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North Dakota Beef Industry

Economic Contribution Analysis

Summary Report

Dean Bangsund and Nancy Hodur, PhD

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Preface

This report is one in a series of summary documents examining the role of agriculture in North Dakota. These summary reports cover only the highlights from an ongoing study of the industry in the state.



Industry Highlights

The following figures combine all segments of the Beef Industry. Beef production is a three-year average from 2018 through 2020, all other industry segments represent a three-year average from 2015 through 2017, and economic metrics include direct and secondary economic effects. Output value represents farm-gate sales, insurance indemnities, farm program payments, miscellaneous revenue, and in the case of multiple farm enterprises under common ownership, the value of an animal when it is transferred to another enterprise.

Beef Production

- ❖ \$32 million output value of beef finishing
- ❖ \$66 million output value for beef bulls
- ❖ \$78 million output value for beef backgrounding
- ❖ \$97 million output value for beef replacement heifers
- ❖ \$708 million output value for beef cow-calf

Economic Metrics

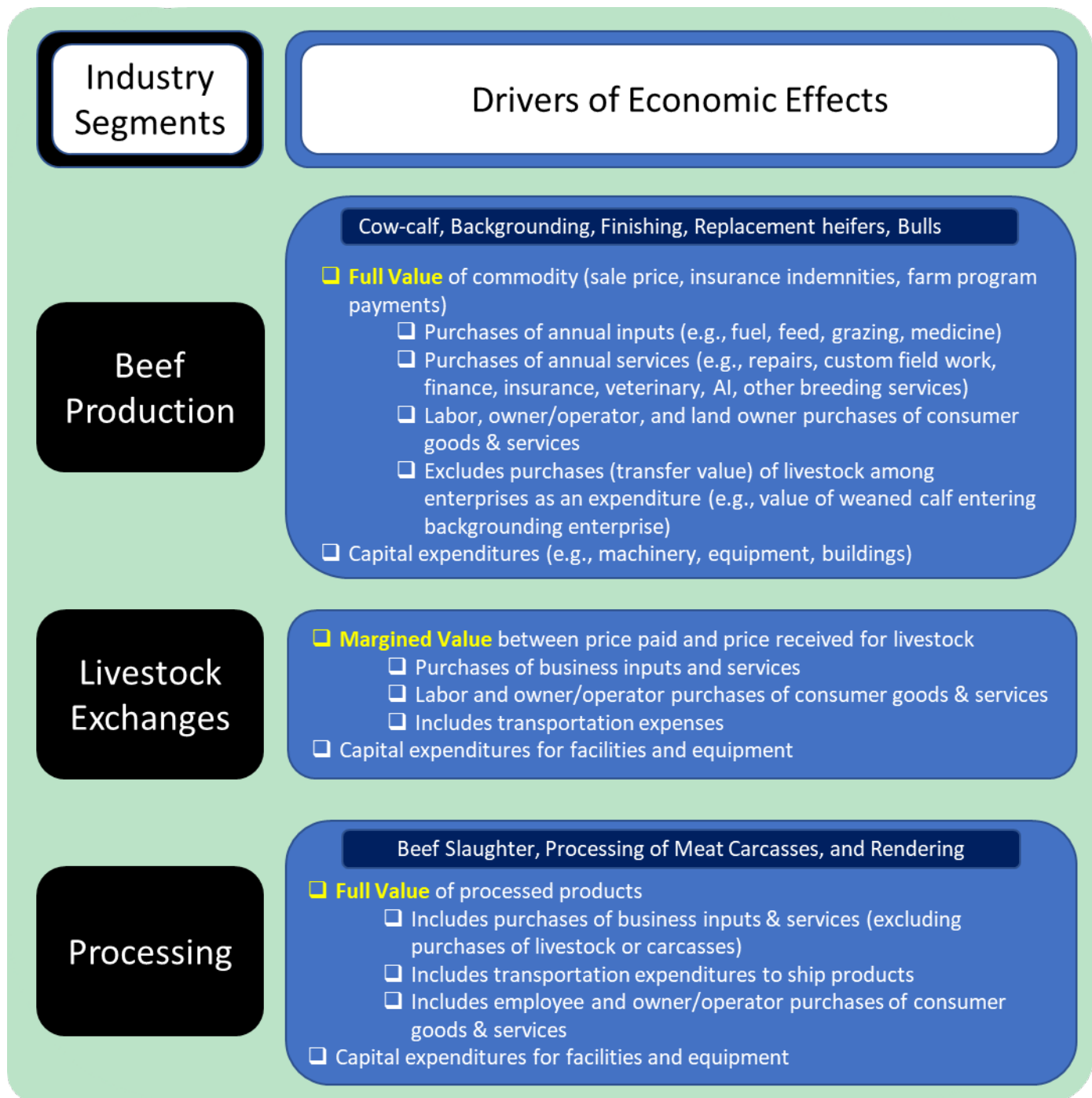
- ❖ \$2.5 billion in gross business volume (GBV)
 - \$2.1 billion GBV beef production
 - \$400 million GBV other beef industry segments
- ❖ 14,400 jobs
 - 13,000 jobs supported by production
 - 1,400 jobs supported by livestock exchanges, transportation, and processing
- ❖ \$531 million in labor income
- ❖ \$1 billion in value-added
- ❖ \$86 million in local and state government revenues

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Industry Composition

The Beef Industry in North Dakota was defined to include farm production, livestock exchanges, and processing. For each component, production expenditures, outlays for capital acquisitions, employment compensation, and owner/operator income are measured for their economic contribution to the state economy. Therefore, each segment is measured for direct effects and secondary effects relating to business-to-business transactions (indirect) and households to business expenditures (induced).



Understanding the Numbers

Economic contribution assessments measure the gross size of an industry or economic sector.

Size is estimated by combining *direct* or first-round effects (i.e., sales, spending, and/or employment) with economic modeling to estimate secondary effects of business-to-business transactions (*indirect*) and household spending for goods and services (*induced*).

Economic measures frequently used in economic contribution assessments:

- ❖ **Labor Income** – earnings of workers and sole proprietors
- ❖ **Employment** – wage and salary jobs and sole proprietor/self-employed jobs
- ❖ **Gross Business Volume** – sum of all business-to-business and household-to-business transactions
- ❖ **Value-added** – represents share of gross state product

An overview and additional information on study methods, data sources, and economic definitions are appended to the end of this report.

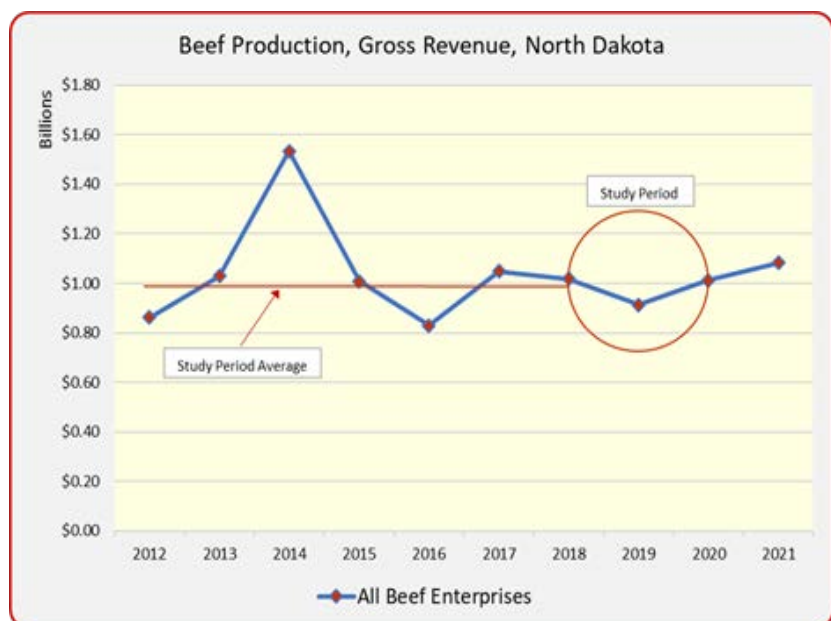
Recent Production History

Beef production included enterprises consisting of cow-calf, replacement heifers, calf backgrounding, beef bulls, and beef finishing.

Cow-calf enterprises represent the production of calves, and include revenues from sales of cull animals and calves. If calves are transferred to another farm enterprise under the same ownership, then the value of the calf at point of transfer is included.

Based on farm gate sales, insurance indemnities, and farm program payments, average annual gross revenues from beef production were

estimated at \$941.4 million from 2018 through 2020. The three-year average was representative of previous years' values going back to 2012, with the exception of production year 2014.

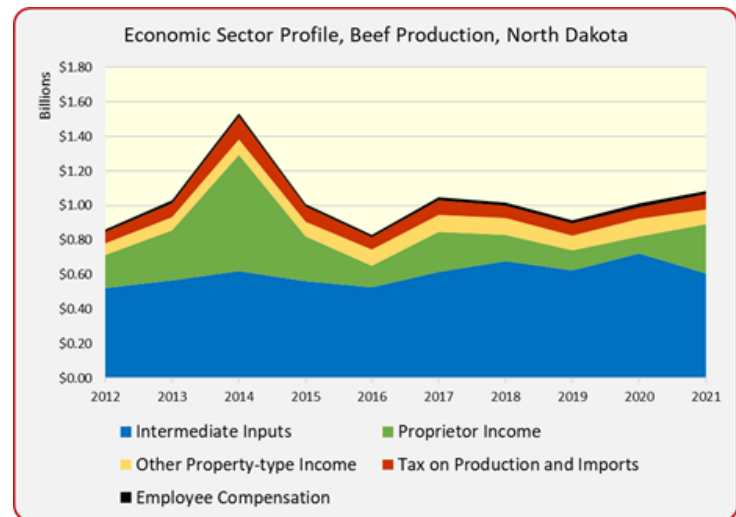
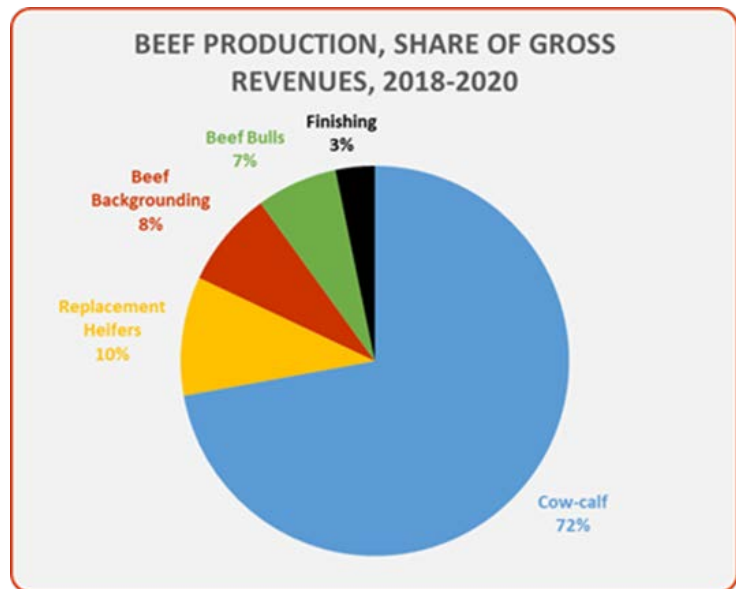


Cow-calf production represented nearly three-fourths of all beef industry gross revenues. Raising replacement heifers and calf backgrounding represented 10 percent and 8 percent, respectively. The remaining 10 percent represented enterprises for raising bulls and beef finishing. Replacement heifers and raising bulls could be considered part of cow-calf operations. If those enterprises are combined with cow-calf enterprises, then nearly 90 percent of all beef production in the state would be attributable to cow-calf operations.

Data from a variety of sources was collected and processed to create a single beef production economic profile. The economic profile provides the foundation for developing estimates of secondary economic output within the North Dakota economy. Economic profiles consist of gross revenues, paid labor, proprietor income, other property type income, taxes, and intermediate inputs (details on economic profiles are appended to the end of this summary)

Gross output for North Dakota's beef enterprises was estimated at \$981.4 million. The remainder of the economic profile for beef production included an average of \$19 million in paid labor, \$121 million in proprietor income, \$70 million in taxes, and \$676 million in production inputs from 2018 through 2020.

Production inputs, which are the largest component of an economic profile, represent goods and services consumed in one production cycle, and do not include capital purchases of equipment, machinery, buildings and other structures. A separate analysis (data not presented), based on producer records, was conducted for purchases of capital equipment for beef enterprises.



Beef Production Statistics and Economic Profile, North Dakota, 2016 through 2020

	2016	2017	2018	2019	2020	Average 2018- 2020
Production Statistics	----- 000s head -----					
All Inventory (beef and dairy)	1,710.0	1,810.0	1,878.0	1,820.0	1,900.0	1,866.0
Beef Cows that Calved	904.0	954.0	984.5	975.0	995.0	984.8
Calf Crop	910.0	903.7	959.2	950.0	920.0	943.1
Cattle on Feed	55.0	50.0	58.1	58.7	42.4	53.2
Economic Profile	----- millions \$ -----					
Output	830.3	1,048.0	1,017.5	913.8	1,013.1	981.4
Employee Compensation	15.7	18.0	16.4	16.5	24.0	19.0
Proprietor Income	125.6	232.7	148.0	117.5	98.4	121.3
Other Property-type Income (OPTI)	92.2	97.7	98.4	83.9	101.9	94.7
Tax on Production and Imports (TOPI)	71.0	83.6	74.6	71.4	65.1	70.4
Intermediate Inputs	525.7	615.9	680.0	624.5	723.6	676.0

Business Volume

Gross business volume for beef production was estimated at \$2.1 billion, with \$981 million in direct effects and \$1.1 billion in secondary economic effects. The beef industry, which included livestock exchanges and processing activities was estimated to have direct output of \$1.3 billion, and when combined with secondary economic effects, had an average annual total gross business volume of \$2.5 billion.

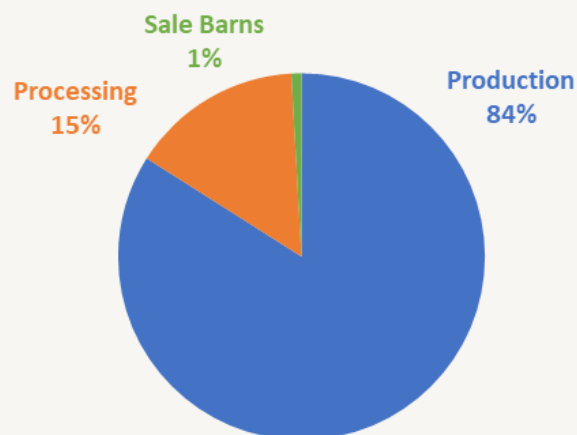
Beef production represented about 84 percent of the beef industry's gross business volume in North Dakota. Beef processing, which was based on an estimate of beef's share of economic activity in NAICS code 3116, represented 15 percent of the industry. Economic output from livestock exchanges/sale barns represented 1 percent of beef industry's output.

Business Volume

Business volume, sometimes called output or economic output, is the value of goods or services produced by an economic sector, and is largely synonymous with sales or gross receipts.

Gross business volume (GBV) is the sum of direct output/sales and output/sales from indirect and induced economic activity in all economic sectors.

Beef Industry, Share of Gross Business Volume



Business Volume, Beef Industry, North Dakota, Annual Average 2018 through 2020

Economic Activity	Beef Production	Livestock Exchange	Processing	Industry Totals
	----- millions \$ -----			
Direct Sales	981.5	12.4	299.2	1,293.1
Indirect Activity	862.5	5.7	50.8	919.0
Induced Activity	274.8	4.3	31.2	310.3
Gross Business Volume	2,118.8	22.4	381.2	2,522.4

Notes: Beef production represents an annual average from 2018 through 2020. Livestock exchanges and commodity processing represent an annual average from 2015 through 2017.

Employment

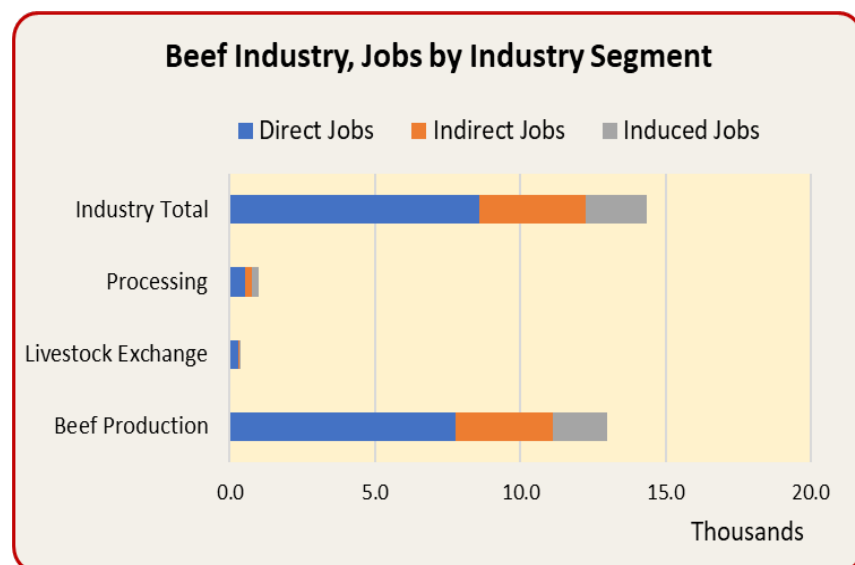
Assigning direct farm employment to specific farm enterprises (i.e., individual crops or livestock operations) is difficult, if not inaccurate, as wage/salary labor and self-employment are assigned based on only one NAICS code. Farms and ranches are represented based on which enterprise provides one-half or more of the establishment's total production. Therefore, if a farm produces multiple crops, it is likely that wage/salary employment will be placed in only one NAICS code for a specific crop. In reality, some of the direct farm labor in some commodity assignments also contributes to the production of other commodities, but current labor tracking systems prevent the estimation of crop-shares or livestock-shares for those employment values.

Direct employment for beef production, using the limitations of NAICS assignments identified above, was estimated at 7,800 jobs (wage/salary and sole proprietors). All direct employment, across the industry's several segments, was estimated 8,600 jobs.

Secondary employment for beef production, across all economic sectors, was estimated at 5,200 jobs. All secondary employment for the industry's other segments was estimated at 565 jobs. The beef industry, including production, exchanges, and all forms of processing was estimated to support 14,350 jobs.

Employment

Employment represents jobs with paid compensation. Estimates of employment include both wage and salary positions and sole proprietors/ self-employed.



Employment, Beef Industry, North Dakota, Annual Average 2018 through 2020

Economic Activity	Beef Production	Livestock Exchange	Processing	Industry Totals
	----- jobs -----			
Direct	7,789	297	508	8,594
Indirect Activity	3,344	45	263	3,652
Induced Activity	1,856	31	226	2,113
All Jobs	12,989	372	997	14,358

Notes: Beef production represents an annual average from 2018 through 2020. Livestock exchanges and commodity processing represent an annual average from 2015 through 2017.

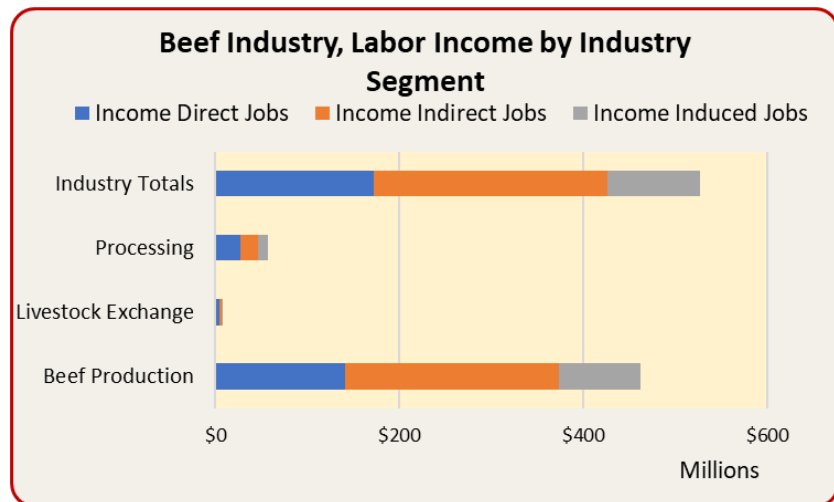
Labor Income

The beef industry directly paid \$172 million for wage/salary and self-employed jobs across all industry segments. Labor income supported by indirect economic activity was estimated at nearly \$260 million, and labor income for induced economic activity was estimated at \$100 million. The beef industry supported a total of \$530 million in labor income across direct, indirect, and induced economic effects.

Beef production comprised the largest share of labor income estimated at \$466 million or about 88 percent of the industry's total labor income.

Labor Income

Labor income represents financial compensation paid to workers, and includes wages, salaries, benefits and income of sole proprietors/ self-employed.



Labor Income, Beef Industry, North Dakota, Annual Average 2018 through 2020

Economic Activity	Beef Production	Livestock Exchange	Processing	Industry Totals
	----- millions \$ -----			
Direct	140.5	3.9	27.6	172.0
Indirect Activity	237.6	2.4	19.0	259.0
Induced Activity	88.6	1.4	10.3	100.3
Total Labor Income	466.7	7.7	56.9	531.3

Notes: Beef production represents an annual average from 2018 through 2020. Livestock exchanges and commodity processing represent an annual average from 2015 through 2017.

Value-added

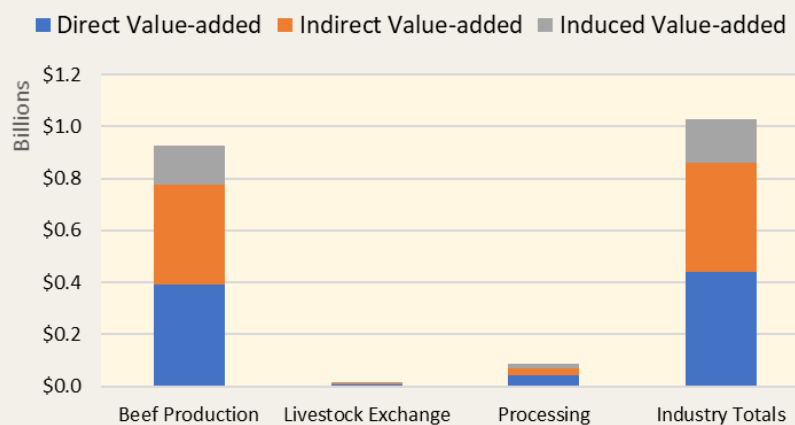
The beef industry had an average annual value-added of \$1 billion. Beef production comprised about 90 percent of the beef industry's total value added.

Of the \$1 billion in value added, direct output in the industry produced about \$350 million, while secondary economic output generated about \$673 million.

Value-added

Value-added is the contribution made to gross state product. Gross state product includes labor income, other property type income, and taxes on production and imports. It does not include the purchases of inputs and services (intermediate inputs) but does include capital consumption.

Beef Industry, Value-added by Industry Segment



Value-added, Beef Industry, North Dakota, Annual Average 2018 through 2020

Economic Activity	Beef Production	Livestock Exchange	Processing	Industry Totals
	----- millions \$ -----			
Direct	305.4	8.2	40.9	354.5
Indirect Activity	472.2	3.3	28.9	504.4
Induced Activity	148.2	2.4	17.7	168.2
Total Value-added	925.8	13.9	87.5	1,027.1

Notes: Beef production represents an annual average from 2018 through 2020. Livestock exchanges and commodity processing represent an annual average from 2015 through 2017.

Government Revenues

Of the taxes paid directly by beef production, property taxes represented nearly \$47 million of the \$48.6 million paid to state and local governments. Secondary business activity generated by beef production generated an additional \$33 million in state and local government revenues. Beef production was estimated to generate over \$81 million in state and local tax revenues.

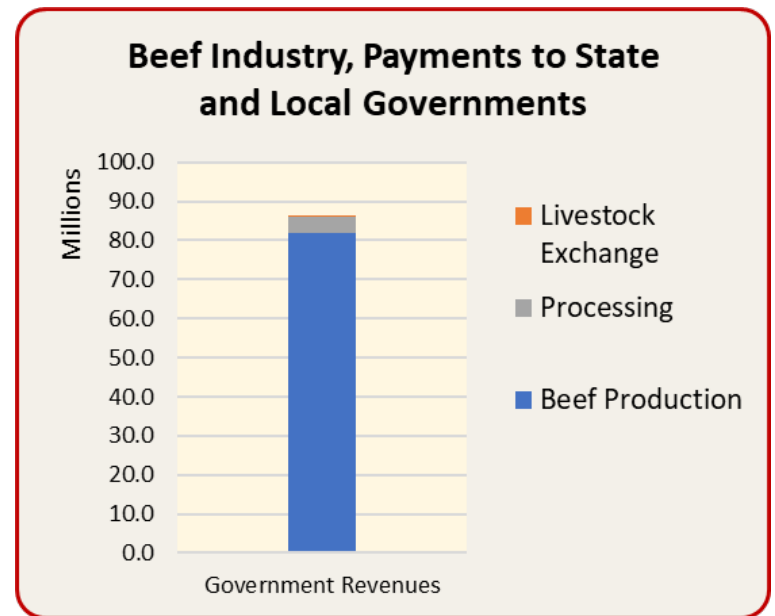
Government Revenues

Government revenues represent industry payments for taxes, licenses, permits, fees, penalties, and fines.

Government Revenues, Beef Production, North Dakota, Annual Average 2018 through 2020	
Government Jurisdiction and Type of Revenue	Government Revenues
	--- 000s \$ ---
Paid Directly by Beef Production¹	
Federal Government	28,440.4
State and Local Governments	48,631.5
Total	77,071.9
Paid Directly by Beef Production to State and Local Government¹	
Social Insurance Taxes	92.7
Sales and Use Tax	1,452.9
Property Tax	46,627.6
Corporate Income Tax	107.0
Personal Income Tax	118.8
Misc. Taxes and Revenues	232.5
Total	48,631.5
Paid by Secondary Business Activity to State and Local Government²	
Social Insurance Taxes	1,276.6
Sales and Use Tax	10,619.1
Property Tax	15,113.9
Corporate Income Tax	928.4
Personal Income Tax	1,938.6
Misc. Taxes and Revenues	3,318.7
Total	33,195.3
Total State and Local Revenues	
Paid by Beef Production	48,631.5
Paid from Secondary Business Activity	33,195.3
Total	81,826.8
¹ Payments made by producers, farm workers, and owners of farm land. ² Payments associated with indirect (business spending) and induced (household spending) activity generated by beef production, land rent, Federal Crop Insurance Administrative and Operational outlays, and producers' capital expenditures. Sources: IMPLAN LLC (2022), FINBIN (multiple years), ND Office of State Tax Commissioner (multiple years).	

State and local government revenues also were estimated for the other segments of the beef industry. Direct payments made by livestock exchanges (beef share) and beef processing were estimated at \$1.2 million. Total direct payments by the beef industry were estimated at nearly \$50 million. Indirect and induced business activity was estimated to generate an additional \$36 million in government revenues.

The beef industry was responsible for \$86 million in state and local government revenues for direct, indirect, and induced economic activity across production, livestock exchanges, and processing.



Government Revenues, Beef Industry, North Dakota, Annual Average 2018 through 2020

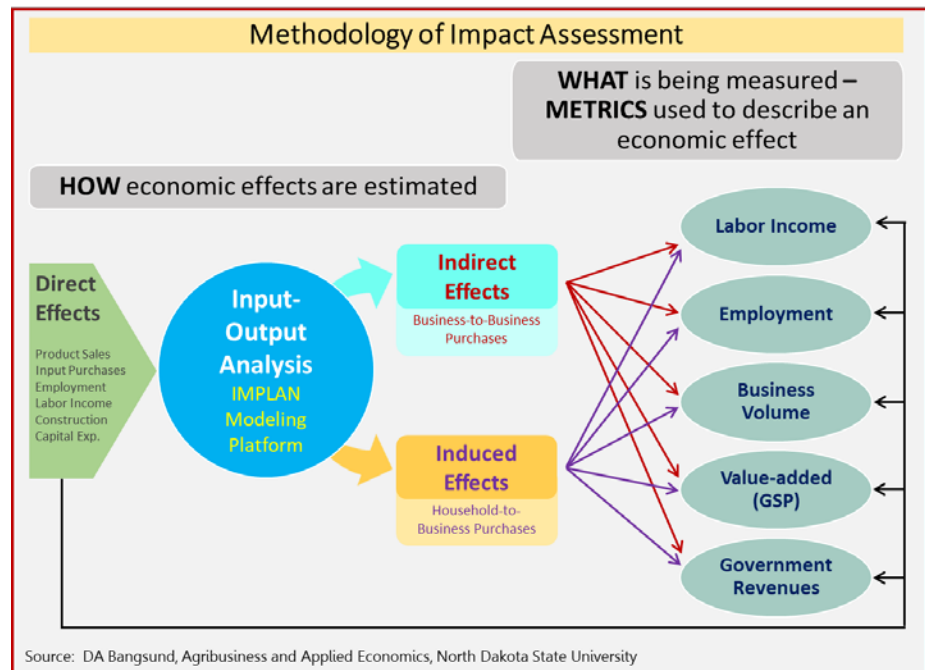
Economic Activity	Beef Production	Livestock Exchange	Processing	Industry Totals
	----- 000s \$ -----			
Direct	48,613.5	28.8	1,142.2	49,784.5
Indirect Activity		153.4	1,954.2	
Induced Activity	33,195.3	145.8	1,036.8	36,485.5
Total Revenues	81,808.8	328.0	4,133.2	86,270.0

Notes: Beef production represents an annual average from 2018 through 2020. Livestock exchanges and commodity processing represent an annual average from 2015 through 2017.

Supplemental Materials

Economic Contribution Analysis

An economic contribution assessment measures the gross size of some aspect or component of an economy, and is usually measured in conjunction with the overall size of a given economy over a specified period. Size is estimated by combining direct or first-round effects (e.g., industry expenditures, business sales, new employment) with economic modeling to estimate how those first round effects generate business-to-business transactions and household spending on consumer goods and services. Both of those conduits for economic output can be framed using labor income, employment, value-added, gross business volume and government revenues.



Key Terms and Concepts

Direct Effects: represent the first-round of payments for services, labor, and materials and/or sales of an industry's products.

Indirect Effects: economic activity created through purchases of goods and services by businesses.

Induced Effects: economic activity created through purchases of goods and services by households.

Industry Output and Gross Business Volume: Industry output is the value of all goods and services produced and supported by an industry. In most industries, output is largely synonymous with sales; however, for some sectors output also includes changes in product inventory. For production agriculture, direct output includes both sales and inventory adjustments.

When output from business-to-business transactions (*indirect*) and households-to-businesses (*induced*) are measured, they also are described as the *sum of gross receipts* as annual adjustments to inventories are largely unquantified and not distinguished from sales. *Gross business volume* (GBV) therefore includes direct output/sales and includes secondary sales from indirect and induced economic activity.

Value-added: Value-added is synonymous with measures of gross domestic product (GDP) and gross state product (GSP), and are some of the most commonly used economic measures to indicate the economic size and change in economic output. However, official government estimates of GDP and GSP do not include secondary economic effects generated by any industry. For agriculture, official government estimates are primarily limited to crop, livestock, and forestry sectors. Economic contribution assessments include secondary economic effects, and include GSP from those effects, thereby providing a more realistic and representative portrait of an industry.

Key components of value-added include labor income, consumption of fixed capital, profits, business current transfer payments (net), income derived from dividends, royalties, and interest. In nontechnical terms, value-added is equal to product value minus production inputs. For example, value-added from growing wheat would be the value of wheat produced less the value of the inputs consumed in raising that crop, such as fertilizer, chemical, repairs, fuel, etc. Depreciation charged to durable assets (e.g., tractors) are not included in value-added measures.

Employment Compensation: wages, salaries, and benefits earned by an employee.

Proprietor Income: payments received by self-employed individuals and unincorporated business owner/operators.

Labor Income: combination of wages, salaries, and benefits for employees and compensation for self-employed individuals.

Input-output Analysis (I-O): mathematical application of the interdependence among producing and consuming sectors in an economy.

I-O Matrix: depiction of an economy using a grid of rows and columns that represents consumption and production for each economic sector in an economy.

Intermediate Inputs: goods and services consumed in one year to produce another good or service. Intermediate inputs do not include expenditures for capital inputs used for multiple production seasons (e.g., machinery, buildings).

Capital Inputs: Represent the use of inputs to produce another good or service that are not consumed in one production season and are subject to depreciation. *Capital expenditures* represent the purchase of those depreciable assets.

Industry Balance Sheet: Dividing an industry or economic sector into various components for use in estimating the economic effects using input-output analysis. Components of the balance sheet include measures of output, wage and salary employment, self-employment, payroll and proprietor income, other property type income, taxes on production and imports, and intermediate inputs.

Institutions: Represent governments and other non-private entities consuming goods and services in an economy.

Households: Represent one or more individuals in a specific living arrangement for which income from all sources is used to purchase goods and services.

North American Industry Classification System (NAICS): government classification system for all goods and services produced in the economy.

Employment Sources and Measures

Employment is broadly measured in two distinct categories: covered and uncovered. Covered workers are those that are employed by a business, institution, or government agency, receive a wage or salary, and are subject to unemployment insurance (UI). Jobs that fall under an UI program are called 'covered' employment. Quarterly Census of Employment and Wages (QCEW) employment reported by Job Service ND is 'covered' employment. QCEW data are collected for each state and reported by the US Bureau of Labor Statistics (BLS). Therefore, employment statistics for self-employed farmers and ranchers cannot be derived from QCEW data.

By definition, **capital expenditures** would arise from use of Other Property Type Income (OPTI); however, OPTI does not generate any indirect or induced effects. Capital expenditures were modeled independently from the custom crop and livestock sectors to estimate the economic effects from purchases of new buildings and structures, tractors, combines, machinery, equipment, and other durable goods not consumed in one production cycle.

Cash rent can be included as proprietor income within an ag production sector, assigned to a real estate sector as an intermediate input, or placed in OPTI. Cash rent was placed in OPTI, and a share of cash rent paid by producers, net of property tax, was modeled as a revenue stream to in-state landowners.

The revenue stream to landowners was modeled as a labor income event within the custom IO matrix. Federal crop insurance generates additional revenue to the state from **Administrative and Operating (A&O) subsidies**. A&O subsidies were modeled as separate industry spending events since those revenue streams affect financial sectors and are not internally linked in the IO matrix to crop and livestock production sectors.

Study Parameters

-) Crop and livestock production was based on 2018 through 2020 data.
-) All other segments of the industry were based on 2015 to 2017 data, except ethanol production, which was based on 2021 production.
-) Expenses associated with summer fallow and prevent plant were included in crop production.
-) Sale barns/livestock exchanges were estimated separately in the study, but are presented in this summary as part of commodity handling.
-) Default IMPLAN data was used for all forestry activities in the state.
-) Data for the study came from surveys of industry firms, state and federal government agencies, NDSU Extension, and other secondary sources. Survey and secondary data were used to develop industry balance sheets (i.e., profiles) for the Agriculture's numerous economic sectors.

Treatment of Traditional Sectors Supporting Production Agriculture

This summary omits specific details of how the secondary economic effects are distributed among the state's numerous sectors and sub-sectors. Several economic sectors support production agriculture by providing inputs and services to crop and livestock producers. Examples include implement sales, custom field work and applications, seed companies, and supply stores. Under some definitions, those activities and sectors are presented as "direct" segments of the Agriculture Industry, much like crop production and grain handling are considered stand-alone components of the industry. However, from the perspective of how this study's input-output analysis was structured, those sectors represent "indirect" economic output of the industry, meaning those sectors are supported and sustained from purchases relating to crop and livestock production.

Sectors traditionally considered core components of Agriculture, but defined as indirect components of the industry in this assessment, are identified in the following table and with corresponding NAICS codes for those activities.

Key Economic Sectors Representing Components of Production Agriculture Whose Output and Employment are Contained (grouped) within Indirect Economic Effects

Industry Segment	Economic Sector Description	NAICS ¹
Agricultural Production		
	Support activities for agriculture and forestry	115
	Construction of new commercial structures, including farm structures	2362
	Support activities for transportation	4882
	Warehousing and storage	4931
	Securities and commodity contracts intermediation and brokerage	5231
	Insurance agencies, brokerages, and related activities	5242
	Commercial and industrial machinery and equipment rental and leasing	5234
	Veterinary services	5419
	Commercial and industrial machinery and equipment repair and maintenance	8113
Wholesale Trade		
	Agricultural chemicals merchant wholesalers	424910
	Agricultural machinery and implement merchant wholesalers	423820
	Animal feeds (except pet food) merchant wholesalers	424910
	Auction markets, tobacco, horses, mules	424590
	Beans, dry, merchant wholesalers	424510
	Berries, fresh, merchant wholesalers	424480
	Cattle, hog, sheep merchant wholesalers	424520
	Doughs, frozen, merchant wholesalers	424420
	Dried foods (e.g., fruits, milk, vegetables) merchant wholesalers	424490
	Dry beans merchant wholesalers	424510
	Eggs merchant wholesalers	424440
	Elevators merchant wholesalers	423830
	Farm supplies merchant wholesalers	424910
	Feed additives merchant wholesalers	424910
	Fertilizer and fertilizer materials merchant wholesalers	424910
	Flour merchant wholesalers	424490
	Grain elevators, merchant wholesalers grain	424510
	Honey merchant wholesalers	424490
	Irrigation equipment merchant wholesalers	423820
	Land preparation machinery, construction, merchant wholesalers	423810
	Livestock equipment, merchant wholesalers	424470
	Storage bins merchant wholesalers	423820
	Veterinarians' equipment and supplies merchant wholesalers	423390
	Veterinarians' medicines merchant wholesalers	423490
	Wool, raw, merchant wholesalers	424210
¹ North American Industrial Classification System		

Economic Sectors for Processing, Manufacturing, and Transportation included in Agriculture Industry, Defined by North American Industry Classification System

Industry Segment	Sector Description	NAICS ¹
Crop and Livestock Commodity Processing		
	All other food manufacturing	3119
	Animal, except poultry, slaughtering	3116
	Beet sugar manufacturing	3113
	Bottled and canned soft drinks & water	3121
	Bread and bakery product, except frozen, manufacturing	3118
	Breweries	3121
	Canned fruits and vegetables manufacturing	3114
	Confectionery manufacturing from purchased chocolate	3113
	Creamery butter manufacturing	3115
	Dehydrated food products manufacturing	3114
	Distilleries	3121
	Dry pasta, mixes, and dough manufacturing	3118
	Fats and oils refining and blending	3112
	Flour milling	3112
	Fluid milk manufacturing	3115
	Frozen cakes and other pastries manufacturing	3118
	Frozen fruits, juices and vegetables manufacturing	3114
	Frozen specialties manufacturing	3114
	Malt manufacturing	3112
	Meat processed from carcasses	3116
	Nonchocolate confectionery manufacturing	3113
	Other animal food manufacturing	3111
	Other basic organic chemical manufacturing (ethanol)	3251
	Rendering and meat byproduct processing	3116
	Roasted nuts and peanut butter manufacturing	3119
	Soybean and other oilseed processing	3112
	Spice and extract manufacturing	3119
	Tobacco product manufacturing	3122
	Wet corn milling	3112
	Wineries	3121
Agricultural Manufacturing		
	Pesticide and other agricultural chemical manufacturing	3253
	Farm machinery and equipment manufacturing	3331
Transportation		
	Truck transportation	4841
	Railroad transportation	4821
¹ North American Industrial Classification System		

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 Northern Pulse Growers Association
 Red River Valley Sugarbeet Growers Association

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