value of production for various sub-sectors was subjected to a similar type of economic impact analysis as done for the 2018-2020 values. The model used was the same – based on 2016 transactions tables. Since the structure of the economy was assumed not to change by 2030, the multipliers (both pseudo and ratio-form) would be the same as presented in earlier chapters. Results for the current trend-based scenario are presented in Appendix F.

10.5.2 Growth Based Scenario

Direct impacts of the cattle sector under the Growth Based Scenario were also subjected to a similar type of analysis. Results are presented in terms of each farm level sub-sector as well as for the S&MP sector followed by the aggregate cattle sector (Avoiding any double counting). All these results were prepared for the four regions – Canada, Eastern Canada, Western Canada, and Alberta.

For Canada as a whole, results are shown in Tables 10.8 to 10.10, respectively, for the three farm subsectors, the S&MP, and for the aggregate cattle sector, respectively. Under the assumed level of growth, farm level production, through direct and indirect impacts (also called Type I impacts), would degenerate $6 billion worth of GDP and almost 120,000 jobs (Table 10.9). Please note that these changes are not new additions to the economy since they are based on growth of the cattle sector in 2018-2020. When all impacts (direct, indirect, and induced) are accounted for, the farm level cattle sector would contribute $10 billion to the provincial GDP and generate 218,500 person-years of employment.

Table 10.9: Economic Impacts of the Farm Level Cattle Sub-Sectors on the Canadian Economy under the Growth Based Scenario to 2030

Indicators	Unit	Cow-Calf	Back-grounding	Feeder / Feedlots	Total*
		Type I Impacts (Direct and Indirect)			
Sales of Goods and Services	Million $	$1,811	$8,829	$12,480	$23,120
GDP at Market Prices	Million $	$732	$2,194	$3,301	$6,194

Labor Income	Million $	$502	$1,390	$2,206	$4,111
Employment	Person-Years	29,448	33,760	56,758	119,966
		Type II Impacts (Direct, Indirect, and Induced)			
Sales of Goods and Services	Million $	$2,689	$11,111	$16,282	$30,082
GDP at Market Prices	Million $	$1,255	$3,558	$5,570	$10,384
Labor Income	Million $	$867	$2,340	$3,781	$6,986
Employment	Person-Years	41,915	66,316	110,321	218,552

Corresponding with the growth in farm level production of cattle, the S&MP sub-sector would also increase its own economic activities. Its contribution to the GDP would be between $7 - $10 bullion (Type I and Type II, respectively. This would be associated with 90 to 150 thousand person-years of employment in the Alberta economy (Table 10.10). When both farm level production and S&MP sub-sectors are combined (with no double counting in transactions among various sectors), the cattle sector in Canada would contribute to the Canadian economy between $14 to $21 billion in terms of provincial gross domestic product. These changes would translate into 178,000 to 340,000 person-years of employment (Table 10.11) in Canada as well.

Table 10.10: Economic Impacts of the S&MP Sector on the Canadian Economy under the Growth Based Scenario to 2030

Particulars	Unit	Type I Impact Level	Type II Impact Level
Production of Goods and Services	Mill. $	$21,980	$27,336
Gross Domestic Product at Market Prices	Mill. $	$7,194	$10,388
Labor Income	Mill. $	$3,178	$5,399
Employment	Person-years	89,962	165,541

Table 10.11: **Economic Impacts of the Aggregate Cattle Sector on the Canadian Economy, under the Growth Based Scenario to 2030**

Particulars	Unit	Type I Impact Level	Type II Impact Level
Production of Goods and Services	Mill. $	$39,138	$50,583
Gross Domestic Product at Market Prices	Mill. $	$14,523	$21,351
Labor Income	Mill. $	$6,715	$11,465
Employment	Person-years	177,987	340,081

In Eastern Canada, the cattle sector is not a significant part of the regional economy as is the case in Western Canada. Nonetheless, its impacts were estimated for the three farm level sub-sectors (Table 10.12), S&MP sub-sector (Table 10.13) and then an aggregate cattle sector (Table 10.14). The three farm level production sub-sectors would only contribute between $1.2 and $2.3 billion (Type I and Type II, respectively) to the GDP of Eastern Canadian provinces (Table 10.12). As noted earlier, much of this production takes place in in the province of Quebec and Ontario.

Table 10.12: Economic Impacts of the Farm Level Cattle Sub-Sectors on the Eastern Canadian Economy under the Growth Based Scenario to 2030

Indicators	Unit	Cow-Calf	Back-grounding	Feeders / Feedlots	Total
		Type I Impacts (Direct and Indirect)			
Sales of Goods and Services	Mill. $	$309	$984	$3,086	$4,379
GDP at Market Prices	Mill. $	$110	$234	$926	$1,237
Labor Income	Mill. $	$70	$150	$663	$896
Employment	Person-years	3,396	5,014	14,517	22,927
		Type II Impacts (Direct, Indirect, and Induced)			

Sales of Goods and Services	Mill. $	$447	$1,266	$4,385	$6,098
GDP at Market Prices	Mill. $	$191	$400	$1,694	$2,287
Labor Income	Mill. $	$128	$266	$1,195	$1,588
Employment	Person-years	5,268	8,834	32,135	46,237

Total employment in Eastern Canada as created by the cattle sector would also be between 23,000 person-years of employment if one includes only the direct changes plus the indirect changes, which increases to 46,000 person-years if direct, indirect, and induced changes are included here (Table 10.12).

The S&MP sub-sector is also not a relatively large sub-sector in the context of Canada as a whole. However, its contribution under the growth-based scenario, would be between $2-3 billion to the region's GDP (Table 10.13). Associated with this growth, would be 27,000 to 50,000 person-years of employment associated with the S&MP sub-sector in the region. When the farm level and S&MP sub-sector economic activities are combined, the total impact of the cattle sector on the Eastern Canadian economy is estimated between $3.3 to $5.1 billion in terms of GDP and between 41,000 to 82,000 person-years of employment (Table 10.14)

Table 10.13: Economic Impacts of the S&MP Sector on the Eastern Canadian Economy under the Growth Based Scenario to 2030

Particulars	Unit	Type I Impact Level	Type II Impact Level
Production of Goods and Services	Mill. $	$6,103	$7,775
Gross Domestic Product at Market Prices	Mill. $	$1,996	$2,984
Labor Income	Mill. $	$888	$1,573
Employment	Person-Years	27,124	49,791

Western Canada is the hub to produce cattle sector and related activities. Its cattle sector production activities are higher than those in Eastern Canada and are expected to grow even more under the growth-based scenario, Results are shown in Tables 10.15 to 10.17.

Results for the farm-level sub-sectors suggest that GDP could be between $5 and $8 billion in Western Canada (Table 10.15). Compared to the results for Eastern Canada this level is relatively high in a factor of almost 3 to 5 times. Similarly, employment level would be 97,000 to 172,000 person-year equivalent because of the activities of cow-calf, backgrounding and feeders / feedlot operations.

Table 10.14: **Economic Impacts of the Aggregate Cattle Sector on the Eastern Canadian Economy, under the Growth Based Scenario to 2030**

Particulars	Unit	Total Type I	Total Type II
Production of Goods and Services	Mill. $	$8,785	$11,801
Gross Domestic Product at Market Prices	Mill. $	$3,306	$5,087
Labor Income	Mill. $	$1,564	$2,801
Employment	Person-years	41,136	82,205

Increase in the cow-calf production and feeders/feedlots may result in higher level of live cattle and calves exports to U.S.A. This may have a slight dampening effect on the backgrounding and feeder/feedlot as well as S&MP sub-sector in the region. Even after making adjustment for the live cattle exports, the S&MP sub-sector in Western Canada would contribute some $5 to $7 billion to the GDP of the region (Table 10.16). Associated with this growth would be similar growth in employment, which would increase to between 62,000 to 116,000 person-years equivalents.

The aggregate cattle sector in Western Canada would improve Western Canada GDP between $11 billion (Type I) to $16 billion (Type II). Contribution to regional employment in 2030 may lie between 137,000 to 258,000 person-years (Table 10.17). Similar changes, but at a lower level, would be experienced in the Alberta economy (Tables 10.18, 10.19, and 10.20). The aggregate cattle sector would add $5 to $8 billion in the provincial GDP and 62,000 to 82,000 person-years of employment.

Table 10.15: Economic Impacts of the Farm Level Cattle Sub-Sectors on the Western Canadian Economy under the Growth Based Scenario to 2030

Indicators	Unit	Cow-Calf	Back-grounding	Feeders / Feedlots	Total

		Type I Impacts (Direct and Indirect)			
Sales of Goods and Services	Mill. $	$1,502	$7,845	$9,394	$18,741
GDP at Market Prices	Mill. $	$622	$1,959	$2,376	$4,957
Labor Income	Mill. $	$432	$1,240	$1,543	$3,215
Employment	Person-years	26,052	28,746	42,241	97,039
		Type II Impacts (Direct, Indirect, and Induced)			
Sales of Goods and Services	Mill. $	$2,241	$9,846	$11,897	$23,984
GDP at Market Prices	Mill. $	$1,063	$3,158	$3,875	$8,097
Labor Income	Mill. $	$739	$2,074	$2,585	$5,398
Employment	Person-years	36,647	57,482	78,186	172,315

Table 10.16: Economic Impacts of the S&MP Sector on the Western Canadian Economy under the Growth Based Scenario to 2030

Particulars	**Unit**	**Type I Impact Level**	**Type II Impact Level**

Production of Goods and Services	Mill. $	$15,876	$19,561
Gross Domestic Product at Market Prices	Mill. $	$5,198	$7,404
Labor Income	Mill. $	$2,290	$3,826
Employment	Person-Years	62,838	115,750

Table 10.17: **Economic Impacts of the Aggregate Cattle Sector on the Western Canadian Economy, under the Growth Based Scenario to 2030**

Particulars	**Unit**	**Total Type I**	**Total Type II**
Production of Goods and Services	Mill. $	$30,353	$38,782
Gross Domestic Product at Market Prices	Mill. $	$11,217	$16,264
Labor Income	Mill. $	$5,151	$8,664
Employment	Person-years	136,851	257,876

Table 10.18: Economic Impacts of the Farm Level Cattle Sub-Sectors on the Alberta Economy under the Growth Based Scenario to 2030

Indicators	Unit	Cow-Calf	Back-grounding	Feeders / Feedlots	Total
		Type I Impacts (Direct and Indirect)			
Sales of Goods and Services	Mill. $	$770	$4,804	$5,983	$11,557
GDP at Market Prices	Mill. $	$309	$1,038	$1,306	$2,653
Labor Income	Mill. $	$215	$671	$876	$1,762
Employment	Person-years	8,738	12,914	21,066	42,718
		Type II Impacts (Direct, Indirect, and Induced)			
Sales of Goods and Services	Mill. $	$1,098	$5,748	$7,228	$14,074
GDP at Market Prices	Mill. $	$509	$1,612	$2,063	$4,183
Labor Income	Mill. $	$351	$1,066	$1,395	$2,812
Employment	Person-years	10,532	18,096	27,888	56,517

Table 10.19: Economic Impacts of the S&MP Sector on the Alberta Economy under the Growth Based Scenario to 2030

Particulars	Unit	Type I Impact Level	Type II Impact Level
Production of Goods and Services	Mill. $	$12,453	$14,578
Gross Domestic Product at Market Prices	Mill. $	$3,706	$4,998
Labor Income	Mill. $	$1,518	$2,542
Employment	Person-Years	32,932	44,587

Table 10.20: **Economic Impacts of the Aggregate Cattle Sector on the Alberta Economy, under the Growth Based Scenario to 2030**

Particulars	Unit	Total Type I	Total Type II
Production of Goods and Services	Mill. $	$17,126	$20,869
Gross Domestic Product at Market Prices	Mill. $	$5,408	$7,682
Labor Income	Mill. $	$2,604	$4,165
Employment	Person-years	61,788	82,307

Chapter 11

SUMMARY AND CONCLUSIONS

11.1 Study Methodology

National and regional governments, as well as various commodity groups, are concerned about the allocation of resources among various economic sectors and across regions. New investors and planning experts seek information on the effect their investment or planning measures could have on the local and regional economy. In fact, the problem of how to plan and quantify for regional economic development and growth is frequently faced by local and regional planners. In many jurisdictions, knowledge of local/regional level economic activities that would arise from certain public/private decisions help shape regional economic development policies. Sufficient information must be developed so that alternative regional development strategies can be compared and those meeting the objective(s) can be selected.

Every economic activity that takes place in a region leads to some monetary expenditures (called direct expenditures). Such expenditures create some repercussions in terms of economic changes felt elsewhere in the economy, some of which are within the same region, while others are felt in other parts of the national (or even international) economy. On a national scale, these repercussions have been identified in Keynesian economics as the multiplier effect. Every economic activity is different in terms of its multiplier effect. Knowledge of these is, therefore, considered important for regional economic development planning and policy making.

Although national multiplier activity related to changes in the income level of individuals can be accomplished by using the original Keynesian multiplier, at the regional level the analysis needs some major modifications. Regional and sectoral multipliers are typically created through an input-output model. The basic difference between national and regional multiplier activity is the existence of additional leakages through interregional trade. To capture the true level of regional development from a development alternative, one needs to know not only the direct outlays associated with the alternative but also its secondary impacts on the regional economy. This is required since comparison of initial expenditure on an alternative may lead to a somewhat misguided allocation of resources.

This study was designed to estimate the total economic impacts of cattle production (those associated with the sector directly and including all the regional level repercussions). Since many industries in Canada depend, for their own economic existence, on this sector, it was considered appropriate to undertake analysis of economic repercussions by identifying

various types of production units and its linkages with the non-agriculture sectors. This led to the creation of a cattle sector which included two sub-sectors, one each for the farm level production sub-sector, and slaughtering and meat processing (S&MP) sub-sector. Because of interdependencies that exist between these two sub-sectors, an aggregate sector was also created.

An input-output model is a useful method of estimating economic effects of any economic activity. The major merits of this methodology include the following: one, various types of industries can be identified separately in terms of their secondary impacts; and two, models can be developed for a level of spatial scale. In this study, this approach was used to estimate the total economic impacts of the Agriculture and Food Cluster.

To estimate the total economic impact of the cattle sector, one national, two regional and one provincial input-output model were developed using the 2016 transactions data provided by Statistics Canada. The initial transactions table provided by Statistics Canada contained a larger number of sectors and commodities. The study model was created from this transactions table with 58 sectors and 67 intermediate commodities, and seven primary commodities.

Economic impacts were estimated individually for Eastern Canada, Western Canada (including Alberta) and Alberta. Both Type I (direct and indirect impacts) and Type II (direct, indirect, and induced impacts) changes were estimated. Multipliers (pseudo and ratio-form) were created from thee impacts.

11.2 Canadian Cattle Sector

Cattle production is a major industry in Canada. Its economic contribution is mainly seen in terms of initial monetary expenditures incurred by the industry or sales of their product. Since the repercussions of this activity are not always that obvious, the current practice of ignoring the multiplier effect of this sector may lead to serious underestimation of its importance to the national, regional, or provincial economy. To understand the total economic impacts of an industry, one needs to look ‘under the hood’ to see how the regional economy functions and develops.

The cattle sector in Canada is dominated by activities in the province of Alberta. Over half of the country’s activities related to this sector are within the province the Alberta (Figure 11.1). This combined with the other three western Canadian provinces (Manitoba, Saskatchewan, and British Columbia), makes up 76% of total activities related to this sector. The other feature of the Canadian cattle sector is that regionally it is not homogenous. In Eastern Canada, for every dollar’s worth of farm level activities 1.58 times

the activities in the processing sector are produced. This perhaps may reflect the additional value added by the sector. But in Alberta this value is only 1.24, perhaps affected by relatively higher fresh beef exports to other countries (Figure 11.2). Lower level of processing activity is also noted in the other three Western Canadian provinces. This may also suggest an increase in the ratio for Alberta.

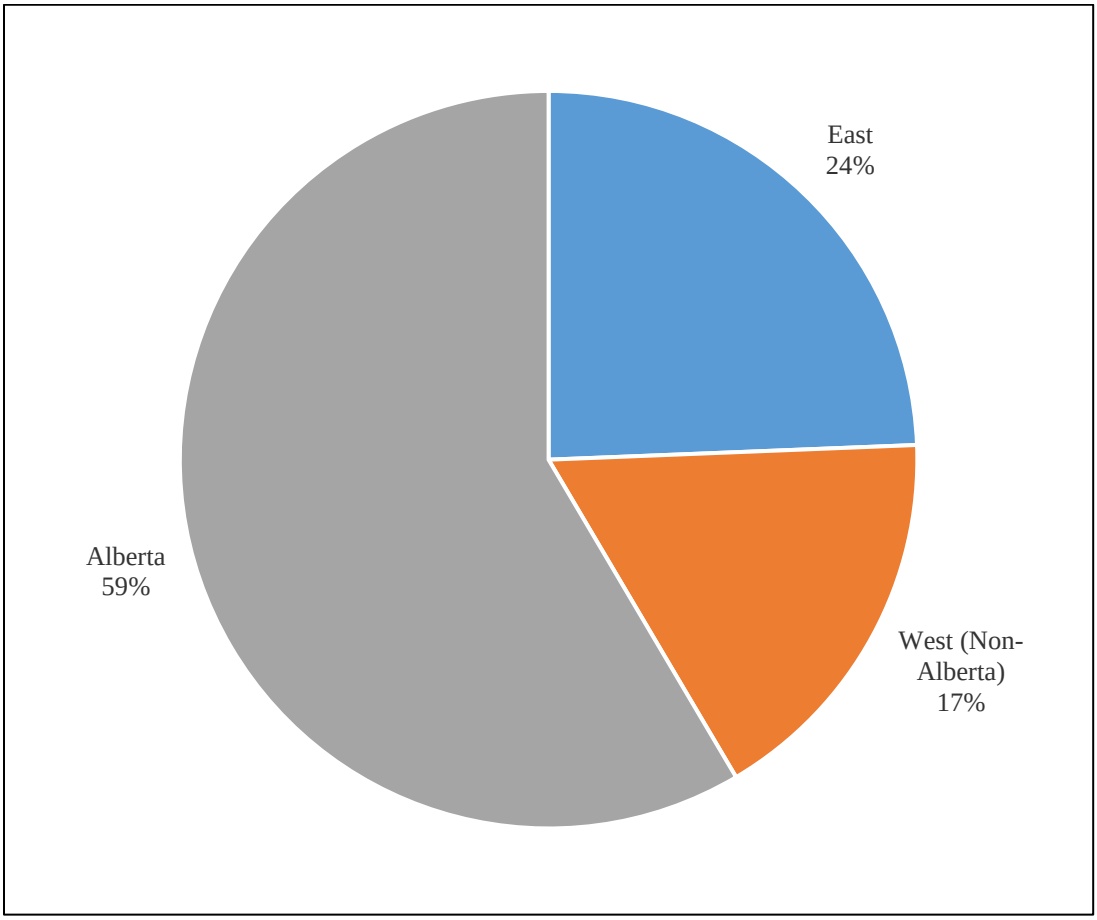


Figure 11.1: Regional Distribution of Total (Farm and Processing) Direct Value of Canadian Cattle Sector

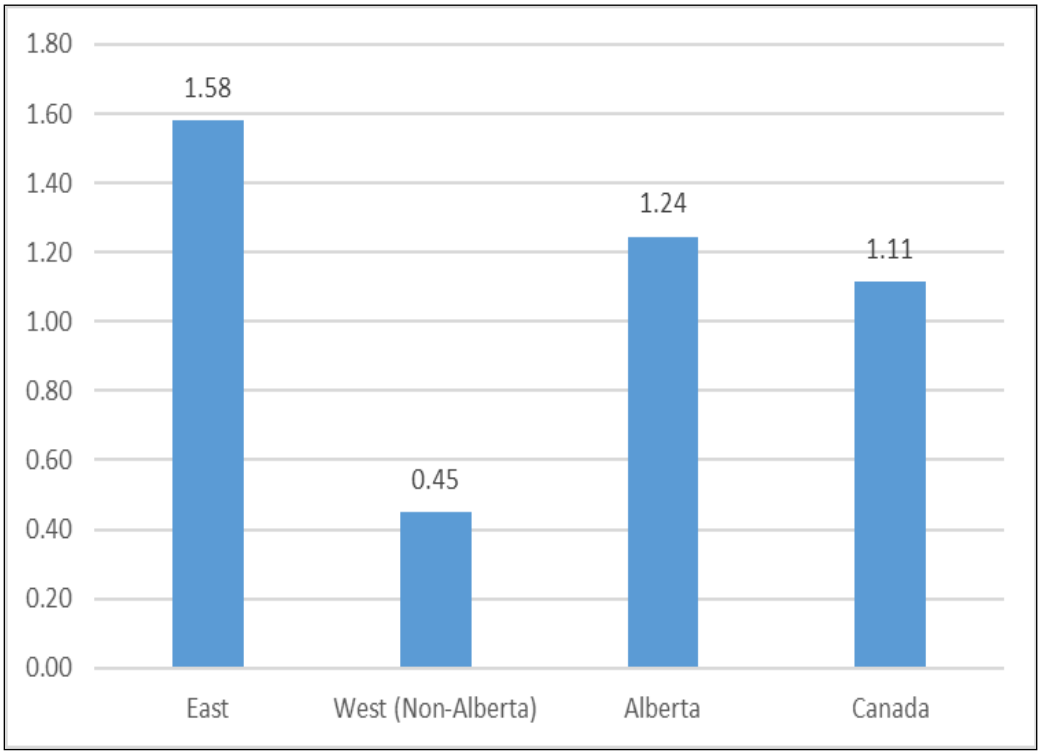


Figure 11.2: Ratio of Farm to Processing Level Activities by Region, Canada

11.3 Results

11.3.1 Current Cattle Sector

For each of the four regions of this study (Canada, Western Canada, Eastern Canada, and Alberta), five scenarios were developed: Three scenarios for the farm level production sub-sector, one each for the three types of farms – cow-calf operations, Backgrounding operations, and feeding/feedlot operations; One scenario for the processing sub-sector; one scenario for the aggregate sector.

A summary of impacts in terms of gross domestic product and employment are summarized in Table 11.1. Because of double counting issues, only the results of the aggregate (combined farm and S&MP without any double counting of purchases) scenario are presented. Impacts are shown in terms of gross domestic product and employment – two indicators typically used for regional economic planning. Total contribution to the Canadian GDP suggests that the sector contributes $52 billion annually either directly or through its secondary impacts. Similarly, in terms of employment, the sector is associated with 347,352 person-years of employment. In terms of the total regional level impacts, the sector is more predominant in Western Canada with a total employment of 258,130 person-

years than in Eastern Canada. Within the Western Canada, the province of Alberta has the lion share of the total impact as it has almost half of the total employment in the region.

Table 11.1: Summary of Economic Impacts of Net Aggregate Cattle Sector on National/Regional Economy, by Regions

Region	GDP in Million $		Employment in Person-Years	
	Direct	Total (Type II)	Direct	Total (Type II)
Canada	$19,567	$51,628	71,453	347,352
Western Canada	$14,798	$38,820	51,923	258,130
Eastern Canada	$4,767	$12,808	19,530	89,222
Alberta	10,341	20,467	26,158	80,724

Multiplier activity associated with the sector is shown in Table 11.2. Most GDP Type II multipliers are in the range of two to five times the direct impacts. Higher multiplier level for Canada is a result of lack of leakages which happens to a regional economy. Employment multipliers were also in the same range. Higher multipliers are a result of a mature economy with fewer imports from other parts of Canada or the world, and more domestic support for various sectors.

Table 11.2: Summary of Ratio-form Multipliers of Net Aggregate Cattle Sector on National/Regional Economy, by Regions

Region	GDP		Employment	
	Type I	Type II	Type I	Type II
Canada	2.280	3.355	2.545	4.861
Western Canada	2.302	3.338	2.638	4.971
Eastern Canada	2.215	3.408	2.296	4.568
Alberta	2.294	3.258	2.118	2.822

The major conclusion of this study is that cattle production in Canada is a significant economic activity that leads to other changes in the economic fabric of the nation. Each of these regions enjoys not only direct impact, but also those generated through secondary mechanisms – indirect and induced.

Based on the results of this study, if relative contributions of a sector are estimated using direct impacts only, it will lead to serious underestimation. The obvious inference that can be drawn from the above data is that the Canadian cattle sector makes a much higher

contribution to the national and regional (as well as to provincial) economy than what is obvious from traditional measures related to direct contribution.

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11.3.2 Future Growth in the Cattle Sector in Canada

In this study two future projections were developed – the first one was based on the past trends and indicated a somewhat lack of growth in the sector. For a realistic cattle sector in 2030, a second growth scenario was developed using a 10% increase in the sector under dryland conditions, and a 36% growth under irrigated conditions. The results for the second (growth based) scenario are presented in Table 11.3. For Canada as a whole, the cattle sector could bring a GDP between $14 to $21 billion by 2030, associated with an employment contribution between 178 to 340 thousand person-years of employment in the Canadian economy.

Table 11.3. Contribution of the Aggregate Cattle Sector in Canada by Regions, under Growth Based Scenario, 2030

Region	Type of Impact	GDP (Million $)	Employment (Person-Years)
Alberta	Type I	5,408	61,788
	Type II	7,682	82,307
Western Canada (Including Alberta)	Type I	11,217	136,851
	Type II	16,264	257,876
Eastern Canada	Type I	3,306	41,136
	Type II	5,087	82,205
Canada	Type I	14,523	177,987
	Type II	21,351	340,081

11.4 Areas for Future Research

Regional economies are in a constant flux of development. Economic conditions change from time to time. This suggests the need for future studies in the area. Some of these are described below:

1. Statistics Canada revises the regional transactions tables periodically. It is advised that a newer set of data be used to test the robustness of the conclusions drawn from the analysis undertaken for this study.

2. In the present study, data for cost of production budget was based on current economic conditions, where prices have been lower. This resulted in small GDP and income impacts and very high ratio-form and pseudo multipliers.

3. Since data are collected by local and provincial agencies, methodology for cost of production budgets is not comparable. This makes the results somewhat non-comparable. In future, a common set of cost accounting needs to be used to produce results that would bring forth more accurate economic impacts for the sector. The same comment applies to the processing sector.

4. Development of details of direct contributions made by the disaggregated farm level production units was based on some simplifying assumptions. These included the restriction of a farm producing a single product. An alternative manner to model these farms could be to allow multiple products. This may provide a more realistic picture of agriculture's total contributions. Further stratification of farms by their level of specialization might also provide better impact for the cattle sector in Canada.

5. Induced economic impacts are highly sensitive to the assumption of average or marginal propensity to consume. In this study, the coefficients used were assumed. Future studies can improve on this assumption.

Hopefully, an extension of the present study on lines suggested above would lead to a better appreciation of the economic importance of the cattle sector.

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Appendix A

Additional Features and Regional Distribution of Beef Cattle Sector in Canada

A.1 Structure of Farm Level Beef Cattle Production Sub-Sector

The total number of beef cattle (cattle raised for meat) in Canada is estimated at 9.3 million animals on 62,605 beef farms across Canada (Statistics Canada, 2021a). Most of the Canadian beef farms are cow-calf operations. The number of beef farms has been decreasing, but the average farm size has been increasing over the years, the average size in 2010 was 152 while in 2020 the average size was 164 (Statistics Canada, 2021h). In the 2016 census, there were 193,492 farms in Canada, but only 53,837 farms reported beef cattle (Table A.1).

Table A.1: Number of Beef Cows and Farms Reporting, Canada, Census

	# of Farms Beef Cows			Number of Beef Cows			% of Total
Region	**2016**	**2011**	**2006**	**2016**	**2011**	**2006**	**2016**
Canada	53,837	61,425	83,000	3,732,555	3,849,368	5,081,596	100%
NFLD	35	42	70	254	382	761	0.01%
PEI	320	386	550	9,391	10,207	16,107	0.25%
NS	767	944	1,132	16,269	18,329	25,925	0.44%
NB	557	712	909	13,610	16,312	22,248	0.36%
QC	3,805	4,575	5,699	145,057	187,332	226,236	3.89%
OT	9,681	11,567	15,017	236,253	282,062	377,354	6.33%
MB	5,739	6,668	9,216	428,882	484,727	655,587	11.49%
SK	12,428	14,074	19,738	1,093,496	1,124,149	1,444,640	29.30%
AB	17,022	18,618	25,665	1,576,354	1,530,391	2,035,841	42.23%
BC	3,483	3,839	5,004	212,989	195,477	276,897	5.71%

Source: Statistics Canada (2021g).

The trend in the 2006 and 2016 census data shows that there is a decrease in the number of farms with less than 1,000,000 in gross farm receipts, but an increase on those selling over this amount (Table A.2). In fact, there has been a steady increase in the number of farms making at least one million dollars over the 2006-2016 period.

A.2 Regional Structure of Farm Level Beef Cattle Production

Beef production is different across Canada, with more beef farms of larger average size in Western Canada than in the Eastern Canada. As already noted, the two most beef cow populated provinces are Alberta and Saskatchewan, which have more than 71% of total Canadian beef cows (as shown in Figure 2.2). In Eastern Canada, cattle numbers include dairy cattle (although a separate production activity), but such is not the case with

processing of these cattle. Although there is some dairy production in Western Canada, the scale of production is lower than in Eastern Canada.

Table A.2: Number of farms by gross farm receipts (2010 dollars) Canada, 2006 2011 and 2016

Gross Farm Receipts	Number of Farms			Percent change, 2011-2016
	2006	2011	2016	
Less than $10,000	36,603	36,656	34,156	-14.66
$10,000-$24,999	34,840	30,899	27,554	-9.24
$25,000-$49,999	29,911	25,703	23,519	-11.77
$50,000-$99,999	30,873	25,743	24,010	-14.85
$100,000-$249,999	40,753	32,095	30,721	-23.36
$250,000-$499,999	28,381	23,445	21,884	-15.02
$500,000-$999,999	17,275	17,562	16,907	-26.81
$1.0 mil -$1.99 mil	6,853	8,868	9,237	24.03
$2,000,000 and over	3,884	4,759	5,504	6.39
Total	229,373	205,730	193,492	-16.81

Source: Statistics Canada (2020b).

A.2.1 Western Canada

Canadian beef cattle and calf production is concentrated in the three Prairie Provinces, with Alberta having most cattle. About 82.2% of all beef cows in Canada are in this region. Similarly, for other categories of beef animals the proportion of these cattle in Western Canada is between 70 – 80% of the Canadian total (Table A.3).

Table A.3: Share of Western Canada of Total Canadian Livestock Numbers, 2020

Type of Livestock	% of Total Canadian Number
Calves under one year	78.3
Steers	70.8
Heifer for Slaughter or Feeding	81.7
Total Beef Cows	82.2

Source: Statistics Canada (2021a).

The availability of pasture and meat processing plants makes it easier to raise and process cattle in Alberta. When comparing cost of production studies from Alberta to Quebec/Ontario for cow-calf production the costs and net returns appear to be similar for the same size of operation (Lamothe, 2018; AgriProfit$, 2019). The competitive advantage

for Western Canada is that the average size of a beef cow herd is considerably larger, Quebec (113), Ontario (96), Alberta (235) (Statistics Canada, 2021h). Keeping the costs of production low is very important to Canadian beef producers since they are price takers for their final product. Feed is a major part of the cost of production. Other costs like transportation, labor, veterinary and medicine, utilities, and marketing are the variable cost[26]. Total farm cash receipts[27] for cattle amounted to $9.1 billion in 2019 (Statistics Canada, 2020a), which constitutes approximately 13% of the total Canadian farm cash income in 2020.

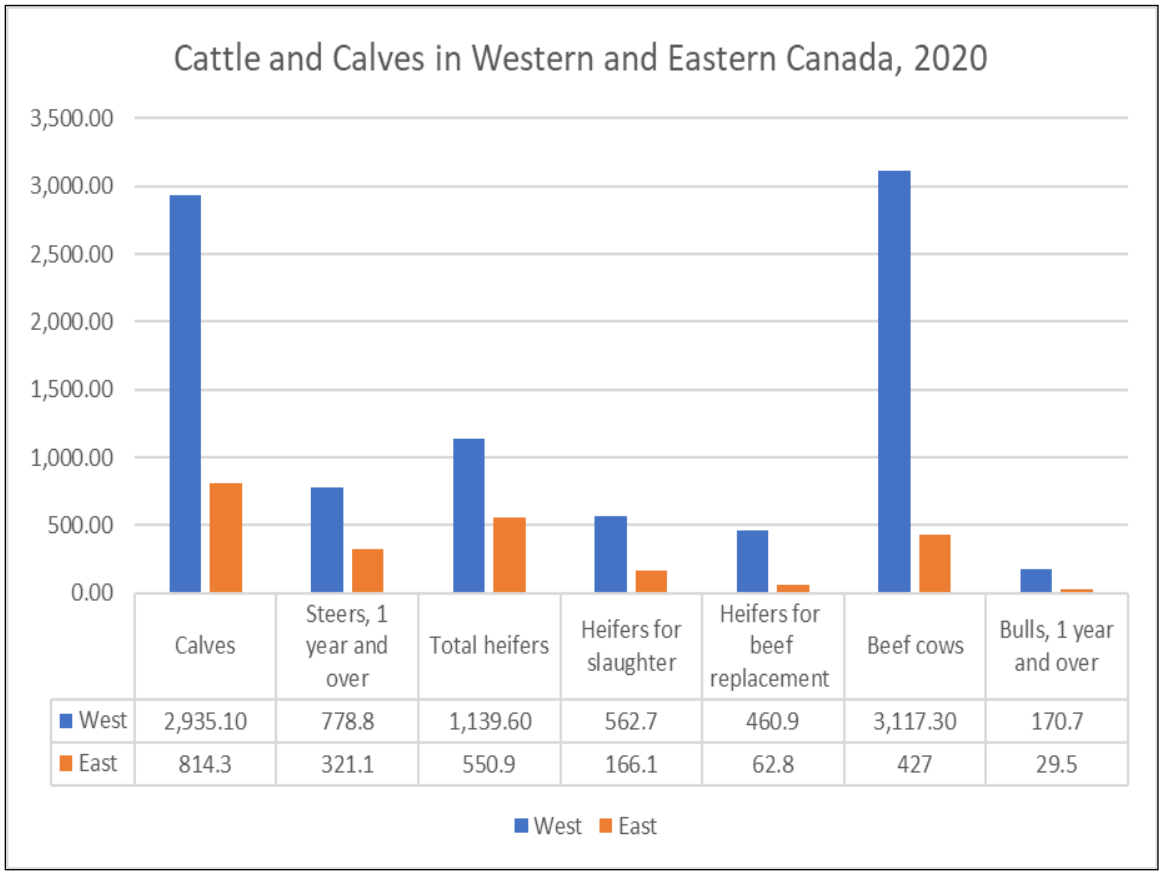
Beef cow herd is larger in Western Canada relative to the eastern provinces, as shown in Figure A.1. The average number of cattle and calves per farm in Western Canada stood at 217 head on January 1st, 2020. The herd size in this region is estimated to be 8.8 million head (as shown in Table A.4). The cow-calf operations rely mostly on native pasture, and tame hay. The total land in pasture is 45.7 million acres across the western region, compared to only 2.8 million acres in Eastern Canada. In terms of land use, in Western Canada 32% of total farmland is in pasture (native or tame), against only 7% in Eastern Canada (Figure A.2). These differences in pasture area might be one of the factors that may explain higher beef cattle numbers in the western region than the east.

A.2.2 Eastern Canada

Eastern Canada is made up of the Atlantic Provinces (Newfoundland and Labrador, Prince Edward Island, Nova Scotia, and New Brunswick), Quebec, and Ontario. Most of the cattle and calf production in Eastern Canada is in dairy operations, with only 18 percent of the total cattle in beef production. As of 2016, Ontario accounts for 56 percent of the total beef numbers, Quebec for 35 percent, and the Atlantic province for only 9 percent. Cash receipts to the region from cattle and calves are $1.84 billion dollars which is only 6 percent of the total farm cash receipts. In Eastern Canada, the number of farms reporting beef cows has decreased tremendously over the years, as of 2016 there are 15,165 farms, down from a total of 23,377 farms in 2006 – a reduction of 35% (Table A.5).

[26] Feed costs on a feedlot average about 22.6% of total cost for various type of animals, ranging from 15.5% for the shortkeep steer and 28.1% for a heifer calf. Data provided by Canfax Research Services. For details see Appendix C.

[27] One should note a possible bias in these estimates. Statistics Canada reports income from the sale of cattle and calves but does not distinguish whether they originate from beef operations or dairy operations. Further investigation of this issue would improve future economic impact analysis. In this study, an approximation was made using beef vs. dairy cow numbers. In Western Canada, the beef cows were 93.7% of total number of cows, as against 41.1% for Eastern Canada. These numbers were used to estimate income from the sale of calves from beef herds.



	Calves	Steers, 1 year and over	Total heifers	Heifers for slaughter	Heifers for beef replacement	Beef cows	Bulls, 1 year and over
West	2,935.10	778.8	1,139.60	562.7	460.9	3,117.30	170.7
East	814.3	321.1	550.9	166.1	62.8	427	29.5

Source: Statistics Canada (2021a; 2021h).

Figure A.1: Cattle and Calves on Cattle Operations, Western and Eastern Canada, 2020

A.3 Slaughtering and Meat Processing Sub-Sector

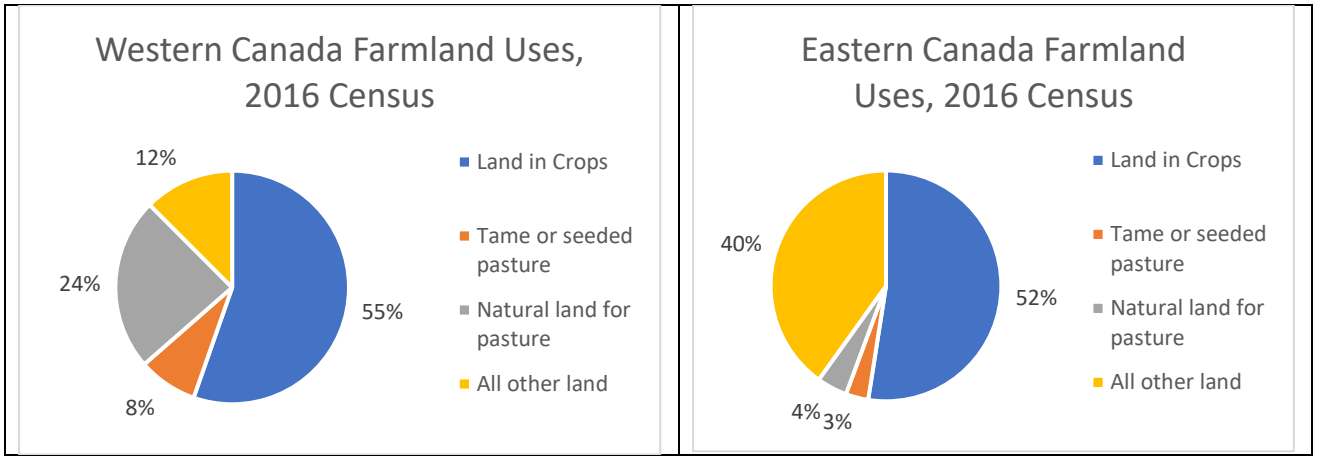
Over the last two decades (2000 to 2020), the Canadian beef production sector has been more aligned with domestic use due to BSE. Then the USA's country of origin labelling, added extra cost to track and process Canadian live cattle imports. Also, the appreciation of the Canadian dollar (2011 to 2013) did not help Canadian live cattle exports.

This has helped the meat processing sector as more Canadian cattle were available for domestic meat production. Average disposition of farm cattle and production of meat is shown in Table A.6.

Table A.4: Number of Beef Cattle by Type of Operation Western Canada, 2011-2020

Year	Total	Cow-Calf Operations	Feeder and Stocker Operations	Feeding Operations
On January 1 in Thousand Head				
2011	8,505	6,025	1,376	1,104
2012	8,631	6,050	1,452	1,129
2013	8,734	6,159	1,481	1,094
2014	8,603	6,049	1,438	1,116
2015	8,234	5,816	1,361	1,058
2016	8,221	5,848	1,324	1,049
2017	8,164	5,869	1,253	1,042
2018	8,141	5,726	1,350	1,065
2019	8,083	5,604	1,437	1,043
2020	7,894	5,447	1,352	1,095
On July 1 in Thousand Head				
2011	9,814	6,351	2,146	1,317
2012	9,812	6,431	2,202	1,178
2013	9,806	6,408	2,177	1,221
2014	9,506	6,193	2,091	1,223
2015	9,171	5,986	2,009	1,177
2016	9,134	6,021	1,933	1,179
2017	9,124	6,042	1,891	1,191
2018	9,036	5,902	1,983	1,152
2019	8,892	5,786	1,891	1,215
2020	8,840	5,731	1,839	1,270

Source: Statistics Canada (2021a).



Source: Statistics Canada (2020c).

1. Total Area West = 142.19 million acres
2. Total Area East = 27.95 million acres

Figure A.2: Farmland Use in Western[1] and Eastern Canada[2] (2016)

Table A.5: Number of Beef Cattle by Type of Operation, Eastern Canada, 2011-2020

Year	Total	Cow-Calf Operations	Feeder and Stocker Operations	Feeding Operations
On January 1 in Thousand Head				
2011	1,703	1,012	327	364
2012	1,679	978	301	400
2013	1,607	938	284	385
2014	1,590	923	277	391
2015	1,572	909	270	394
2016	1,535	896	263	376
2017	1,477	822	289	366
2018	1,484	852	258	374
2019	1,538	839	255	444
2020	1,457	816	240	402
On July 1 in Thousand Head				
2011	1,763	1,009	390	364
12	1,721	968	353	400
2013	1,669	939	344	385
2014	1,640	923	325	391
2015	1,588	884	311	394
2016	1,546	864	306	376
2017	1,549	865	318	366
2018	1,546	867	305	374
2019	1,540	846	251	444
2020	1,531	852	277	402

Source: Statistics Canada (2021a).

Table A-6: Disposition of Farm Level Cattle, & Production of Meat, 2010-2020

	Total Slaughter	Live Export	Live Import	Production	Total Slaughter	Avg Weight	Total Weight	Edible Offal
2010	3,441.40	1,026.30	23.5	4,757.8	3,441.40	360.5	1,240,624.7	39,538
2011	3,101.50	657.30	47.3	4,617.6	3,101.50	356.6	1,105,994.9	35,616
2012	2,827.30	767.80	36.2	4,411.8	2,827.30	362.9	1,026,027.2	32,363
2013	2,797.80	903.20	19	4,411.1	2,797.80	366.0	1,023,994.8	32,034
2014	2,910.90	960.00	7.2	4,495.5	2,910.90	367.1	1,068,591.4	33,250
2015	2,682.00	659.90	14	4,197.7	2,682.00	379.4	1,017,550.8	30,884
2016	2,849.80	686.60	10	4,272.4	2,849.80	390.2	1,111,992.0	32,698
2017	3,052.00	574.20	29.2	4,346.1	3,052.00	382.6	1,167,695.2	34,995
2018	3,230.30	548.30	14.1	4,346.9	3,230.30	381.2	1,231,390.4	37,102
2019	3,381.20	661.90	16.7	4,335.6	3,381.20	387.1	1,308,862.5	38,825
2020	3,416.07	662.50		4,271.3	3,416.07	394.6	1,347,981.7	

Source: Canadian Beef Grading Agency (2021); Statistics Canada (2021n,d).

Appendix B

List of Sectors and Commodities in the Canadian Regional Input-Output Model – CRIO-16

Table B.1: List of Sectors in the Study Input-Output Model – CRIO-16

Sectors
1 Irrigated Other Crop Production
2 Dryland Other Crop Production
3 Irrigated Feed Production
4 Dryland Feed Production
5 Greenhouse, nursery, and floriculture production (except cannabis)
6 Irrigated Cattle Production
7 Dryland Cattle Production
8 Irrigated Other Animal Production
9 Dryland Other Animal Production
10 Forestry and Logging
11 Mining & Quarry
12 Utilities
13 Building Construction
14 Eng. Construction
15 Other Construction
16 Animal Food Manufacturers
17 Grain & Oilseed Milling
18 Sugar Product Manufacturers
19 Fruits & Vegetable Processors
20 Dairy Prod. Manufacturers
21 Meat Prod. Manufacturers
22 Seafood Prod. Manufacturers
23 Other Food Manufacturers
24 Beverage & Tobacco Manufacturers
25 Textile Mills
26 Clothing Manufacturers
27 Paper Manufacturers
28 Printing
29 Petroleum & Coal Manufacturers
30 Chemical Manufacturers
31 Plastic & Rubber Manufacturers
32 Metallic and Mineral Manufacturers
33 Other Non-Food Manufacturers
34 Equipment Manufacturers
35 Vehicle Manufacturers
36 Wholesale Trade
37 Retail Trade
38 Air Transportation
39 Rail Transportation
40 Truck Transportation
41 Passenger Transportation
42 Pipeline Transportation
43 Couriers & Messengers
44 Warehousing & Storage
45 Publishing Industries
46 Motion Picture Industries
47 Broadcasting

48 Finance and Insurance
49 Professional and Personal Services
50 Administrative, Waste Management
51 Educational Services
52 Health Care & Social Assistance
53 Arts, Entertainment & Recreation
54 Accommodation & Food
55 Other Non-Public Administrative Services
56 Other Federal Government Services
57 Other Provincial Government Services
58 Other Municipal & Aboriginal Services

Table B.2: List of Commodities in the Study Input-Output Model – CRIO-16

Commodity
Intermediate Commodities
1 Irrigated Other Crops
2 Dryland Other Crops
3 Irrigated Feed
4 Dryland Feed
5 Irrigated Cattle & Calves
6 Dryland Cattle & Calves
7 Irrigated Other Animals
8 Dryland Other Animals
9 Forestry Products
10 Crude Oil
11 Energy Products
12 Electricity
13 Mining Ores
14 Sewage & Waste Disposal
15 Potash
16 Gravel Products
17 Non-Metallic Minerals
18 Seafood Products
19 Meat Products
20 Dairy Products
21 Animal Feeds
22 Other Food Products
23 Soft Drinks
24 Tobacco Products
25 Textile Products
26 Lumber Products
27 Pulp & Paper Products
28 Petroleum Products
29 Chemical Products
30 Iron Products
31 Agricultural & Garden Machinery & Equipment
32 Other Machinery
33 Computers & Parts
34 Communication Equipment
35 Electronic Products
36 Motor Vehicles
37 Aircrafts
38 Railway Products
39 Construction Materials
40 Published Products
41 Transportation
42 Warehouse & Storage
43 Commissions
44 Repairs
45 Rental & Leasing (excl. real est.)

46 Real Estate Leasing
47 Buildings
48 Eng. Works
49 Intellectual Prop.
50 Mineral Exploration
51 Software
52 Licensing
53 Support & Custom serv.
54 Support Services for Mining
55 Construction & Manufacturing Services.
56 Advertising
57 Communications
58 Financial Services
59 Insurance
60 Professional Services
61 Other Administrative Services
62 Accommodation
63 Personal Care
64 Federal Services
65 Provincial Services
66 Municipal and Aboriginal Services
67 Residual commodities
Primary Inputs
68 Indirect taxes
69 Subsidies
70 Labor Income
71 Other Operating Surplus
72 Imports Interprovincial
73 Imports Foreign
74 Other Leakages

Table B.3: Employment Coefficients for the CRIO-16 Model, by Regions

Sector	Employment Coefficients Workers per 1000 $ Output for			
	Alberta	**Canada**	**West**	**East**
1 Irrigated Other Crop Production	0.001923	0.003639	0.003639	0.003639
2 Dryland Other Crop Production	0.001634	0.004282	0.004282	0.004282
3 Irrigated Feed Production	0.001923	0.004282	0.004282	0.004282
4 Dryland Feed Production	0.001634	0.004282	0.004282	0.004282
5 Greenhouse, nursery, and floriculture production (except cannabis)	0.011312	0.007627	0.007627	0.007627
6 Irrigated Cattle Production	0.006004	0.007532	0.007532	0.007532
7 Dryland Cattle Production	0.005103	0.008861	0.008861	0.008861
8 Irrigated Other Animal Production	0.003607	0.003111	0.003111	0.003111
9 Dryland Other Animal Production	0.003066	0.003660	0.003660	0.003660
10 Forestry and Logging	0.002785	0.002586	0.002586	0.002586
11 Mining & Quarry	0.001898	0.001308	0.001308	0.001308
12 Utilities	0.003178	0.002143	0.002143	0.002143
13 Building Construction	0.002730	0.002099	0.002099	0.002099
14 Engineering Construction	0.001143	0.003367	0.003367	0.003367
15 Other Construction	0.003948	0.004995	0.004995	0.004995
16 Animal Food Manufacturers	0.001244	0.001244	0.001244	0.001244
17 Grain & Oilseed Milling	0.000704	0.000704	0.000704	0.000704
18 Sugar Product Manufacturers	0.002328	0.002328	0.002328	0.002328
19 Fruits & Vegetable Processors	0.002520	0.002520	0.002520	0.002520
20 Dairy Prod. Manufacturers	0.001558	0.001558	0.001558	0.001558
21 Meat Prod. Manufacturers	0.001617	0.002011	0.002011	0.002011
22 Seafood Prod. Manufacturers	0.003751	0.003751	0.003751	0.003751
23 Other Food Manufacturers	0.002888	0.002888	0.002888	0.002888
24 Beverage & Tobacco Manufacturers	0.001392	0.008019	0.008019	0.008019
25 Textile Mills	0.002077	0.002077	0.002077	0.002077
26 Clothing Manufacturers	0.006383	0.006383	0.006383	0.006383
27 Paper Manufacturers	0.001304	0.003158	0.003158	0.003158
28 Printing	0.005061	0.005041	0.005041	0.005041
29 Petroleum & Coal Manufacturers	0.000254	0.000340	0.000340	0.000340
30 Chemical Manufacturers	0.000532	0.005633	0.005633	0.005633
31 Plastic & Rubber Manufacturers	0.002833	0.003958	0.003958	0.003958
32 Metallic and Mineral Manufacturers	0.000544	0.000424	0.000424	0.000424
33 Other Non-Food Manufacturers	0.005901	0.001983	0.001983	0.001983
34 Equipment Manufacturers	0.002424	0.002588	0.002588	0.002588
35 Vehicle Manufacturers	0.013764	0.001484	0.001484	0.001484
36 Wholesale Trade	0.004296	0.004747	0.004747	0.004747
37 Retail Trade	0.011491	0.012125	0.012125	0.012125
38 Air Transportation	0.002874	0.003066	0.003066	0.003066

39 Rail Transportation	0.001773	0.002772	0.002772	0.002772
41 Passenger Transportation	0.005494	0.005554	0.005554	0.005554
42 Pipeline Transportation	0.013591	0.004319	0.004319	0.004319
43 Couriers & Messengers	0.001598	0.010141	0.010141	0.010141
44 Warehousing & Storage	0.005038	0.004579	0.004579	0.004579
45 Publishing Industries	0.015622	0.010178	0.010178	0.010178
46 Motion Picture Industries	0.003397	0.000532	0.000532	0.000532
47 Broadcasting	0.010994	0.006869	0.006869	0.006869
48 Finance and Insurance	0.000302	0.014173	0.014173	0.014173
49 Professional and Personal Services	0.002904	0.000089	0.000089	0.000089
50 Administrative, Waste Management	0.001992	0.004029	0.004029	0.004029
51 Educational Services	0.014094	0.009612	0.009612	0.009612
52 Health Care & Social Assistance	0.009799	0.118248	0.118248	0.118248
53 Arts, Entertainment & Recreation	0.010357	0.016778	0.016778	0.016778
54 Accommodation & Food	0.015511	0.072942	0.072942	0.072942
55 Other Non-Public Administrative Services	0.009701	0.003076	0.003076	0.003076
56 Other Federal Government Services	0.041760	0.027359	0.027359	0.027359
57 Other Provincial Government Services	0.004386	0.004719	0.004719	0.004719
58 Other Municipal & Aboriginal Services	0.002103	0.002203	0.002203	0.002203

Appendix C

Share of Feed Cost to total Cost of Production by Type of Beef Cattle

Table C.1: Feedlot COP Western Canada (2016 – October 2020 Average)

Type of Feedlot Animal	Feed Costs % of total
Shortkeep Steer	15.5%
Shortkeep Heifer	19.1%
Yearling Steer	18.8%
Yearling Heifer	22.3%
Steer Calf	27.3%
Heifer Calf	28.1%
Feedlot Average Cost	22.6%

Source: Data provided by Canadian Cattlemen's Association (2021).

Appendix D

Direct Impact of the Canadian Beef Cattle Sector in Canada and Regions

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Table D.1: Regional Distribution of Value of Production by Type of Activity, Canada, 2018-2020

2018	Value of Production in Thousand Dollars			
Scenario	**Canada**	**Eastern Canada**	**Western Canada**	**Alberta**
Cow-calf Operations	1,093,188	207,308	886,112	456,159
Backgrounding Operations	3,677,839	459,684	3,222,807	2,225,473
Feeding Operations + feedlots	4,298,679	1,171,403	3,122,392	2,190,624
Total Farm Cash Income	9,069,707	1,838,396	7,231,311	4,872,256
Slaughtering & Meat processing	9,571,506	2,808,161	6,763,345	5,728,207
Total Direct Value of Production	18,641,213	4,646,557	13,994,656	10,600,463

2019	Value of Production in Thousand Dollars			
Scenario	**Canada**	**Eastern Canada**	**Western Canada**	**Alberta**
Cow-calf Operations	1,107,211	137,504	973,332	559,071
Backgrounding Operations	3,546,210	296,108	3,268,351	2,305,870
Feeding Operations + feedlots	4,952,006	1,442,910	3,487,222	2,503,089
Total Farm Cash Income	9,605,427	1,876,522	7,728,906	5,368,030
Slaughtering & Meat processing	10,164,313	2,860,575	7,303,739	6,290,272
Total Direct Value of Production	19,769,740	4,737,097	15,032,645	11,658,302

2020	Value of Production in Thousand Dollars			
Scenario	**Canada**	**Eastern Canada**	**Western Canada**	**Alberta**
Cow-calf Operations	947,761	151,989	796,045	434,020
Backgrounding Operations	3,298,282	357,013	2,943,448	2,052,984
Feeding Operations + feedlots	4,856,405	1,315,218	3,538,735	2,565,856
Total Farm Cash Income	9,102,448	1,824,220	7,278,228	5,052,859
Slaughtering & Meat processing	11,184,100	3,093,836	8,090,265	7,021,316
Total Direct Value of Production	20,286,548	4,918,056	15,368,493	12,074,175

Appendix E

Estimation of Employment in the Canada Cattle Sector

Employment of Canadian cattle sector for Eastern and Western Canada was a challenge primarily because the only data published is for either all primary industries or for combined crop and animal production. Cattle production is not identified in these estimates. Since estimates of direct employment in various types of cattle farms and cattle slaughtering and meat processing sector activities were needed, alternative method of estimation was developed.

E.1 Farm Level Employment for the Cattle sub-sector

The starting point in this estimation was to determine total employment in Canada for beef farms. This estimate was provided by Statistics Canada[28] at 44,300 workers (on a full-time equivalent basis) in Canada for the year 2017. For 2020, this estimate was revised to 43,430 workers. Using a linear interpolation method, employment for 2018 and 2019 were estimated. Average employment for the study period (2018-2020) was 43,737 workers. Assuming similar worker productivity, these values were apportioned into three types of farms. For each type of farm, number of farms were estimated using revenue per head and total value of production for that type of farm (cow-calf, backgrounders, or feeders or feedlots).

E.2 Slaughtering and Meat processing Sub-Sector Employment

The starting point in this estimation was employment in the slaughtering and meat processing sector by various provinces provided by Statistics Canada (as a Special Tabulation). These data were for the year 2016 and were assumed to apply for the study period. Since the meat processing sector in Eastern Canada is different from Western Canada, an adjustment for the share of cattle to the total value of output of this sub-sector was estimated. In Eastern Canada, using the purchases of various types of animals the proportion of cattle was estimated at 48.3% whereas that for the Western Canada was 88.0%. This assumes that the value added per dollar of input cost is the same for all animals. Using this proportion, the estimated employment levels are shown in Table E.1.

Total employment in the Canadian cattle sector is estimated to be 71,452 workers, of which 27% are in Eastern Canada, with the remaining 73% in Western Canada.

[28] We are thankful to Dr. Ray Bollman and Debra Hauer of Statistics Canada for their assistance.

Table E.1: Estimated Employment Levels (Full-time Equivalent) for the Canadian Cattle Sector, by Region

Region	Type of Farm Level Operations				Slaughtering and Meat Processing	Total Employment
	Cow-calf	Backgrounding	Feeders and / or Feedlots	Total		
East	2,662	1,738	5,045	9,445	10,085	19,530
West	19,753	3,681	10,858	34,291	17,631	51,922
Total	22,415	5,418	15,903	43,736	27,716	71,452
Alberta	10,780	2,570	7,333	20,683	7,926	28,609

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Appendix F

Regional Cattle Sector Impacts in 2030 based on Current Trends Scenario

Direct impacts of the Canadian cattle sector under the Current Trend Based scenario in various regions were presented in Table 10.5. Results for Canada are presented in Tables F.1 to F.3, for Eastern Canada in Table F.4 to F.6, for Western Canada in Table F.7 to F.9, and for the province of Alberta in Table F.10 to F.12.

Table F.1: Economic Impacts of Canadian Farm Cattle Sub-Sector in 2030 (Current Trend Based Scenario)

Indicator	Unit	Value			
		Cow-Calf	Back-grounding	Feeder / Feedlots	Total
		Type I Impacts (Direct and Indirect)			
Sales of Goods and Services	Million $	$1,634	$7,962	$11,269	$20,866
GDP at Market	Million $	$660	$1,978	$2,983	$5,590
Labor Income	Million $	$454	$1,253	$1,993	$3,711
Employment	Person-Years	26,557	30,455	51,254	108,265
		Type II (Direct, Indirect and Induced Impacts)			
Sales of Goods and Services	Million $	$2,425	$10,020	$14,706	$27,151
GDP at Market Prices	Million $	$1,133	$3,209	$5,032	$9,374
Labor Income	Million $	$782	$2,109	$3,416	$6,308
Employment	Person-Years	37,803	59,815	99,658	197,277

Table F.2: Economic Impacts of Alberta S&MP Sub-Sector in 2030 (Current Trend Based Scenario)

Indicators	Unit	Type I Impact Level	Type II Impact Level
Production of Goods and Services	Mill. $	$21,384	$26,594
Gross Domestic Product at Market Prices	Mill. $	$6,999	$10,106
Labor Income	Mill. $	$3,092	$5,253
Employment	Person-years	87,514	161,037

Table F.3: Economic Impacts of Aggregated Canadian Cattle Sector in 2030 (Current Trend Based Scenario)

Particulars	Unit	Type I Impact Level	Type II Impact Level
Production of Goods and Services	Mill. $	$37,188	$48,091
Gross Domestic Product at Market Prices	Mill. $	$13,802	$20,306
Labor Income	Mill. $	$6,384	$10,908
Employment	Person-years	169,195	323,514

Table F.4: Economic Impacts of Eastern Canadian Farm Cattle Sub-Sector in 2030 (Current Trend Based Scenario)

Indicator	Unit	Value			
		Cow-Calf	Back-grounding	Feeders / Feedlots	Total
		Type I Impacts (Direct and Indirect)			
Sales of Goods and Services	Mill. $	$281	$895	$2,807	$3,983
GDP at Market Prices	Mill. $	$100	$213	$842	$1,125
Labor Income	Mill. $	$64	$136	$603	$815
Employment	Person-years	3,089	4,560	13,203	20,852
		Type II Impacts (Direct, Indirect, and Induced)			
Sales of Goods and Services	Mill. $	$407	$1,151	$3,988	$5,546
GDP at Market Prices	Mill. $	$174	$364	$1,541	$2,080
Labor Income	Mill. $	$116	$242	$1,087	$1,444
Employment	Person-years	4,791	$8,035	29,227	42,053

Table F.5: Economic Impacts of Eastern Canadian S&MP Sub-Sector in 2030 (Current Trend Based Scenario)

Particulars	Unit	Type I Impact Level	Type II Impact Level
Production of Goods and Services	Mill. $	$5,925	$7,548
Gross Domestic Product at Market Prices	Mill. $	$1,938	$2,897
Labor Income	Mill. $	$862	$1,527
Employment	Person-Years	$26,331	48,336

Table F.6: Economic Impacts of Aggregated Eastern Canadian Cattle Sector in 2030 (Current Trend Based Scenario)

Particulars	Unit	Total Type I	Total Type II
Production of Goods and Services	Mill. $	$8,785	$11,801
Gross Domestic Product at Market Prices	Mill. $	$3,306	$5,087
Labor Income	Mill. $	$1,564	$2,801
Employment	Person-years	41,136	82,205

Table F.7: Economic Impacts of Western Canadian Farm Cattle Sub-Sectors in 2030 (Current Trend Based Scenario)

Indicator	Unit	Value			
		Cow-Calf	Back-grounding	Feeder / Feedlots	Total
		Type I Impacts (Direct and Indirect)			
Sales of Goods and Services	Million $	$1,353	$7,067	$8,462	$16,883
GDP at Market Prices	Million $	$560	$1,765	$2,140	$4,465
Labor Income	Million	$389	$1,117	$1,390	$2,896
Employment	Person-Years	23,468	25,895	38,051	87,414
		Type II (Direct, Indirect and Induced Impacts)			
Sales of Goods and Services	Million $	$2,019	$8,869	$10,717	$21,605
GDP at Market Prices	Million $	$958	$2,845	$3,491	$7,294
Labor Income	Million $	$666	$1,868	$2,329	$4,863
Employment	Person-Years	33,012	51,780	70,431	155,223

Table F.8: Economic Impacts of Western Canadian S&MP Sub-Sector in 2030 (Current Trend Based Scenario)

Particulars	Unit	Type I Impact Level	Type II Impact Level
Production of Goods and Services	Mill. $	$15,458	$19,046
Gross Domestic Product at Market Prices	Mill. $	$5,061	$7,209
Labor Income	Mill. $	$2,230	$3,725
Employment	Person-years	$61,183	$112,701

Table F.9: Economic Impacts of Aggregate Western Canadian Cattle Sector in 2030 (Current Trend Based Scenario)

Particulars	Unit	Type I Impact Level	Type II Impact Level
Production of Goods and Services	Mill. $	$28,403	$36,290
Gross Domestic Product at Market Prices	Mill. $	$10,496	$15,219
Labor Income	Mill. $	$4,820	$8,107
Employment	Person-years	128,059	241,308

Table F.10: Economic Impacts of Alberta Farm Cattle Sub-Sectors in 2030 (Current Trend Based Scenario)

Indicator	Unit	Value			
		Cow-Calf	Back-grounding	Feeder / Feedlots	Total
		Type I Impacts (Direct and Indirect)			
Sales of Goods and Services	Million Dollars	$693	$4,322	$5,383	$10,398
GDP at Market Prices	Million Dollars	$278	$934	$1,175	$2,387
Labor Income	Million Dollars	$193	$604	$788	$1,586
Employment	Person-Years	7,862	11,619	18,954	38,435
		Type II Impacts (Direct, Indirect, and Induced)			
Sales of Goods and Services	Million Dollars	$988	$5,172	$6,503	$12,663
GDP at Market Prices	Million Dollars	$458	$1,450	$1,856	$3,764
Labor Income	Million Dollars	$316	$959	$1,255	$2,530
Employment	Person-Years	9,476	16,282	25,092	50,851

Table F.11: Economic Impacts of Alberta S&MP Sub-Sector in 2030 (Current Trend Based Scenario)

Particulars	Unit	Type I Impact Level	Type II Impact Level
Production of Goods and Services	Mill. $	$11,844	$13,865
Gross Domestic Product at Market Prices	Mill. $	$3,525	$4,754
Labor Income	Mill. $	$1,444	$2,287
Employment	Person-years	31,322	42,407

Table F.12: Economic Impacts of Aggregate Alberta Cattle Sector in 2030 (Current Trend Based Scenario)

Particulars	Unit	Type I Impact Level	Type II Impact Level
Production of Goods and Services	Mill. $	$15,885	$19,356
Gross Domestic Product at Market Prices	Mill. $	$5,016	$7,125
Labor Income	Mill. $	$2,415	$3,863
Employment	Person-years	57,310	76,341