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North Dakota Corn Industry

Economic Contribution Analysis

Summary Report

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Preface

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



Industry Highlights

The following figures combine all segments of the North Dakota corn industry. Crop production is a three-year average from 2018 through 2020, ethanol is based on 2021 data, other industry segments represent a three-year average from 2015 through 2017, and economic metrics include direct and secondary economic effects.

Annual average corn production from 2018 through 2020.

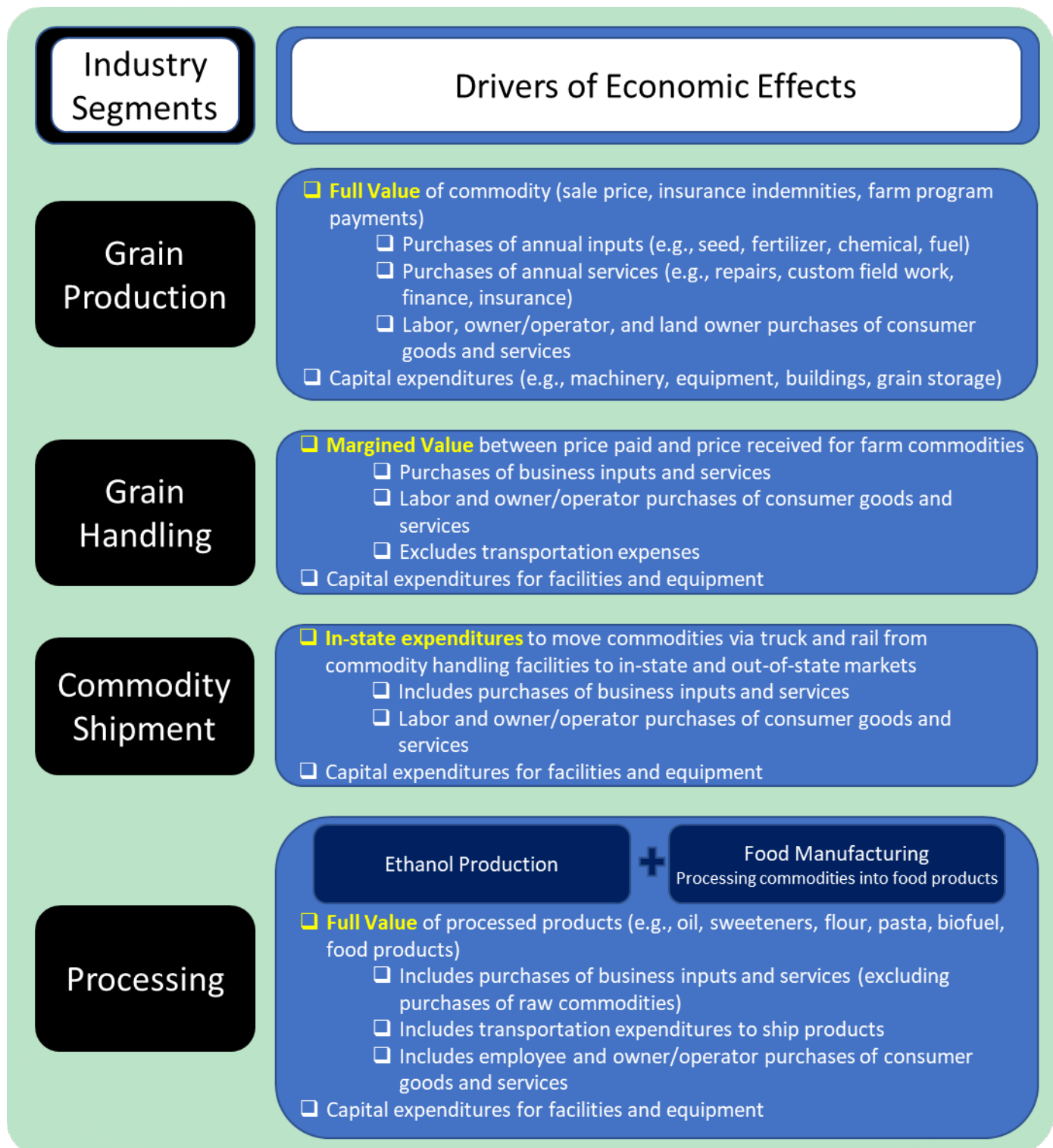
- ❖ 2,702,900 planted acres
- ❖ 388,210,000 bushels produced
- ❖ \$1,348,200,000 farm gate value
- ❖ \$1,753,900,000 combined farm gate value, insurance indemnities, farm program payments, and other crop income

Economic metrics for the North Dakota corn industry.

- ❖ \$6.1 billion gross business volume
 - \$3.1 billion from corn production
 - \$3.0 billion from grain handling, transportation, ethanol, and other processing
- ❖ 16,800 jobs
 - 10,220 jobs supported by production
 - 6,580 jobs supported by grain handling, transportation, ethanol, and other processing
- ❖ \$1.2 billion in labor income
- ❖ \$2.4 billion in value-added
- ❖ \$130 million in local and state government revenues

Industry Composition

The corn industry in North Dakota includes farm production, grain handling, transportation, processing, and ethanol. 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

The study period for the economic contribution of corn production was 2018 through 2020, and included all corn-grain production in ND. Corn grown for silage was not included in the corn sector economic contribution. The next three figures show how key economic information for corn production in North Dakota compares from 2012 through 2020.

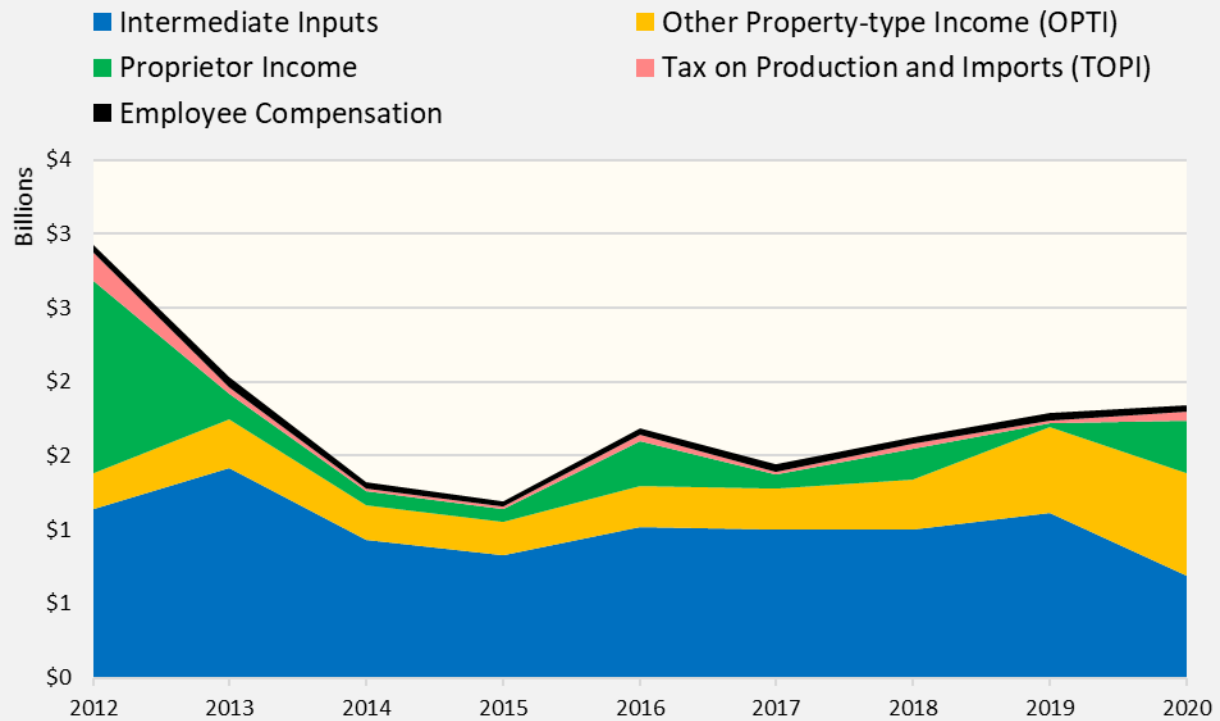
Economic sector profiles, part of the economic modeling requirements, show the relative financial values for proprietor income, paid labor, taxes, other property type income (cash rent, capital outlays), and intermediate inputs (term for inputs consumed during one production year such as seed, fertilizer, fuel, among others). As would be expected in farm production, production revenues varied considerably over the period.

Gross revenues for corn production were comprised of farm gate value (price/bu x bushels), farm program payments, insurance indemnities, and other revenues. During the 2012 to 2020 period, farm gate values were the dominant source of revenues for corn production.

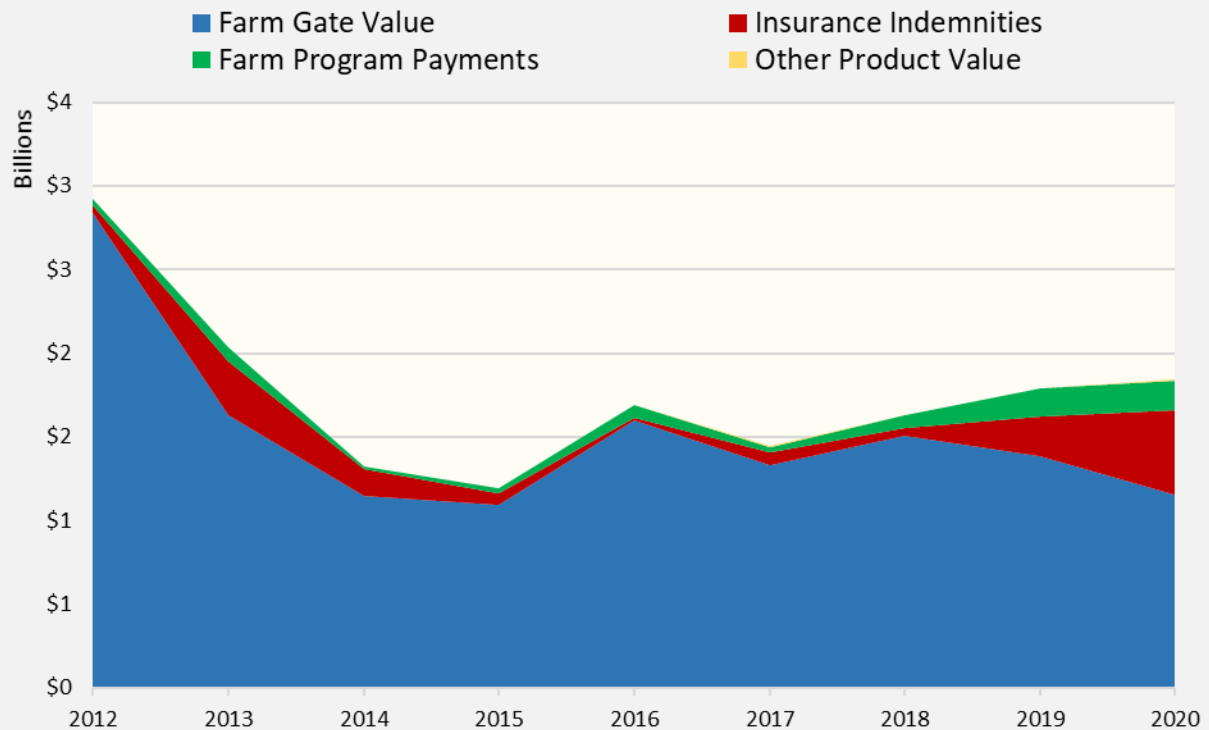
Corn production revenues in North Dakota averaged \$1.75 billion from 2018 to 2020. The average from 2018 through 2020 was compared to the annual revenues for 2012 through 2017, and was considered representative of average revenues for corn production over that period.

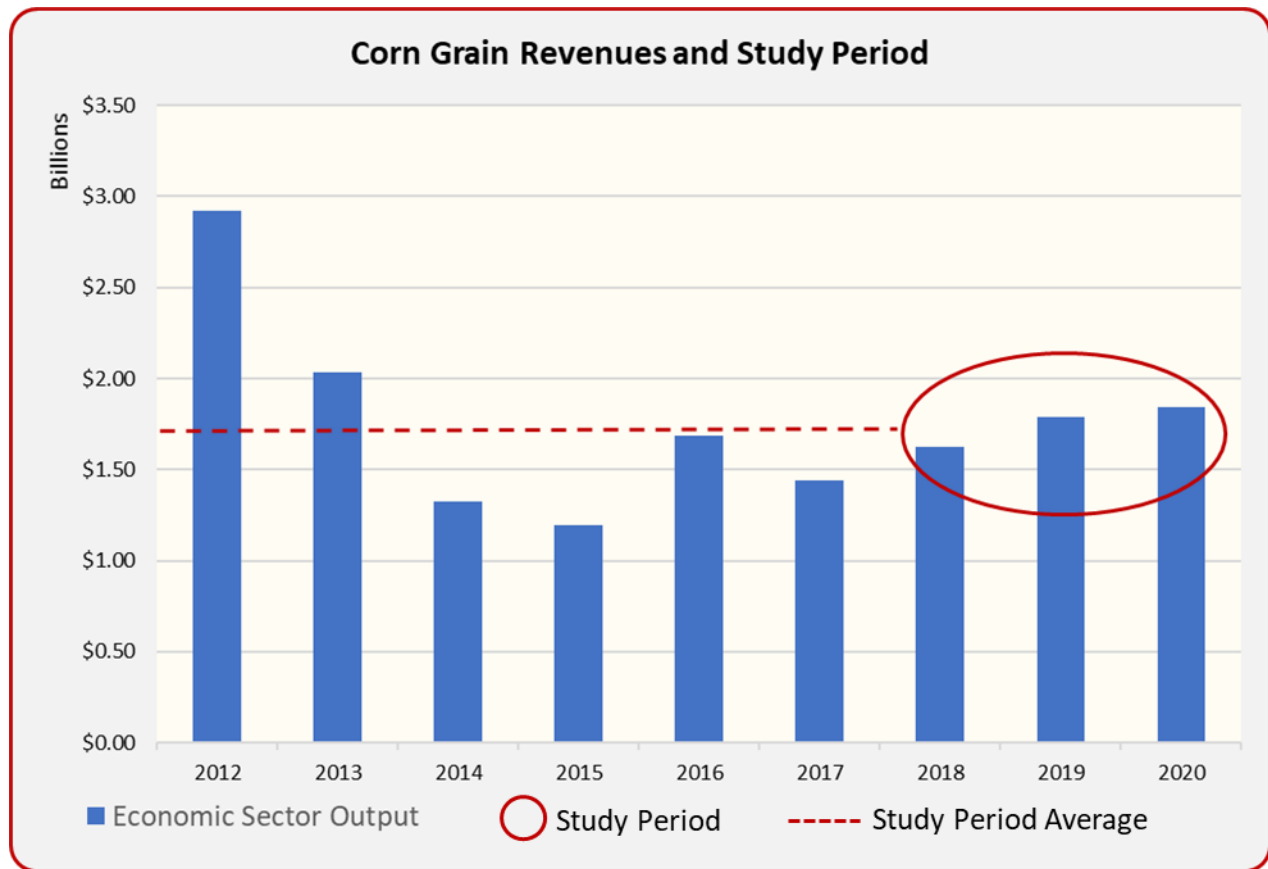
Corn production averaged about \$935 million in production inputs, nearly \$200 million in proprietor income, and \$48 million in paid labor expenses annually from 2018 through 2020.

Corn Grain, Economic Sector Profile



North Dakota Corn Grain Production Revenues





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

	2016	2017	2018	2019	2020	Average 2018- 2020
Production Statistics						
Acreage (000s)	3,181.6	3,137.6	2,870.5	3,319.8	1,918.5	2,702.9
Yield (bu/ac)	166.8	139.7	157.9	136.1	135.4	143.6
Price (per bushel)	\$3.01	\$3.04	\$3.32	\$3.07	\$4.44	\$3.47
Farm Gate Value (millions \$)	1,597.5	1,332.9	1,504.6	1,386.6	1,153.4	1,348.2
Other Product Value (millions \$)	0.7	3.6	0.0	0.0	6.3	2.1
Insurance Indemnities (millions \$)	14.4	76.7	45.2	232.9	504.6	260.9
Farm Program Payments (millions \$)	76.0	29.0	77.4	169.8	180.6	142.6
Economic Profile						
	----- millions \$ -----					
Output	1,702.9	1,518.9	1,627.2	1,789.4	1,845.0	1,753.9
Employee Compensation	41.8	46.9	42.2	54.0	49.2	48.5
Proprietor Income	301.6	89.4	207.6	27.6	356.7	197.3
Other Property-type Income (OPTI)	291.7	357.1	342.8	578.9	688.0	536.6
Tax on Production and Imports (TOPI)	50.1	24.5	36.0	13.2	59.4	36.2
Intermediate Inputs	1,017.7	1,001.0	998.5	1,115.7	691.5	935.3

Business Volume

Gross business volume for corn production was estimated at \$3.1 billion, with \$1.75 billion in direct effects and \$1.35 billion in secondary economic effects. The corn industry, which included grain handling, commodity shipment, corn processing, and ethanol production was estimated to have direct output of \$4 billion, and when combined with secondary economic effects, had an average annual total gross business volume of \$6.1 billion.

Corn production represented about half of the corn industry's gross business volume in North Dakota. Ethanol represented 27 percent of the industry. Economic output from commodity shipment was 10 percent, with grain handling and other processing comprising the remaining 13 percent of the industry.

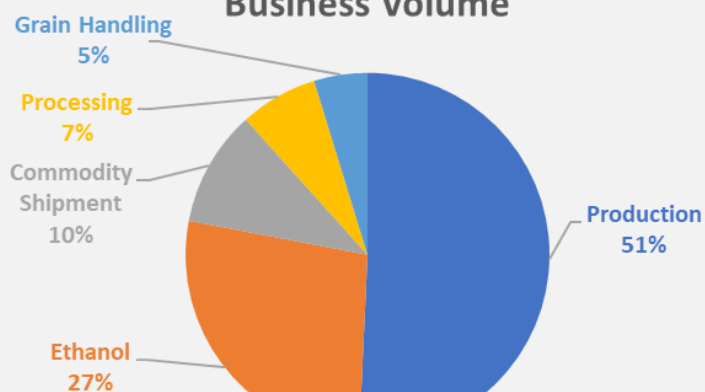
Ethanol production had a gross business volume of nearly \$1.7 billion in 2021. A separate section, presented later in this summer, highlights the findings of a recent industry-wide survey of ethanol production in the state. To prevent disclosure of the state's only non-corn-based plant, all ethanol production is presented in this summary. Output from the lone non-corn plant is sufficiently small as to not distort the findings for the corn industry in North Dakota.

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.

Corn Industry, Share of Gross Business Volume



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

Economic Activity	Crop Production	Grain Handling	Commodity Shipments	Commodity Processing	Ethanol	Industry Totals
----- millions \$ -----						
Direct Sales	1,753.9	190.1	370.5	290.5	1,420.9	4,025.9
Indirect Activity	964.0	53.5	130.7	101.6	174.7	1,424.5
Induced Activity	394.0	47.6	133.5	32.2	75.9	683.2
Gross Business Volume	3,111.9	291.2	634.7	424.3	1,671.9	6,134.0

Notes: Crop production represents an annual average from 2018 through 2020. Grain handling, commodity shipments, and commodity processing represent an annual average from 2015 through 2017. Ethanol represents annual operations in 2021 and capital expenditures averaged from 2019 through 2021.

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 for those employment values.

Direct employment for corn production, using the limitations of NAICS assignments identified above, was estimated at 2,600 jobs (wage/salary and sole proprietors). All direct employment, across the industry's several

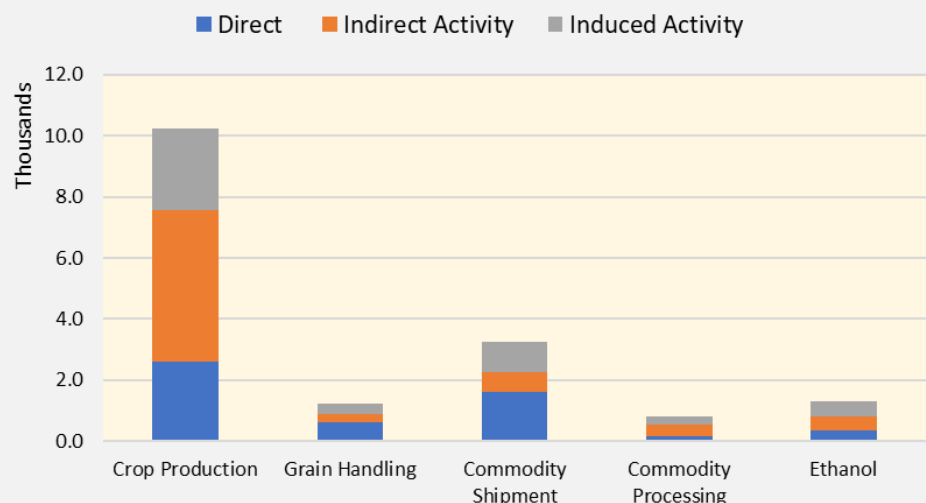
segments, was estimated at 5,300 jobs. Over 1,600 jobs were in commodity shipment, with the majority of those jobs in the trucking transportation sector (data not shown).

Secondary employment for corn production, across all economic sectors, was estimated at 7,600 jobs. All secondary employment for the industry's other segments was estimated at 3,800 jobs. The corn industry, including production, grain handling, commodity shipment, and all forms of commodity processing was estimated to support 16,800 jobs.

Employment

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

Employment, by Type, by Industry Segment



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

Economic Activity	Crop Production	Grain Handling	Commodity Shipments	Commodity Processing	Ethanol	Industry Totals
Direct	2,598	630	1,628	144	342	5,342
Indirect Activity	4,967	266	650	416	468	6,767
Induced Activity	2,659	344	968	233	500	4,704
All Jobs	10,216	1,239	3,243	793	1,310	16,801

Notes: Crop production represents an annual average from 2018 through 2020. Grain handling, commodity shipments, and commodity processing represent an annual average from 2015 through 2017. Ethanol represents annual operations in 2021 and capital expenditures averaged from 2019 through 2021.

Labor Income

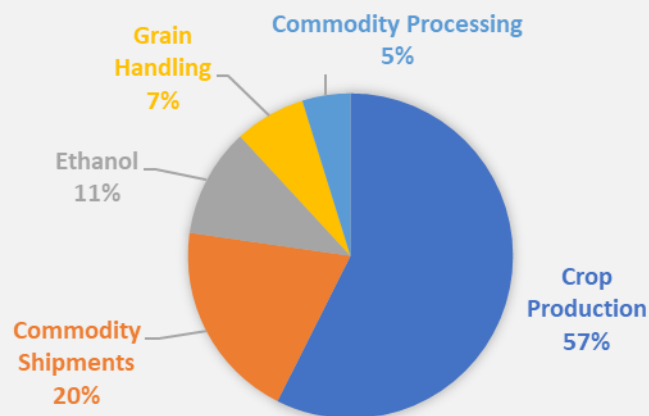
The corn industry directly paid \$532 million for wage/salary and self-employed jobs across all industry segments. Labor income supported by indirect economic activity was estimated at \$467 million, and labor income for induced economic activity was estimated at \$221 million. The corn industry supported a total of \$1.2 billion in labor income across direct, indirect, and induced economic effects.

Corn production comprised the largest share of labor income estimated at \$700 million or 57 percent of the industry's total labor income. Consistent with employment among the industry's segments, commodity shipment was responsible for \$242 million in labor income, followed by ethanol, with \$132 million in 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, by Industry Segment



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

Economic Activity	Crop Production	Grain Handling	Commodity Shipment	Commodity Processing	Ethanol	Industry Totals
----- millions \$ -----						
Direct	237.0	53.8	155.8	15.3	69.9	531.8
Indirect Activity	335.7	16.8	42.4	32.5	39.7	467.1
Induced Activity	127.2	15.6	43.9	10.6	23.7	221.0
All Labor Income	699.9	86.2	242.1	58.4	132.4	1,219.0

Notes: Crop production represents annual average from 2018 through 2020. Grain handling, commodity shipments, and commodity processing represent an annual average from 2015 through 2017. Ethanol represents annual operations in 2021 and capital expenditures averaged from 2019 through 2021.

Value-added

The corn industry had an average annual value-added of \$2.35 billion. Corn production comprised 54 percent of the industry's total value added.

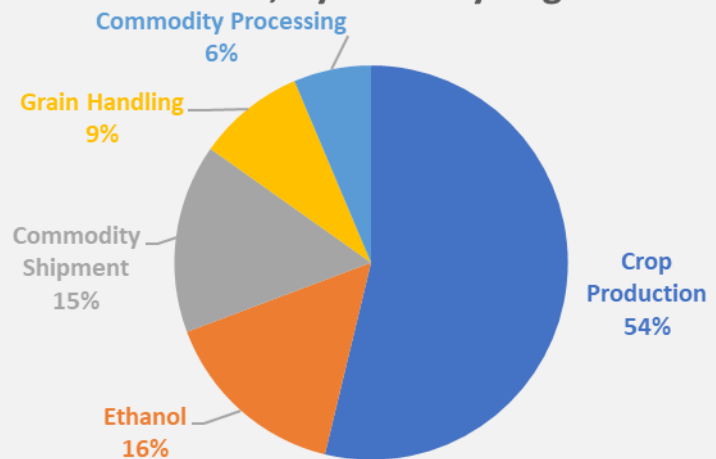
Of the \$2.35 billion in value added, direct output in the industry produced about \$1.2 billion, while secondary economic output generated about \$1.1 billion.

Contribution to gross state product was nearly equal for commodity shipment and ethanol production, each estimated at \$365 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.

Value-added, by Industry Segment



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

Economic Activity	Crop Production	Grain Handling	Commodity Shipments	Commodity Processing	Ethanol	Industry Totals
----- millions \$ -----						
Direct	538.1	151.7	217.5	78.7	254.8	1,240.8
Indirect Activity	516.0	29.3	71.8	52.9	70.5	740.5
Induced Activity	212.7	27.1	76.0	18.4	40.1	374.3
Total Value-added	1,266.7	208.1	365.3	150.0	365.4	2,355.5

Notes: Crop production represents annual average from 2018 through 2020. Grain handling, commodity shipments, and commodity processing represent an annual average from 2015 through 2017. Ethanol represents annual operations in 2021 and capital expenditures averaged from 2019 through 2021.

Government Revenues

Corn production generated over \$45 million in state and local government revenues. Property taxes were estimated at \$34.9 million of production's total direct payments.

Secondary business activity associated with production was estimated to generate \$50.9 million in state and local government tax revenues. Corn production, through direct and secondary business volume, was estimated to generate \$96.4 million in state and local government revenues.

Government Revenues

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

Government Revenues, Corn Grain Production, North Dakota, Average Annual 2018 through 2020

Government Jurisdiction and Type of Revenue	Government Revenues --- 000s \$ ---
Paid Directly by Corn Grain Production¹	
Federal Government	40,124.5
State and Local Governments	45,509.0
Total	85,633.5
Paid Directly by Corn Grain Production to State and Local Government¹	
Social Insurance Taxes	559.5
Sales and Use Tax	3,556.0
Property Tax	34,859.2
Corporate Income Tax	1,371.7
Personal Income Tax	2,098.4
Misc. Taxes and Revenues	3,064.2
Total	45,509.0
Paid by Secondary Business Activity to State and Local Government²	
Social Insurance Taxes	2,389.6
Sales and Use Tax	16,291.9
Property Tax	23,308.2
Corporate Income Tax	1,112.6
Personal Income Tax	2,793.0
Misc. Taxes and Revenues	5,024.5
Total	50,919.8
Total State and Local Revenues	
Paid by Corn Grain Production	45,509.0
Paid from Secondary Business Activity	50,919.8
Total	96,428.8

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 corn grain 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).

Overall, the corn industry made direct payments of \$57 million to state and local governments. Across all industry segments, the industry contributed an additional \$73 million in government revenues. Direct and secondary business activity resulted in state and local government revenues of \$130 million.

North Dakota Corn Industry , State and Local Government Revenues, Annual Average 2018 through 2020

Economic Activity	Crop Production	Grain Handling	Commodity Shipments	Commodity Processing	Ethanol	Industry Totals
----- 000s \$ -----						
Direct	45,509.0	3,611.7	4,201.9	899.6	2,902.1	57,124.3
Indirect	50,919.8	1,769.8	4,735.1	2,700.7	3,630.8	73,010.9
Induced		1,631.0	4,588.5	1,105.1	1,930.1	
Total Payments	96,428.8	7,012.5	13,525.5	4,705.4	8,463.0	130,135.2

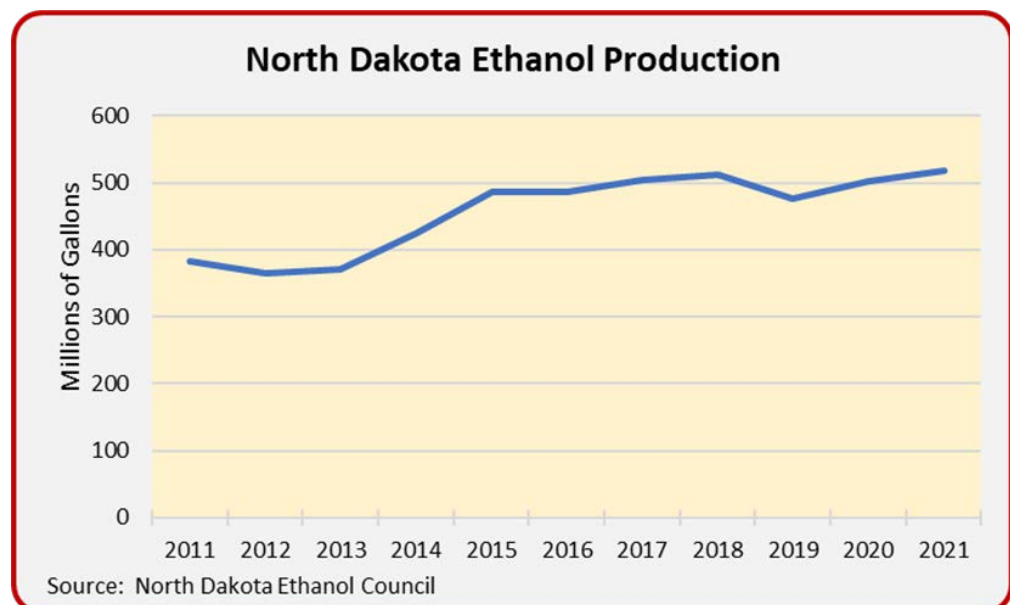
Notes: Crop production represents annual average from 2018 through 2020. Grain handling, commodity shipments, and commodity processing represent an annual average from 2015 through 2017. Ethanol represents annual operations in 2021 and capital expenditures averaged from 2019 through 2021.

Ethanol Industry Summary

The ND Ethanol Council sponsored an industry-wide survey of ethanol producers in ND during the summer of 2022. The information collected represented updated processing volumes, due to recent industry expansions, and capital expenditures collected in North Dakota relating to those expansions.

As with other surveys of industries, the information is aggregated at an economic sector level, and provides key information for modeling the direct, indirect, and induced economic contributions. The ethanol industry was estimated to purchase \$1.2 billion in operating inputs in 2021, of which, \$1 billion was for corn. Corn purchases are excluded from ethanol production expenses, since corn in the economic contribution study is valued prior to reaching the ethanol facilities.

The following tables present the economic data gathered for ethanol production in ND, and include the economic profile used in the larger agriculture industry contribution assessment. Also presented are the estimated economic contribution from ethanol plant operations and ethanol industry capital expenditures.



Purchases of Inputs and Services, Ethanol Industry, North Dakota, 2021

NAICS Code	Economic Sector	Operating Inputs	
		Total	Sourced in- state
		----- 000s \$ -----	
11	Agriculture, Forestry, Fishing and Hunting	1,008,025	895,190
21	Mining, Quarrying, and Oil and Gas Extraction	0	0
22	Utilities	91,139	91,139
23	Construction	9,918	5,512
31	Manufacturing	3,596	0
32	Manufacturing	66,185	2,826
33	Manufacturing	4,861	3,420
42	Wholesale Trade	230	172
44	Retail Trade	235	176
45	Retail Trade	2,196	1,173
48	Transportation and Warehousing	6,215	22
49	Transportation and Warehousing	0	0
51	Information	224	191
52	Finance and Insurance	12,756	4,776
53	Real Estate and Rental and Leasing	12,411	638
54	Professional, Scientific, and Technical Services	1,774	854
55	Management of Companies and Enterprises	0	0
56	Administrative and Support and Waste Management and Remediation Services	1,200	656
61	Educational Services	212	153
62	Health Care and Social Assistance	0	0
71	Arts, Entertainment, and Recreation	0	0
72	Accommodation and Food Services	133	40
81	Other Services (except Public Administration)	1,309	690
92	Public Administration	0	0
Totals		1,222,620	1,007,628

Source: Ethanol industry survey (2022).

Economic Sector Profile, Ethanol Production, North Dakota, 2021

Economic Metric	Value
	-- millions \$ --
Output (all product sales)	1,489.8
Employee Compensation	38.4
Proprietor Income	33.9
Other Property-type Income	192.8
Taxes on Production and Imports	2.1
Operating Inputs	1,222.6
	-- jobs --
Wage and Salary Employment	284
Proprietor Jobs	58

Sources: Ethanol industry survey (2022); IMPLAN (2022).

Capital Expenditures, Ethanol Industry, North Dakota, 2019 through 2021

Year and Type of Capital Expenditure	Capital Outlays	
	Total	Sourced In-state
2019	----- 000s \$ -----	
Expansion	9,641	2,656
Replacement	6,866	3,026
Other	50	0
2020		
Expansion	20,091	7,301
Replacement	5,807	2,970
Other	0	0
2021		
Expansion	42,868	16,911
Replacement	8,599	3,963
Other	33	33

Source: Ethanol industry survey (2022).

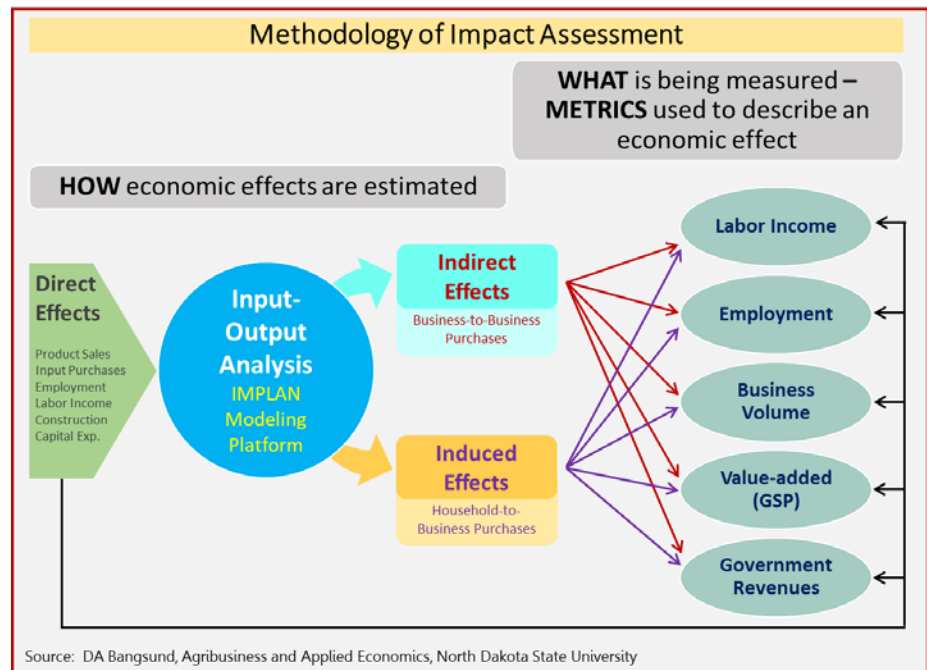
Economic Contribution, Ethanol Production and Capital Outlays, North Dakota, 2021

Industry Segment and Type of Economic Activity	Employment	Labor Income	Value-added	Gross Business Volume
	---- jobs ----	----- millions \$ -----		
Operations (2021)				
Direct	342	69.0	254.8	1,420.9
Indirect	371	33.3	63.0	161.2
Induced	473	22.4	37.9	71.7
Total	1,185	124.7	355.8	1,653.9
Capital Expenditures (annual average 2019 through 2021)				
Direct	85	5.6	6.0	10.6
Indirect	13	0.9	1.4	2.9
Induced	28	1.3	2.2	4.2
Total	125	7.8	9.7	17.6

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), 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 (IO): Mathematical application of the interdependence among producing and consuming sectors in an economy.

IO 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.

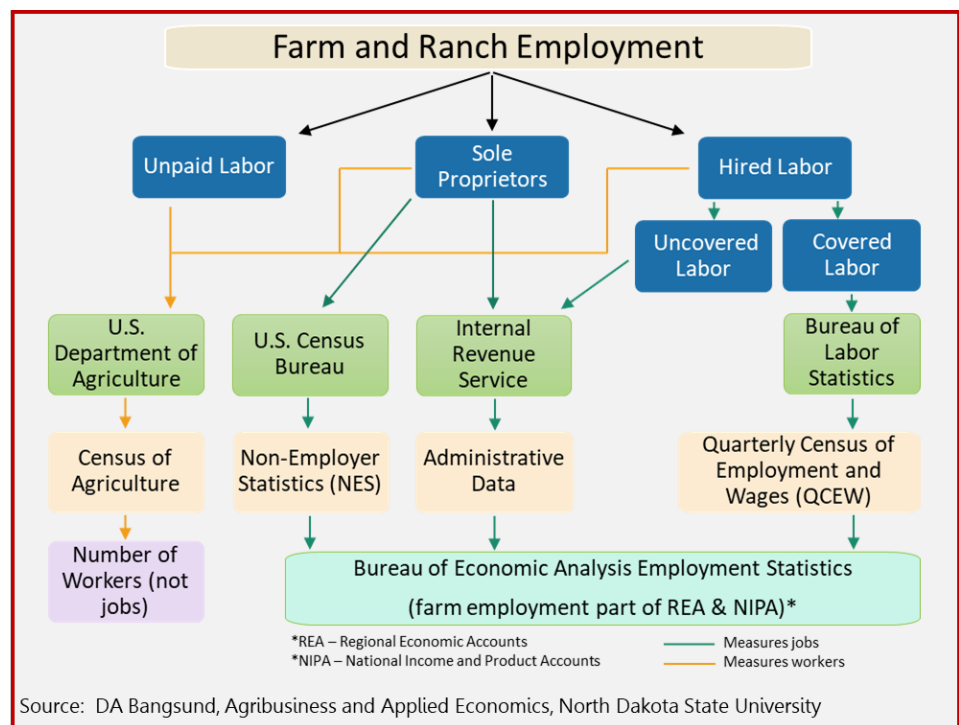
Households: Represent one or more individuals in a specific living arrangement for which income from all sources is used to purchase goods and services.

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 North Dakota is 'covered' employment. QCEW data are collected for each state and reported by the U.S. Bureau of Labor Statistics (BLS). Therefore, employment statistics for self-employed farmers and ranchers cannot be derived from QCEW data.

By contrast, 'uncovered' employment largely includes self-employed and sole-proprietors not enrolled in a state's UI program (enrollment is voluntary for self-employed individuals). The majority of on-farm employment is self-employed with only a small portion of on-farm employment qualifying as covered employment. The U.S. Bureau of Economic Analysis (BEA) reports uncovered employment in conjunction with QCEW employment from BLS. The only source of on-farm employment that includes covered and



uncovered hired labor, self-employed, and sole proprietors is the BEA's Regional Economic Accounts. The U.S. Department of Agriculture's Census of Agriculture collects information on individuals, not jobs, and cannot be directly substituted for BEA employment statistics.

For most 'industries', sole proprietors are not the predominate form of employment, and QCEW is often used to measure employment in those industries. In some economic 'sectors', sole proprietors represent a meaningful level of employment, such as independent truckers, construction and repair, retail shops, personal service providers, among others, but do not represent a meaningful share of employment at a broader 'industry' level. Crop and livestock production are largely unique among industries in that the majority of employment is represented by sole proprietors.

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 for those employment values.

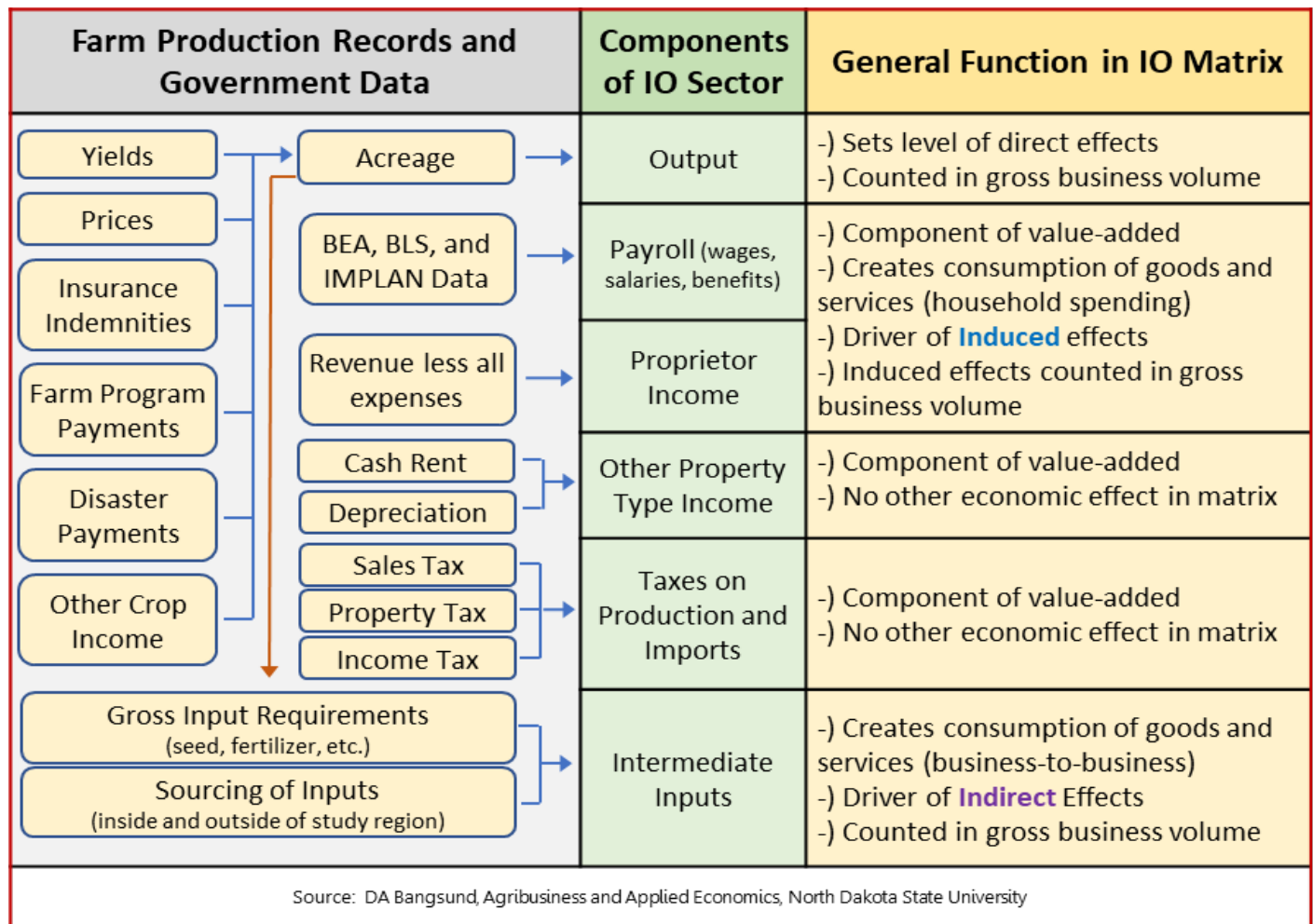
Developing Economic Sector Profiles

An industry balance sheet or economic profile is one of the most important elements in economic contribution studies. Nearly all key economic metrics have their origin within an industry's economic profile/sector. Information and data to create economic sector profiles were collected from surveys of industry firms, government agencies, and farm production records and statistics.

While the IMPLAN modeling platform provides baseline economic profiles generated from proprietary estimation techniques applied to government data, this study relied on state-sourced data and industry

input to create a customized IO matrix. The process of developing study-specific economic profiles and then modifying an IO matrix is time consuming and requires considerable empirical analysis, but the results from those efforts produce a credible and transparent evaluation of an industry's role in an economy.

To the extent possible, other economic sectors (e.g., manufacturing) were customized using financial information from an industry-wide survey conducted in 2017-2018. Survey data also was used to estimate capital expenditures for various manufacturing and processing sectors. Ethanol producers were surveyed in 2022, and information from that survey provided a custom economic profile for ethanol production and produced a three-year average of capital expenditures.



What Economic Activities are Included in Crop and Livestock Production?

The following activities were included for crop and livestock sectors:

- ❖ Production
- ❖ Capital Expenditures
- ❖ Cash Rent
- ❖ Insurance Industry A&O

Crop and livestock production generate economic effects from spending of labor income and purchase of production inputs to produce a crop or raise livestock, and first-round effects are driven by the custom economic profiles.

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 Ag 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	1151
	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 the 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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