



IMPACT Center
WASHINGTON STATE UNIVERSITY

2019 Contributions of the Washington Beef Sector

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2019 Contributions of the Washington Beef Sector

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1. Introduction and Study Overview

Since 2014 WSU and the Washington Beef Industry have been working to understand the linkages of the beef sector to the broader economy. The beef sector is composed of cow-calf ranches, feedlot operations, and beef processing at packing plants. This study seeks to report three key findings: 1) the changes in the underlying sector over the past several years, 2) changes in sector structure using primary data collected from surveys of the cow-calf and feedlot sectors, and 3) the overall economic contributions to Washington's economy.

Chapter 2 analyzes the beef sector nationally, regionally, and for Washington State specifically. We first outline the evolution of cattle inventories geographically. Washington is struggling to maintain regional competitiveness in the cow-calf sector seeing larger than average declines in state cow herd inventories. Nonetheless, Washington has several comparative advantages in particular feed supplies, resulting in large imports into the feedlot sector. Washington also remains one of the top states for beef processing, importing large volumes of finished cattle for processing and export.

Chapter 3 outlines the results of the cow-calf and feedlot surveys. The surveys capture data on operational size, location, duration of operation, revenues, labor tax, and other operational expenses. All of this helps us to see where the supply chains of the cow-calf and feedlot industries link to. Due to having only two competitive commercial beef processing facilities in Washington, the highly competitive nature of those operations, and mandatory price reporting competitive exemptions on data reporting, the revenue and expenditure data were estimated using national data and production ratios.

Chapter 4 highlights the web of industries that are connected directly and indirectly to the beef sector, and how those other industries and their employees are affected by the new dollars the beef sector brings into the state. We are therefore able to show how new dollars enter the economy, and ripple through it creating jobs, income, and increase the value of final goods produced in the state. In total the beef sector contributed \$1.64 billion to the Washington economy and supported, directly and indirectly, over 15,000 jobs. The beef sector is nearly equivalent in size to the Washington dairy sector, in terms of gross state product and employment contributions.

This is only the second time in the state's history that a comprehensive overview of the beef sector and its supply chain have been investigated. Bolstered by the growth in cattle inventories over the past 5-years and continued strength in the feedlot, and processing industries, Washington's contributions to the state show moderate growth. Continued growth for the sector will likely be determined by competitive factors in the beef production chain and the evolution of dietary preferences and market conditions effecting consumption.

Major Study Findings:

- The modeled 2019 Washington cattle production inventories based on the most current USDA reports were 228,000 calves produced, 564,000 finished feedlot steers and heifers sent to slaughter, and 1,146,000 head of cattle slaughtered.

- Washington's beef cow inventory peaked in 1984 at 436,000 cows and has declined to 230,000 cows in 2019. Washington's beef herd has declined at a much higher rate than the rest of the U.S. The same source of data over the same time frame shows that the U.S. herd peaked at 39.229 million head in 1982 and declined to 31.7 million head in 2019. This represents a 20% decline from peak to current for the U.S. beef herd. Comparatively Washington's decline from peak to current is down 47%, a little more than double the rate of decline of the U.S. herd level.
- However, Washington's beef cow herd inventory has been growing since 2015 from 198,000 to 230,000 beef cows representing a inventory growth of about 16%.
- Cattle production increases value at each step of the production phase. By having more feedlot cattle than calves produced, and having more cattle slaughtered than produced by feedlots magnifies the economic contribution of the industry at each sector.
- Cattle prices have decreased sharply since the record high prices set in 2014 and at the start of 2015. Cow-calf producers realized the greatest increase in value produced from 2010 to 2014 at a 115% increase in value produced, However from 2015 to 2019 the cow-calf sector have realized the largest per head value decrease of -31%, feedlots -21% and wholesale carcass values -8%.
- Washington's packing sector is the primary driving factor in the cattle industry's vertical supply chain. The packer is the market outlet for the feeding sector and in turn the feedlots are the primary market outlet for the cow-calf producers. Washington's packing sector has been relatively stable in terms of the number of cattle slaughtered since 2007. This market stability has provided confidence in market outlets and strongly contributes to Washington feedlots steadily increasing the number of cattle marketed.
- In 2019, the feedlots marketed 564,000 head. This is the highest level of feedlot inventory sold since 2013. The packing plants processed 1.146 million head, the highest number on record.
- For 2019 the direct contributions to gross state product for the cow-calf sector was \$120.2 million dollars. For the feedlot sector it was \$36.2 million dollars. For the processing sector it was \$220.4 million dollars. The combined beef industry's direct contributions to the state economy's bottom line was \$376.8 million dollars.
- Direct cattle sales represent only part of the economic contribution of the beef sector. Input-output analysis was used to estimate the indirect and induced effects that result from the beef sectors input purchases, labor, and profits. The total economic contribution of the beef sector to Washington in 2019 was \$1.638 billion.
- The 2019 total employment stemming from the beef sector was 15,007 FTE jobs. Most of those jobs, roughly 9,912, were attributable to processing sector exports.

2. Market Structure and Sector Overview

Regional Cattle Inventories

Washington's beef industry is unique in the Pacific Northwest. No other Pacific Northwest state has all three production sectors: cow-calf, feedlot, and packers as large collectively as Washington does. Washington has several competitive cattle production advantages in forage and crop aftermath grazing resources, a strong hay production industry, grain production and byproduct feedstuffs, and a good transportation system for cattle movements to grazing, feedlots, and packers as well as beef products to both export and domestic markets. Figures 2.1, 2.2 and 2.3 provide maps showing the inventory number of cows that calved, cattle on feed and commercial cattle slaughter respectively. The maps provide a regional perspective of the size of each sector.

Figure 2.1: *Beef Cow Inventory*

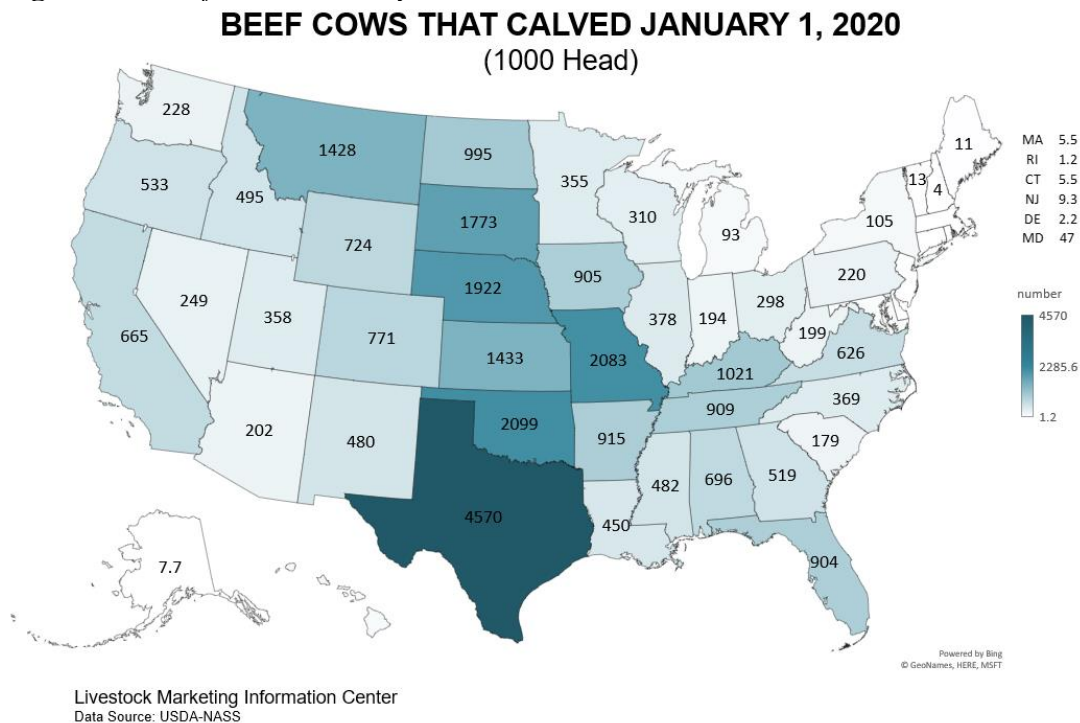


Figure 2.2: *Cattle on Feed Inventory*

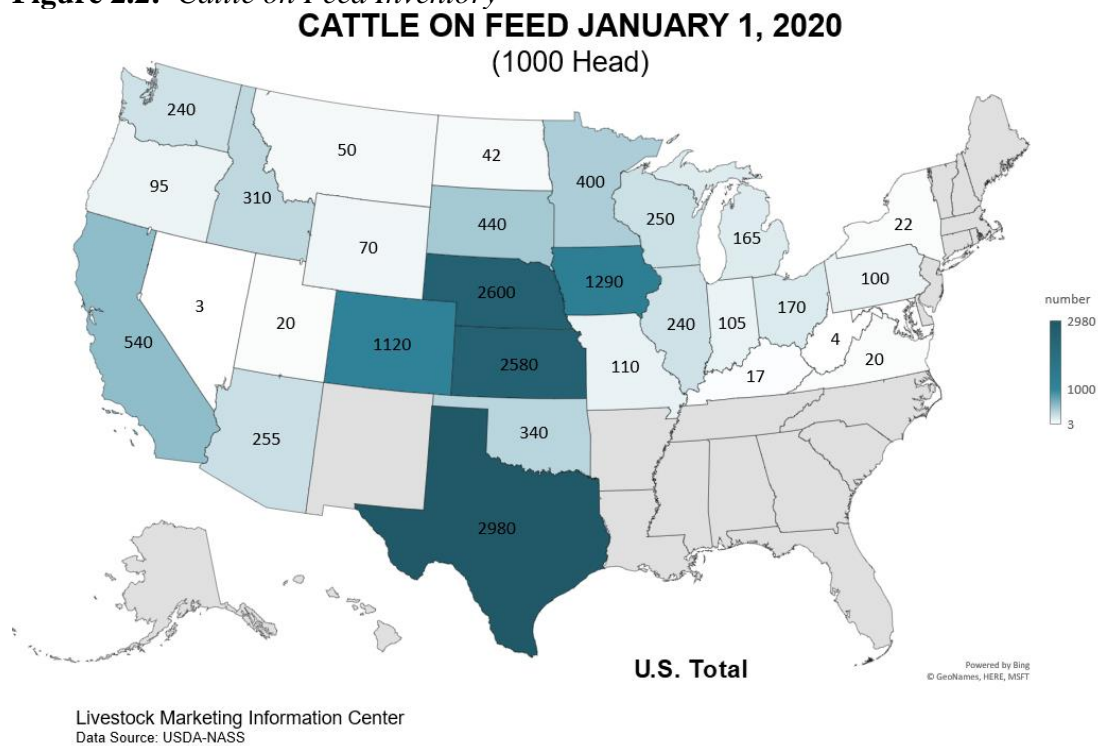
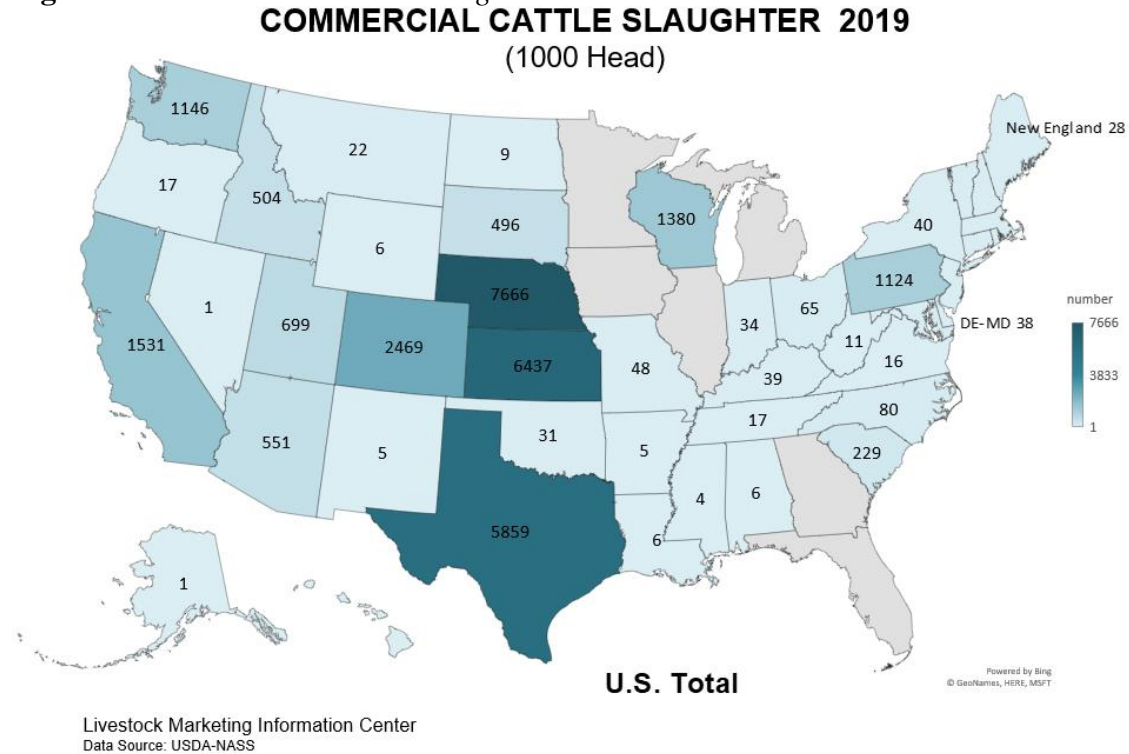


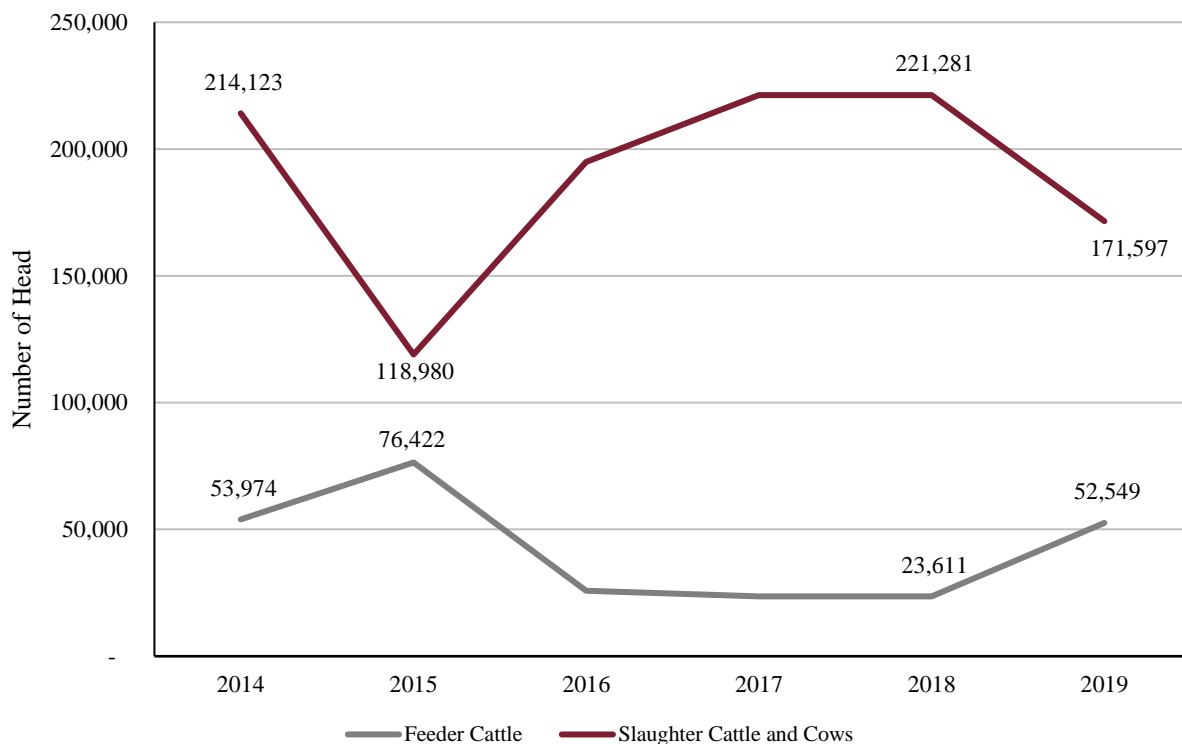
Figure 2.3: *Commercial Cattle Slaughter*



These figures show that Washington has the Pacific Northwest region's smallest cow-calf inventory; a regionally large cattle feeding sector that is smaller than Idaho, and by far the largest commercial cattle slaughter sector. Washington is a regional cattle industry driver because it purchases cattle from outside Washington to supply its cattle feeding and commercial slaughter sectors. The maps also provide a rough indication of the regional flow of cattle.¹

Considering the Pacific Northwest to include Washington, Oregon and Idaho, the cow-calf sector combined to produce about 1.25 million head of calves. The number of cattle on feed is about 0.65 million head. The number of cattle slaughtered is about 1.67 million head. There is a substantial increase in commercial slaughter in the Pacific Northwest from the CS Beef Packers plant near Kuna, Idaho that opened in 2017 and processes cull cows and bulls. If you add Montana to the Northwest region the combined inventory of calves produced increases dramatically to about 2.7 million head of calves but there is little increase in cattle feeding and commercial slaughter. If you consider that the cattle feeders get about two turns of cattle through their feedlot the number of cattle fed approaches the number of cattle slaughtered with Canadian imports contributing to the supply of feeder and slaughter cattle. Figure 2.4 illustrates the number of Canadian live cattle imports into Region 10 which includes Washington, Oregon and Idaho from 2014 to 2019.

Figure 2.4: *Number of Canadian Live Cattle Imports into Washington, Idaho, or Oregon*



Source: USDA Weekly Canadian Live Animal Imports into U.S. by Destination (WA_LS637)

¹ It is a rough approximation because of the production time differences between calf production and weaning, placing cattle on feed and the number of days on feed and the slaughter age each have different calendar years.

Live cattle import data reports feeder cattle and combines fed cattle and cull cows destined for slaughter. The data does not identify a specific destination state, just Region 10 which could be Washington, Idaho or Oregon. The increase in slaughter imports could be influenced by the CS Packers plant that opened in 2017 that is primarily processing cull cows. Feeder cattle imports dropped substantially from 2016 to 2018 from a peak of 76,422 head in 2015 an increase of about double from 2018 to 2019.

Washington Cow-Calf Sector

Washington's cow-calf sector is highly diverse in terms of the size of operation and geographic location across the state. Washington cow-calf operations range in size from a large number of small operations to a small number of large operations. Table 2.1 presents data on Washington's beef cow operations using data from the 2017 USDA Agriculture Census. The data reports that there are 5,831 beef cow-calf operations with an inventory of less than 10 beef cows. This represents 63% of the number of operations and accounts for about 9% of the inventory of beef cows. Conversely operations with a herd size to above 500 beef cows represents only about 0.5% of the number of operations but account for about 18% of the inventory of beef cows. This demographic breakdown of operation size and inventory is typical across states.

Table 2.1: *Washington Number of Operations by Size of Operation*

Inventory of Beef Cows	Number of Operations	Percent of Operations	Percent of Inventory
1 - 9 Head	5,831	62.7%	9%
10 - 19 Head	1,356	14.6%	7%
20 - 49 Head	1,180	12.7%	14%
50 - 99 Head	411	4.4%	12%
100 - 499 Head	468	5.0%	39%
500 - 999 Head	36	0.4%	10%
1,000 Or More Head	13	0.1%	8%
Total	9,295	100%	100%

Source:

https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_1_State_Level/Washington/st53_1_0015_0016.pdf

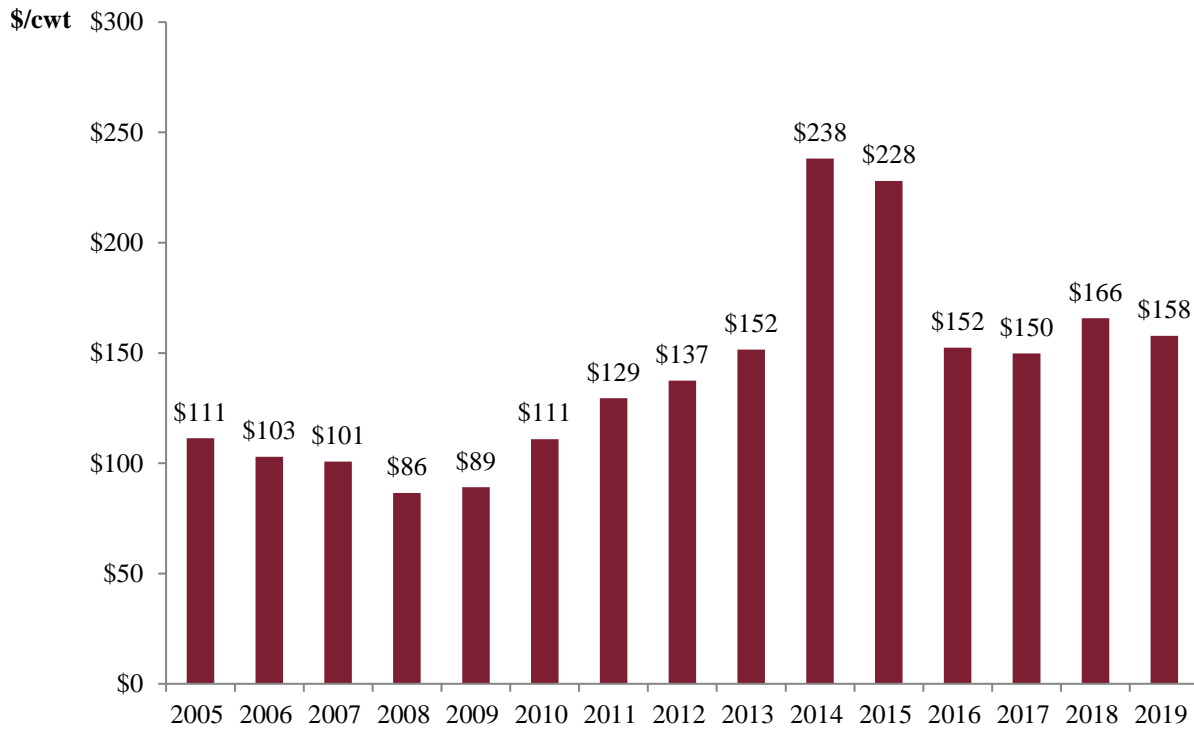
The inventory of beef cows in Washington was in a declining trend from 1984 to 2015. However, from 2015 to 2019 that trend has been reversed. Figure 2.5 shows the January 1 inventory number of beef cows from 1980 to 2019. Washington's beef cow inventory peaked in 1984 at 436,000 cows and has declined to 230,000 cows in 2019. Washington's beef herd has declined at a much higher rate than the rest of the U.S. The same source of data over the same time frame shows that the U.S. herd peaked at 39.229 million head in 1982 and declined to 31.7 million head in 2019. This represents a 20% decline from peak to current for the U.S. beef herd. Comparatively Washington's decline from peak to current is down 47%, a little more than double the rate of decline of the U.S. herd level. Both the U.S. and Washington have the lowest level of beef cow inventory appearing in 2015 but increasing each year to 2019.

Figure 2.5: *Washington Beef Cow Inventory 1980 to 2014*



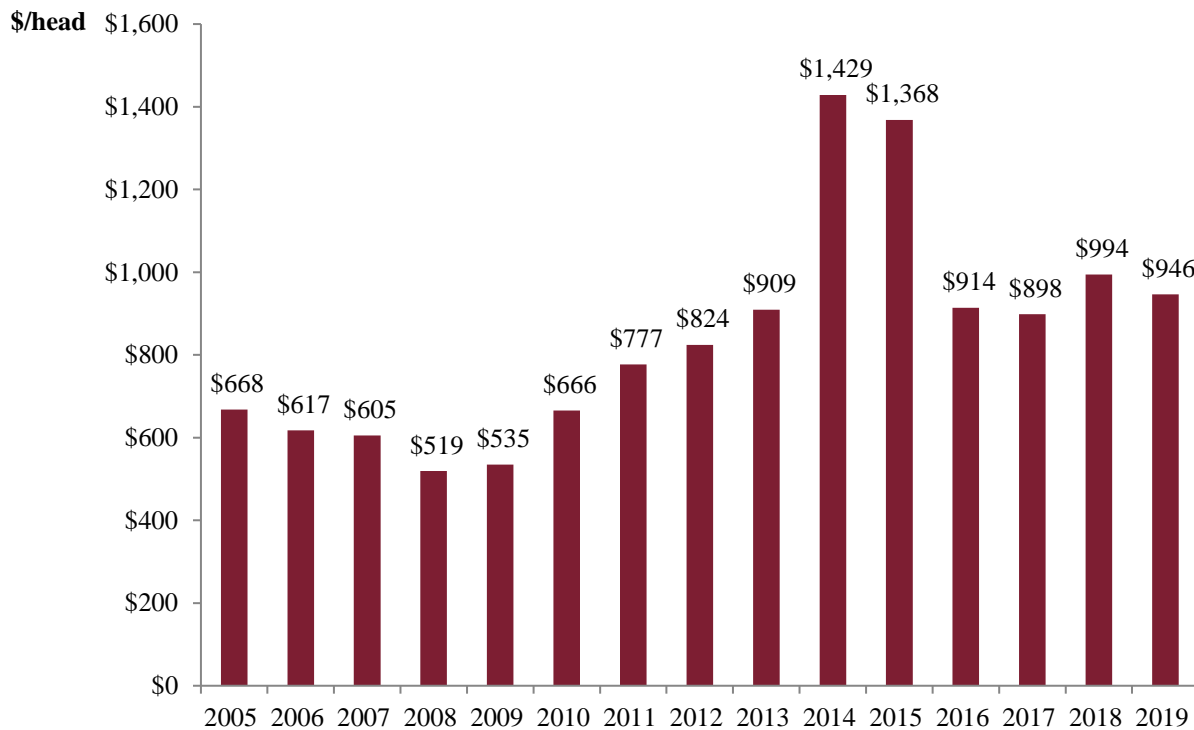
Figure 2.6 presents average 500-600 lbs feeder steer prices. The prices represent Washington auction prices reported to the USDA. Washington calf prices peaked to a record high of \$238/cwt in 2014. In 2015 prices started the year high through April but declined month over month for the rest of the year. Prices in 2016, 2017 and 2019 ranged from \$150 to \$158/cwt with 2018 prices reaching \$166. The price trend corresponds to value received for weaned calf sales. Based on the survey data collected for the study the average weight of steers and heifers sold were 645 and 578 pounds respectively. Figure 7 converts the prices reported in Figure 6 to the value of a 600 pound steer. The 2014 calf value reached a record high at \$1,429. From 2016 to 2019, calf value decreased, -\$515, -\$531, -\$435 and -\$483 per head for each of these years and averages a decrease of -\$491 per head in comparison to the record high year seen in 2014.

Figure 2.6: *Washington Feeder Steer Price*



Source: USDA/AMS Weekly Combined Cattle Report - ML_LS795

Figure 7: *Washington 600 Pound Fall Feeder Steer Value*



Washington Feedlot Sector

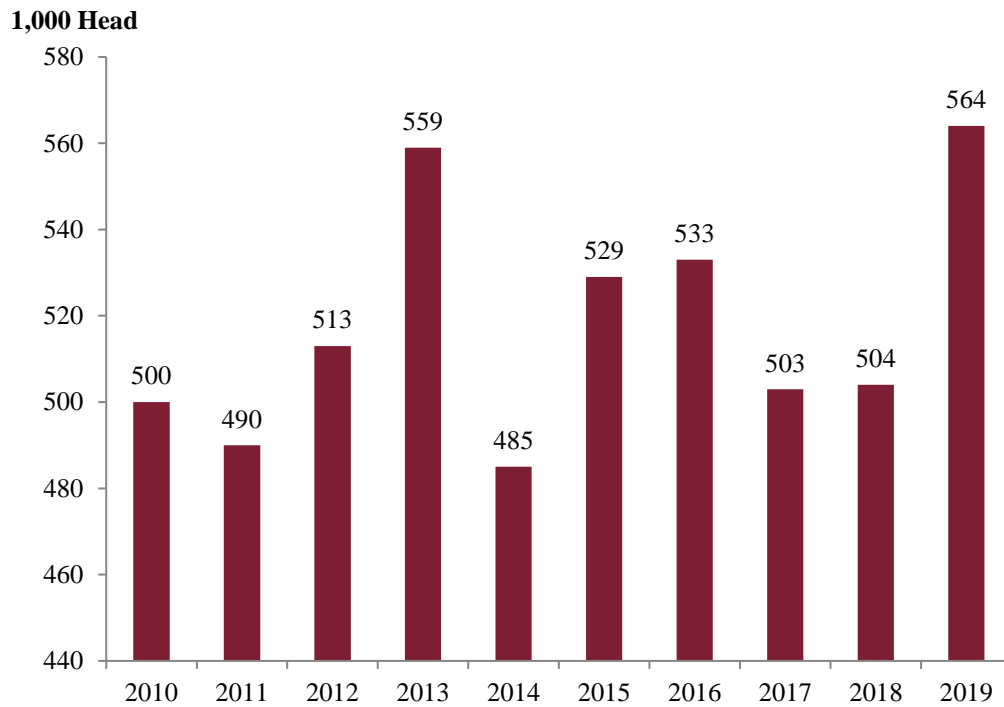
Beef feedlots are a highly competitive sector with strong economies of scale which means that the production cost per head decreases as feedlot size increases. This has led to an increase in feedlot size, reduced the number of feedlots, and concentrated ownership of feedlots meaning that an owner has multiple feedlots at different locations. The USDA no longer reports the number of feedlot operations due to difficulties in defining a feedlot versus a backgrounding operation and revealing competitive feedlot information. The Washington Department of Agriculture identifies 8 licensed certified feedlot operators and their feedlots. The number of feedlots does not impact the economic contribution study which uses the inventory of cattle on feed marketed that is reported by the USDA and representative production costs data that was obtained through a feedlot survey as part of this study and analyzing published feedlot cost of production studies.

Defining and describing feedlots is difficult because feedlots manage cattle as an inventory flow and the in-weights of cattle placements vary widely within a year and across years depending on cattle market conditions and cattle availability which are impacted by feed costs, drought and pasture quality conditions. In terms of the cattle on feed inventory report on January 1, 2019 Washington maintains a ranking of 14th largest in the nation in terms of the number of cattle on feed at 230,000 head which is substantially lower than the top 3 states that have about 2.8 million head on feed, see Figure 2.2.

One statistic that can be used to analyze feedlots is tracking the number marketed. This represents the number sold and can be used to estimate the feedlot sectors total revenue. Figure 2.8 presents the number of cattle marketed by Washington feedlots from 2010 to 2019. The data shows some variation but note the vertical axis starts at 440,000. Both 2013 and 2019 have close to 560,000 head marketed each year and the rest of the years range from a low 485,000 in 2014 to about 500,000 to 530,000 depending on year.

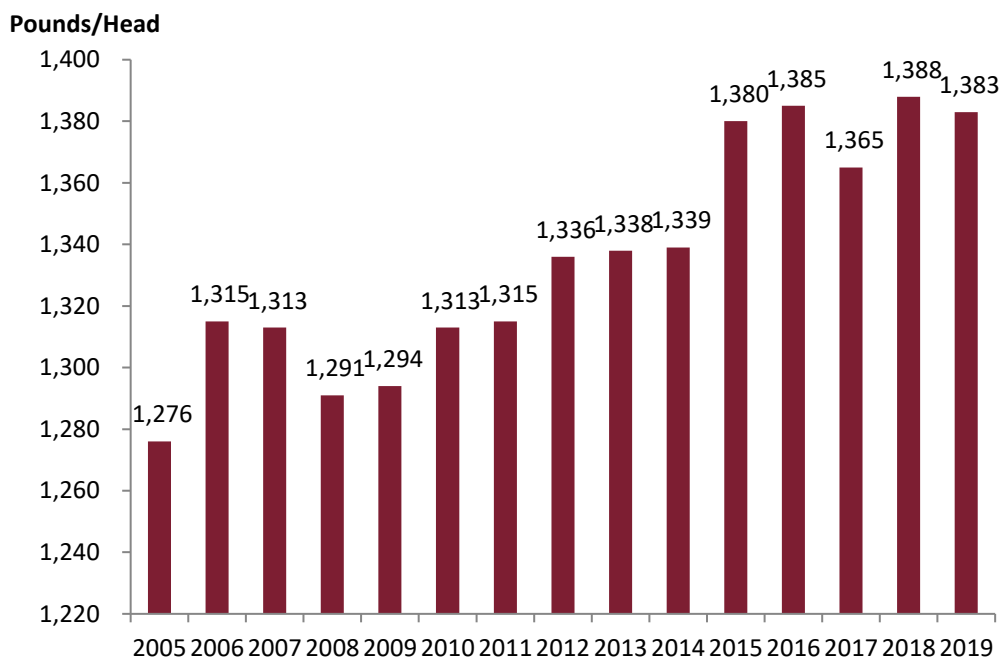
Figure 2.9 presents the Washington fed cattle sold average live weight per year. This is also often referred to as finished weight. The finished live weight is both the weight sold by the feedlot and purchased by the packer. Finished weight is impacted by a variety of factors including market price, feed costs, animal genetics, cattle prices, and environmental conditions for example. Washington has followed the national trend for heavier finished weights primarily due to lower cow herd inventory and improved genetics that provides the opportunity to sell more meat weight while maintaining carcass quality. The average finished weight for fed cattle in Washington was about 1,380 pounds since 2015.

Figure 2.8: *Washington Feedlot Marketings 2010-2019*



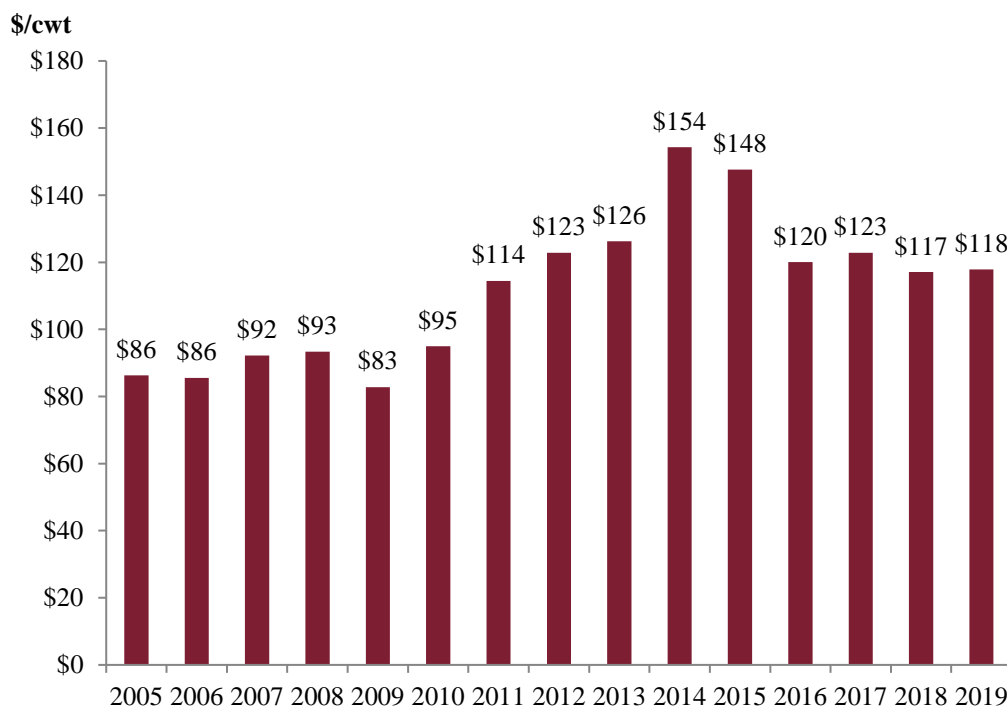
Source: USDA NASS, Washington Annual Statistical Bulletin,
https://www.nass.usda.gov/Statistics_by_State/Washington/Publications/Annual_Statistical_Bulletin/2020/WA_ANN_2020.pdf

Figure 2.9: *Washington Fed Cattle Sold Average Live Weight*



The USDA does not report a finished fed cattle price for Washington. Data from the feedlot survey for this study and discussing cattle prices with the Washington packers for this study, the available 5 Area Average (Texas-Oklahoma, Kansas, Nebraska, Colorado, and Iowa-Minnesota) closely represents Washington finished cattle prices. Figure 2.10 presents the average annual finished cattle price. The price trend for finished cattle follows feeder cattle prices with a record high being set at \$154/cwt in 2014 and falling to relatively consistent prices around \$120/cwt from 2016 to 2019.

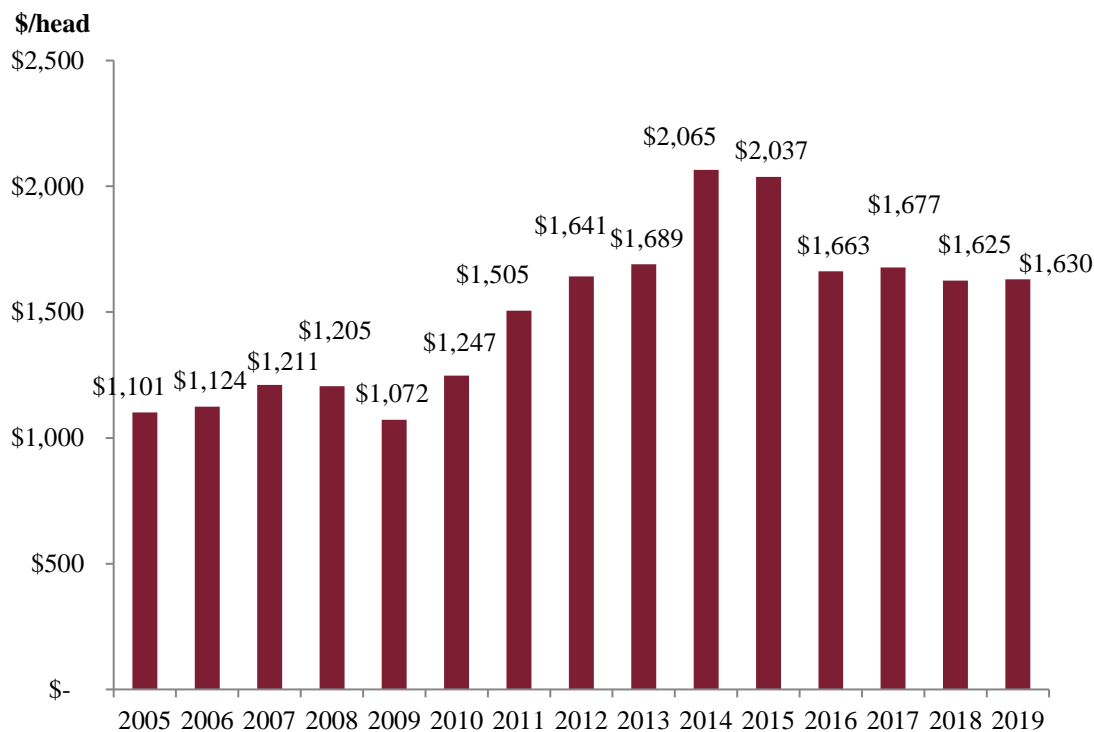
Figure 2.10: 5-Market Annual Average Finished Cattle Price (Texas-Oklahoma, Kansas, Nebraska, Colorado and Iowa-Minnesota)



Source: www.LMIC.info

Figure 2.11 presents the average per head finished value using the finished weight in Figure 9 and prices in Figure 2.10. Consistent with price trends the record high value was set in 2014 at \$2,065. Both 2018 and 2019 had similar finished cattle value at \$1,625 and \$1,630 respectively.

Figure 2.11: *Washington Finished Cattle Value*



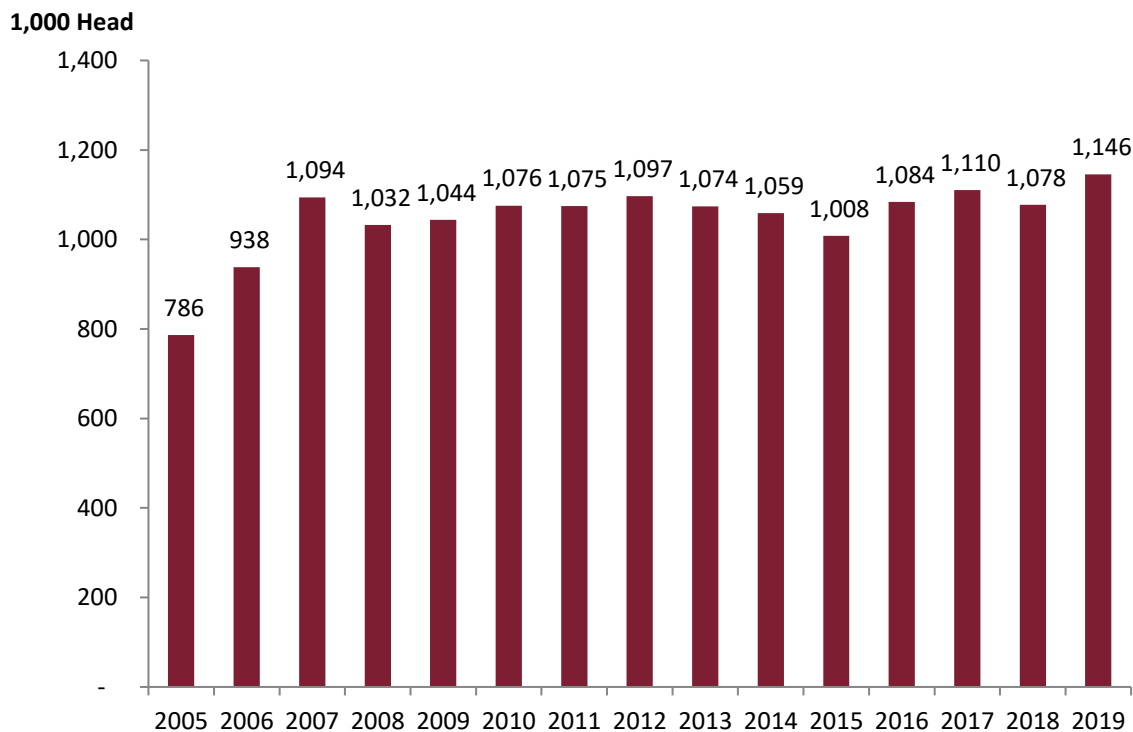
Washington Packer Sector

Livestock packers operate in a highly competitive economic environment relative to purchasing cattle, labor and selling beef products. A high majority of Pacific Northwest feedlot cattle are processed in one of Washington's two packing plants: Agri Beef Foods, LLC in Toppenish WA, or Tyson Foods Inc. Wallula, Washington. The CS Packing plant in Kuna, Idaho opened in 2017 and reports indicate it can process 1,350 head of cattle each day. Prior to this plant, Idaho reported about 30,000 head of annual commercial beef slaughter and in 2019 that value increased to 504,000 head.

Washington has a few relatively small cull cow processing plants such as Schenk Packing Co. and Walt's Meats. The cull cow packing capacity is limited in Washington and services both dairy and beef cull cattle. A large number of culls are shipped out of the state for processing.

Figure 2.12 presents the number of commercial cattle slaughtered in Washington. Since 2007 the number of cattle slaughtered has been highly stable ranging between 1.0 and 1.1 million head. 2019 had the highest number of commercial cattle slaughter at 1.146 million head.

Figure 2.12: *The Number of Commercial Cattle Slaughtered in Washington*



Source:

https://www.nass.usda.gov/Statistics_by_State/Washington/Publications/Annual_Statistical_Bulletin/2020/WA_ANN_2020.pdf

Packers purchase live finished cattle and process them into wholesale boxed beef cuts. Although packers sell boxed beef, a common method to report wholesale meat value relative to per head value is boxed beef cut out value. Figure 13 presents annual average boxed beef cut out values. Cut out values are not reported for Washington separately due to competitive disclosure rules of mandatory price reporting. Data discussions with packing plants indicate that national cut out value data accurately represents Washington price trends. Cut out value price trends mirror feeder and finished values with a record being set in 2014 and falling from 2016 to 2019, however the price decline is not as severe as found for feeder and finished cattle prices.

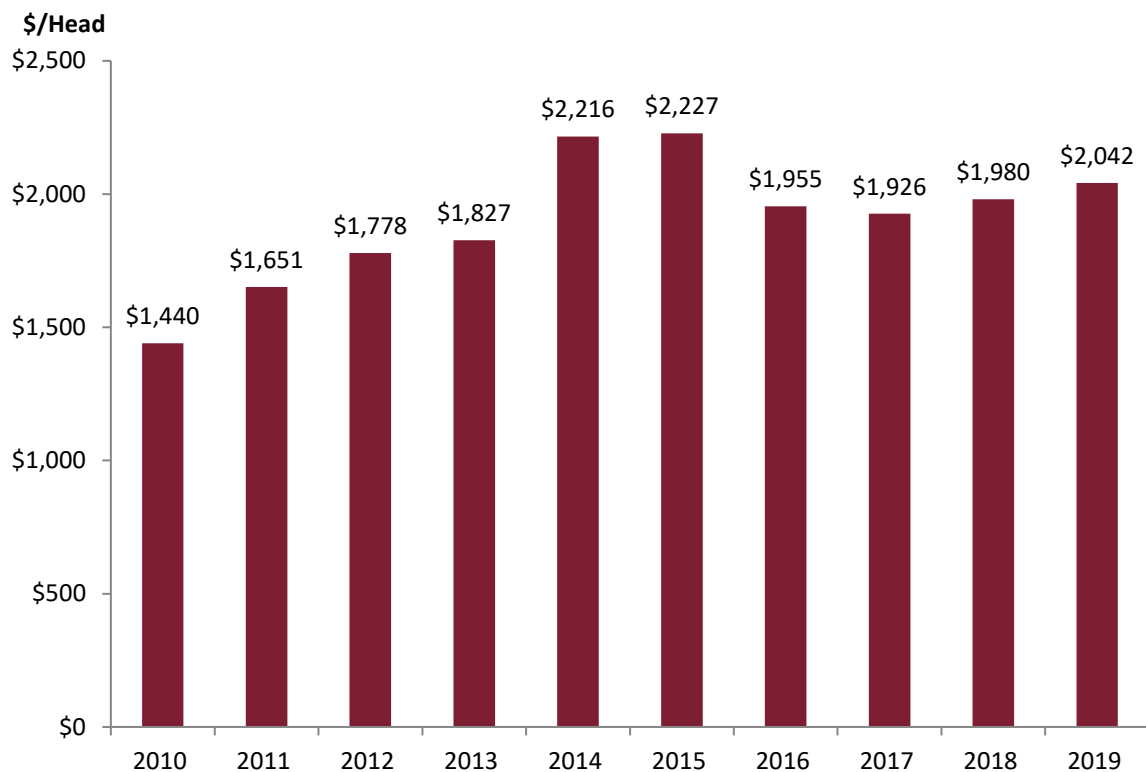
Figure 2.13: *Annual Average Boxed Beef Cut Out Values*



Source: USDA AMS daily report LM_XB403

Dressing percent is the conversion factor from live weight to carcass weight. The industry accepted dressing percentage for a typical beef animal harvested in the United States is 62%. The drop credit is the value packers receive for hides and variety meats. The drop credit is reported by the USDA on a live weight basis, see www.ams.usda.gov/mnreports/lstdb.pdf. Figure 14 presents the calculated per head wholesale value of a processed beef animal using the average finished weight of Washington feedlot cattle as reported in Figure 9, a 62% dressing percentage, a drop credit of \$8.64/cwt live basis.

Figure 2.14: *Calculated Washington Per Head Beef Wholesale Value*



The calculated per head wholesale beef value set a record high values per head in 2014 at \$2,216 and \$2,227 in 2015. Values have fallen since 2015 but trended up since 2017. The Value per head was \$2,042 per head in 2019.

The percent year over year value changes for each sector annually and over a 5-year period are reported in Table 2.2. The cow-calf sector experienced the largest percent increases over the five-year reported time frame at -31% followed by the feedlot sector at -20% and the packer sector the least decline at -8%. The cow-calf sector's value decreased each year except for 2017 to 2018.

Table 2.2: *Percent Change in Beef Values by Sector*

Sector	2015 - 2016	2016- 2017	2017 -2018	2018-2019	5-year avg. 2015-2019
Cow-calf	-33%	-2%	11%	-5%	-31%
Feedlot	-18%	1%	-3%	0%	-20%
Packer	-12%	-1%	3%	3%	-8%

The change in values are important relative to the economic contribution study. An industry generates economic activity by purchasing inputs from supplying industries in the region. The beef industry purchases cattle inputs backward from the packer sector back through the feedlot and then the cow-calf sectors. The cow-calf producers gained the most value for the years 2010 to 2014 when prices were rising, they also had the largest decline in value from 2015 to 2019.

Summary of the Economic Condition of Washington's Beef Industry

Washington's packing sector is the primary driving factor in a vertically integrated production such as the beef industry as packer is the market outlet for the feeding sector and in turn the feedlots are the primary market outlet for the cow-calf producers. Washington's packing sector has been very stable in terms of the number of cattle slaughtered and slaughtered the 1.146 million head in 2019 the highest ever reported. Somewhat surprising is the inventory of beef cows reached a bottom in 2015 and has been in an increasing trend through 2019. This could be due to a delayed price response from the year over year record high prices up to 2014 that incentivized investment and expansion of the cow herd, but cow-calf producers have seen the largest decrease in value from 2015 to 2019 in the industry.

3. Survey Results and Descriptive Statistics

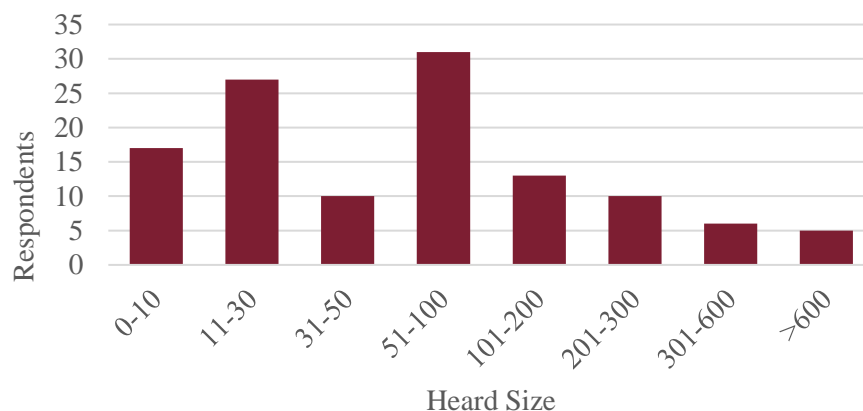
Surveys of the cow-calf and feedlot industries were conducted by WSU's Social and Economic Sciences Research Center (SESRC) over several months. Information collected by the surveys focused on each industry's income, expenses, input purchases, capital improvements, and taxes. It is critical to know how much of the spending was local, as money leaking out of the economy does not contribute to gross state product. This data is used to supplement USDA statistical reports, cow-calf and feedlot enterprise budgets, and IMPLAN transaction tables for Washington State.

Cow-Calf Survey Data

Complete cow-calf Surveys were collected from 124 unique respondents. Several respondents indicated they were unwilling to provide revenue, cost, inventory, or other critical data. Those surveys were removed from the following reported data sets. We understand that this is sensitive information for cattle producers. The 124 completed surveys accounted for 14,002 cows and heifers that calved in 2019. This is about 2.7 percent of the state inventory of cows and heifers that calved, and about two percent of the number of operations. Although this response rate is low the quality of the data returned is high and provided key information that allows us to augment the revenue and cost data needed for the input-output model See Appendix 1.

Washington cow-calf ranches have a long history of operating at their home location. On average cow-calf operations have been at their home location for 68 years with 20 respondents identifying their family have operated their ranch for over 100 years. Figure 3.1 provides the respondents herd size demographics. The herd size demographics follow the overall USDA herd size demographics with a large number of small producers ranging to a low number of large producers. Historically respondents with larger herd sizes were more likely to respond to the survey request.² Overall the survey provides a representation of Washington's cow-calf sector from small to large herds. Of the reporting herds, about 92 percent declared they were spring calving herds.

Figure 3.1: *Cow-calf Survey Number of Respondents by Herd Size*



² The cost and revenue per head data were assumed to be representative of state averages.

Table 3.1 shows the sales, retention, and other inventory changes (kept for beef, or loss due to death). Because this data is not mutually exclusive, respondents were likely captured in multiple rows. Of the 124 respondents, 103 reported sales or retention. The majority of calves, 41% were sold by private treaty, 21% were sold at live auction, and 26% were retained.

Table 3.1: *Cow-Calf Survey – Inventory Sales and Retention*

Method of Sale	Respondents	Number of Calves	Percent of Total
Sold at live Auction	66	2,647	21%
Sold at Video Auction	5	300	2%
Sold by Private treaty	57	5,280	41%
Retained Ownership Stocker	16	1,731	13%
Retained Ownership Feedlot	12	1,646	13%
Kept for Beef	59	472	4%
Death Loss	69	767	6%
Total	-	12,843	100%

Table 3.2 outlines the employment situation for the cow-calf operations and this data is critical for the contribution analysis. This information allows us to ground truth the animal to employment ratio as well as the estimated wage bill for the cow calf sector. This data is used in the Input-Output model to ensure the employment to sales ratio and employee compensation values in that model are accurate. The average cow-calf operation responding to the survey employed 25 people throughout the year with roughly 14 being part time or seasonal. Average annual compensation amounted to \$51,472.

Table 3.2: *Cow-calf Survey - Labor Market Information*

Description	n	Average	Standard Deviation
Number of full-time year-round employees	30	2	1.28
Number of part-time year-round employees	13	1	0.65
Number of seasonal labor employees	28	2	2.57
Number of family labor employees	54	2	2.10
Number of other employees	3	3	0.00
Average annual Payroll	52	\$41,311	\$47,155
Average Annual Benefits	35	\$10,161	\$6,671

Table 3.3 shows average weight of steers, heifers, and cull cows at the time of sales. Reported steer weights ranged from 500 to 850 pounds. Heifer weights ranged from 313-775 pounds, and Cull cow weights ranged from 800 to 1600 pounds. Seventy-six percent of ranches reported preconditioning their steers and seventy-seven percent reported preconditioning their heifers.

Table 3.3: Cow-calf Survey – Average Weights of Animals Sold

Weights	n	Average (lbs)	Standard Deviation (lbs)
Steer calves	92	686	95
Heifer calves	91	611	103
Cull cows	85	1,308	323

The survey asked questions to determine regional purchase coefficients for cow-calf operational spending. The results are reported in Table 3.4. The ranches predominantly purchase inputs locally within Washington. The survey estimates that 57 percent of cow-calf operating purchases are local within 30 miles of their operation. Thirty percent of the inputs are purchased regionally in Washington. Out-of-State purchases were estimated to be twelve percent. This implies that 87% of each dollar spent by cow-calf operations stays within the state generating jobs and incomes for their suppliers.

Table 3.4: Cow-calf Survey – Geographical Spending Patterns

Regional Purchasing	Percent
Locally (within 30 miles)	57
Regionally (more than 30 miles but within Washington)	30
Out-of-State	12

Feedlot Survey

A feedlot survey was also developed to collect data from Washington feedlots. To preserve confidentiality the data was aggregated, and several regional identifiers were not included. This did not distort any statewide indicators that were collected or developed from the survey results.

Table 3.5 presents the survey results on 2019 placements. The predominant number of placements, about 54 percent, were purchased without partnership. The survey accounted for a total of 285,706 placements. This is about 51 percent of total placements reported for Washington by the USDA. The survey questions combined asking for the placements that were sourced from Washington. In total 64,545 of the reported placements, or 22.6%, were sourced from Washington. The survey result on the number of head finished and shipped to the packer in 2019 was 238,326 head.

Table 3.5: Feedlot Survey – Cattle Placements

	Number of Head
Number of head purchased without partnership	154,262
Number of head purchased in partnership	40,452
Number of placements to be custom fed	88,533
Number of placements owned	2,459
Total	285,706

The survey asked about 19 questions on revenues and expenses that addressed cattle purchases, capital expenses, repairs, trucking, purchased and raised feed costs and animal pharmaceutical

expenses. The responses to these questions were used to develop the feedlot revenue and cost budget provided as an Appendix. The employment survey responses are provided in Table 3.6. The number of feeders per FTE is about 1,637 at a labor cost of \$28.40 and benefit cost per feeder of \$7.24.

Table 3.6: *Feedlot Survey – Employment and Earnings*

Description	Value
Feeders per FTE employee	1,637.2
Labor cost per feeder	\$28.40
Benefit cost per feeder	\$7.24

The survey asked questions to determine regional purchase coefficients for the feedlot operating expenses, see Table 3.7. Percent of purchases were weighted by ranch size. Larger ranches tended to purchase more of their inputs from out of state. In aggregate the ranches import roughly half of their inputs and purchase the other half of their inputs from within Washington. The survey estimates that 18 percent of feedlot operating expenses are local within 30 miles of their operation. Thirty-one percent of the inputs are purchased regionally in Washington. Out-of-State purchases were estimated to be fifty-two percent.

Table 3.7:

Expenditure Location	Percent
Locally (within 30 miles)	18
Regionally (over 30 miles but within Washington)	31
Out of state	52

4. Economics Model and Contributions

The agricultural sector in general and the beef industry specifically, represents basic industries to Washington. Basic industries provide income to a region by producing and exporting their output, purchasing production inputs, services and labor. The production of calves, finished feedlot animals, and beef processing products represent the *direct* economic contribution of the beef industry to Washington.

The beef industry also generates *indirect* economic contributions as the revenues from the sales of beef animals and products are re-spent in the local economy. The indirect impact of the beef industry on local economies includes purchases of a variety of agricultural inputs and professional services in the supply chain for producing beef. For example, the packers purchase cardboard packing products that generates economic activity from the firm producing the cardboard packing products. Indirect effects represent additional economic activity in Washington's economy driven by the business-to-business transactions stemming from beef exports. These effects appear as jobs and income in local industries serving the beef industry (e.g., veterinarians, feed suppliers, implement suppliers, packaging, trucking and transport).

In addition to the direct and indirect impacts of the production and sales of beef products, the beef industry is responsible for *induced* economic impacts in the form of the local goods and service purchased by households. As beef sector employees spend their salaries and wages in the state economy on retail goods, home improvement, entertainment, etc., those household-to-business transactions ripple through the economy. These induced expenditures translate into jobs and income for retailers, bank tellers, grocery store clerks, restaurant employees, and gas station attendants and so on.

The income generated directly by the beef sector adds to this interdependency; cow-calf, feedlot and beef processing employees spend their wages and salaries on groceries, housing, entertainment, and a range of other consumer goods and services. Typically, these expenditures occur locally, generating rural economic development. These additional linkages, beyond the beef industry and indirectly related sectors of the economy, create induced effects, which help to form a complex intertwining web of industries within Washington. So the relevant question to ask is not only what beef adds to the Washington economy directly, but also how much do beef farms contribute to Washington's economy through this complex networking of industries.

Model Description

Input-Output models are designed to capture the entirety of this complex networking of industries and, in this case, show what portion of that web is dependent on the beef sector. To that end, this section of the report covers the technical aspects of the model and the nuances made to various components of it in order to ensure its accuracy. We begin by explaining the basics of any input-output model as well as the data used for this particular analysis. Next, we discuss how the model needed to be modified to ensure there was no double counting when evaluating the contributions of the production vs. processing components of the dairy sector. Lastly, we outline the direct effects, sometimes referred to as the shock, the dairy sector provides to the economy. The subsequent effects and total contributions are reported at the end of the chapter.

Basics of Input-Output Analysis

The system of accounts known as Input-Output (I-O) tables represent an economist's version of double-entry bookkeeping for industries. Figure 4.1 below shows a simplified version of an I-O matrix with just a hand full of industries. Each cell, in this table of accounts, is populated by dollar transactions.

Figure 4.1: Aggregated form Input-Output Matrix

	Producers as Consumers						Final Demand			
	Agric.	Min.	Const.	Manuf.	Services	Other	Households	Investment	Government	Net exports
Producers	Agric.									
	Min.									
	Const.									
	Manuf.									
	Services									
	Other									
Value Added	Labor						Gross Domestic Product			
	Returns to Capital									
	Taxes									

Reading down a column of this table shows what inputs an industry is buying in order to produce their output. The Agriculture column, for example, may buy seed from themselves, fertilizer and farm equipment from the manufacturing sector, and legal and accounting services from the service sector. Payments to agricultural employees are captured in the “Labor” row. Payments must be made to owners of capital, and the industry pays taxes to the government. This is where the survey data enabled us to isolate the cow-calf, and feedlot operations. Reading across a row tells us where an industry's income originates. Sticking with agriculture, they sell seed to others in the agricultural sector; cattle are sold to processing plants in the manufacturing sector, as is the case with feedlots and slaughterhouses, or perhaps a dairy sells raw milk directly to consumers. A portion of a household's expenditures will go to buying agricultural goods, and even government may purchase agricultural goods. Lastly, the agricultural industry will sell its output out-of-state, via the “Net exports” column.

Summing all the labor, capital, and tax payments for all industries gives the sum of all value added and will equal the Gross Regional Product (GRP) of the region.³ Similarly summing all of the expenditures of households, government, investment, and net exports yields the GRP of the region. These two methods of calculating GRP are known as the Income and Expenditure approaches, respectively, and they represent a check for ensuring all accounts balance. It is through the I-O system that we are able to trace the dollars through the economy and calculate multiplier effects.

³ In our case the region is Washington State.

However, it is only through selling products outside of the region that an economy is able to attract new dollars into the region. Economists distinguish between industries that are export-oriented and those that serve the local economy, recirculating the dollars once they are in the economy. We call export-oriented industries “basic” and resident serving industries “non-basic.” The beef sector, as with most agricultural and natural resource industries, are considered basic industries. Even though cow-calf and feedlots in Washington sell most of their product to processors in state, the majority of processed beef product are exported outside of the region or state. The basic industries that bring dollars into the economy support the non-basic industries, which could not exist locally without the income to the economy from exports. As such the employment contributions of basic industries support more than the employment directly within the industry.

Basic vs. Non-Basic Impacts: Which Industry Support the Economy?

A small agricultural town may seem to have a large medical industry in terms of employment, while the number of farm employment is fairly low, and often seasonal. However, the farms are exporting their product and bringing money into the economy. The doctor’s offices are predominantly serving the residents. In this story, it is the farmers that are supporting the economy and the doctors are retaining the money within the economy. However, it should be clear that the farms would continue to exist in the absence of the doctor’s offices, while the doctor’s offices would not be likely to stay in the absence of the farms. In this setting, the non-basic medical jobs rely on the basic agricultural jobs. The employment impacts, including many of the doctors and nurses, would be attributed to the non-basic agricultural industries.

This story gets more complex in the case of apples, potatoes, etc. where processing occurs near the primary commodity input. We structure these models to show the interdependency of the grower and processor and assume the grow operation is dominate basic force. This is similar to coal mining or fishing operations where processing is forced to locate where the source of the commodity is located.

Model and Sector Modifications

One of the primary concerns when doing economic contribution studies is the potential for double counting. If we were to claim all the backward links from the slaughterhouses, and then also claim all the backward links of the feedlots, and then all the backward links of the cow-calf operations, all of the animal contributions would be counted three times, once when the calves are sold to the feedlots, once when the feedlots sell the animal to the slaughterhouses, and finally when the slaughterhouses sell the boxed beef. This triple counting of the beef sector supply chain has to be prevented for an accurate analysis. However, we cannot claim only the direct effects of the slaughterhouses either. Doing so would miss the non-beef sector components of the animal processing supply chain, i.e., leaving out electricity, transportation, lab testing expenses, etc. In order to capture all contributions through the supply chain, but prevent the double counting, we can sever the expenditure link between the industries in the sector (Steinback 2004).

This gives slightly more weight to the cow-calf and feedlot operations. Had we maintained the

producer-processor transactional links and only shocked the slaughterhouse exports, beef processors would appear much larger and the producers (cow-calf and feedlot ranches) would appear much smaller. Severing the transactional link is, in our opinion, a more equitable approach for allocating contributions amongst the firms within the beef sector.

The other important component in avoiding double counting is to report value added, also known as gross state product, rather than sales. Though the model is built on producer prices and sales transactions, summing up sales receipts will overstate the actual productivity of a region. If a dairy produces milk, milk is sold to a processor, the processor sells cheese to a commercial pizzeria, and the pizzeria sells pizzas to a retailer, the value of the milk is being incorporated and captured in each round of transactions. To prevent this double, triple, and quadruple counting we report contributions on a value-added basis.

Sales vs. value-added

A way to explain why sales overstates impacts is to imagine individuals spending money in a regional economy. Suppose an individual spends \$40,000 on a new truck. Another individual spends the same amount on an appendectomy at the regional hospital. From a sales perspective, the impacts are the same, \$40,000. However, from a value-added perspective the purchase of the truck provides less to the regional economy. Perhaps \$30,000 of the truck purchase had to immediately go to the manufacturer back in Detroit or Japan. Conversely, the appendectomy at the hospital probably saw most of the spending stay local as income to the doctors, nurses and hospital staff. Perhaps only \$10,000 leaves the region for importing of capital assets like the hospital bed, scalpels, etc. From a value-added perspective, the hospital is more valuable than the auto dealership even though they are equivalent from a sales perspective.

Contributions

The input-output model used in this analysis came from the IMPLAN software and model data for Washington. The contribution of the industry to the Washington economy is measured by different types of impact: direct effects, the immediate effects related to the production and processing of cattle; indirect effects, changes arising from inter-industry transactions as supplying industries respond to the demand from the directly affected industry; and induced effects, the effects due to the local spending on goods and services by employees in the directly and indirectly affected industry sectors. Table 4.1 shows these effects measured in terms of Sales transactions, value added or gross regional product, income, and full-time equivalent employment. In estimating the economic contributions of individual industries, the backward linkages between the cow-calf and feedlot sectors, and between the feedlot and processing sectors were broken in order to avoid double counting when aggregating the effects for the beef sector.

Table 4.1: Beef Sector Economic Contributions by Industry, Effect, and Measure

Cow-Calf	Sales	Value Added	Income	Jobs
Direct	\$233,644,754	\$120,164,548	\$91,256,116	691
Indirect	\$141,025,935	\$73,973,133	\$68,991,059	967
Induced	\$108,102,120	\$67,273,603	\$59,377,194	611
Total	\$482,772,809	\$261,411,284	\$219,624,369	2,270

Feedlots	Sales	Value Added	Income	Jobs
Direct	\$527,217,185	\$36,245,053	\$30,654,585	213
Indirect	\$459,631,414	\$186,921,800	\$174,308,093	1,656
Induced	\$169,358,128	\$105,411,380	\$93,023,408	956
Total	\$1,156,206,727	\$328,578,234	\$297,986,086	2,826

Processors	Sales	Value Added	Income	Jobs
Direct	\$1,695,472,180	\$220,399,868	\$208,653,932	2,684
Indirect	\$760,447,591	\$460,287,653	\$407,863,864	3,897
Induced	\$590,718,191	\$367,740,584	\$324,465,705	3,330
Total	\$3,046,637,962	\$1,048,428,104	\$940,983,500	9,912

Total	Sales	Value Added	Income	Jobs
Direct	\$2,456,334,118	\$376,809,470	\$330,564,633	3,589
Indirect	\$1,361,104,941	\$721,182,586	\$651,163,016	6,521
Induced	\$868,178,439	\$540,425,567	\$476,866,307	4,898
Total	\$4,685,617,498	\$1,638,417,623	\$1,458,593,955	15,007

In 2019, the Washington beef sector generated nearly \$2.46 billion in direct sales, of which about 9.5% came from the cow-calf industry, 21.5% came from the Feedlot industry, and 69% came from the beef processing. The total sales stemming from the beef industry amounted to \$4.69 billion. As stated earlier the sales figures including double counting and do not reflect the final value of goods and services associated with the beef sector. Gross State Product associated with the beef sector and the true **economic contributions of the sector amounted to \$1.64 billion**. Roughly 16% of the sector contributions were attributed to cow-calf operations, 20% were attributed to feedlots and 64% were attributed to beef processing. Total incomes from these industries were \$1.46 billion that were received in the form of Salaries, Wages, and Benefits, as well as proprietor earnings. This income supported 15,007 full time equivalent jobs within the state.

Table 4.2: *Top Industries in Washington Affected by the Beef Sector by Measure*

IMPLAN Code	Industry	Sales	Gross State Product	Income	Jobs
14	Animal production, except cattle and poultry and eggs	\$125,655,344	\$111,705,120	\$119,647,942	870
417	Truck transportation	\$238,817,541	\$110,147,059	\$117,112,380	1,371
400	Wholesale - Other nondurable goods merchant wholesalers	\$179,367,228	\$72,295,801	\$107,402,772	526
398	Wholesale - Grocery and related product wholesalers	\$56,166,969	\$28,222,607	\$29,923,809	282
469	Management of companies and enterprises	\$42,133,537	\$28,739,040	\$29,252,350	204
19	Support activities for agriculture and forestry	\$25,418,148	\$20,288,324	\$21,035,879	582
509	Full-service restaurants	\$24,194,797	\$13,465,483	\$15,816,658	305
455	Legal services	\$18,953,536	\$10,600,153	\$14,438,149	68
456	Accounting, tax preparation, bookkeeping, and payroll services	\$13,495,325	\$9,683,028	\$9,839,221	94
2	Grain farming	\$51,019,789	\$29,655,689	\$8,376,510	171
415	Rail transportation	\$15,174,714	\$7,242,503	\$7,234,272	33

5. Conclusions

The economic contributions of the beef sector remain strong. The sector as a whole produced over \$376 million in direct value-added economic contribution for the state. That represents dollars that would not have existed in the state without the sector's activity and critical exports, which bring new dollars into the economy. Those added dollars to the state then circulate in the economy traveling backwards through the beef sector's supply chain, supporting nearly another \$721 million in indirect, business-to-business, value-added transactions. Employee income is also spent in the state's economy, generating activity in those industries that support household purchases such as food retailers, automotive maintenance, electricity, etc. Those household-to-business expenditures and the associated ripple effects generate approximately another \$540 million in value-added. The entire beef sector in Washington is responsible for just over \$1.63 billion dollars in economic activity and supports over 15,000 full time equivalent jobs.

The packing sector accounts for nearly sixty-four percent of the total economic contribution. The packing industry is highly concentrated and highly competitive economically, processing a large inventory of cattle with low margins. There are two major beef packers in the state. Any economic threat to the packing sector could have an enormous impact to the beef industry statewide. Table 5.1 shows the economic contributions of the sector by industry. We have highlighted the Gross State Product column as it represents the financial economic Contributions of the sector.

Table 5.1: *Economic Contributions by Beef Sector Industry and Measure*

Beef Sector	Sales	Gross State Product	Income	FTE Jobs
Cow-calf Ranches	\$482,772,809	\$261,411,284	\$219,624,369	2,270
Feedlots	\$1,156,206,727	\$328,578,234	\$297,986,086	2,826
Processing Sector	\$3,046,637,962	\$1,048,428,104	\$940,983,500	9,912
Total	\$4,685,617,498	\$1,638,417,623	\$1,458,593,955	15,007

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Appendix 1: Survey Data to Input-Output Vectors

Table A1.1: *Cow-calf Production Functions and IMPLAN Vector*

Sector	IMPLAN ID	IMPLAN Description	Total
Inputs			
Hay	10	All other crop farming	\$45,905,544
Grain	64	Other animal food manufacturing	\$3,493,922
Salts and minerals	34	Other nonmetallic minerals	\$3,969,979
Veterinary medicines	172	Pharmaceutical preparation manufacturing	\$4,349,125
Veterinary services	467	Veterinary services	\$3,186,185
Trucking services	417	Truck transportation	\$3,033,166
Fuel	399	Wholesale - Petroleum and petroleum products	\$5,496,764
Reproduction bulls	19	Support activities for agriculture	\$10,396,756
Repairs	515	Agricultural machinery and equipment maintenance	\$14,728,879
Supplies, misc.	260	Farm machinery and equipment manufacturing	\$5,042,809
Sales commissions			\$6,051,031
Check-off and marketing	465	Advertising, public relations, and related services	\$404,649
		Insurance agencies, brokerages, and related	
Insurance	445	activities	\$906,209
Professional services	463	Technical consulting services	\$649,478
Rents and leases	447	Other real estate	\$5,865,708
Value Added			
Employee compensation	5001	Employee Compensation	\$4,700,057
Proprietor Income	6001	Proprietor Income	\$50,303,041
Other property income	7001	Other Property Type Income	\$36,253,018
Indirect business taxes	8001	Taxes on Production and Imports	\$28,908,432
Total			\$233,644,754

Table A1.2: Feedlot Production Functions and IMPLAN Vector

Sector	IMPLAN ID	IMPLAN Description	Total
Inputs			
Feeder cattle purchases			\$336,666,300
Hay	10	All other crop farming	\$35,698,888
Grain	64	Other animal food manufacturing	\$63,870,598
Salts and minerals	34	Other nonmetallic minerals	\$3,094,418
By product feed			\$31,713,129
Veterinary medicines	172	Pharmaceutical preparation manufacturing	\$5,864,228
Veterinary services	467	Veterinary services	\$1,093,556
Trucking services	417	Truck transportation	\$3,083,775
Fuel	399	Wholesale - Petroleum and petroleum products	\$3,240,758
Repairs	515	Agricultural machinery and equipment maintenance	\$4,166,688
Supplies, misc.	260	Farm machinery and equipment manufacturing	\$1,138,788
Check-off and marketing	465	Advertising, public relations, and related services	\$532,144
Insurance	445	Insurance agencies, brokerages, and related activities	\$151,661
Professional services	463	Technical consulting services	\$657,198
Value Added			
Employee compensation	5001	Employee Compensation	\$9,631,114
Proprietor Income	6001	Proprietor Income	\$20,977,008
Other property income	7001	Other Property Type Income	\$5,244,252
Indirect business taxes	8001	Taxes on Production and Imports	\$392,680
Total			\$527,217,185