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# Economic Contribution of the Soybean Industry in North Dakota

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Agriculture remains a major component in the North Dakota economy (Coon and Leistritz 1998); however, the economic significance of the various activities within the agricultural industry are less understood. Soybeans have become an important crop in North Dakota in the 1990s, yet the economic contribution of the soybean industry remains unquantified.

During the 1990s, soybean acreage increased substantially in nontraditional row-crop regions, such as those found in some parts of North Dakota (U.S. Department of Agriculture 1998). Although not a national leader in the production of soybeans, soybeans have become an important regional crop in North Dakota. In 1998, soybeans accounted for 26 percent of all row crops and 8.3 percent of all crops grown in the state. In 1990, soybeans accounted for 14 percent of row crops in the state and only accounted for 2.7 percent of all crops in the state (North Dakota Agricultural Statistics *various years*). Much of the increase has occurred in the Red River Valley, the traditional soybean producing region within the state. However, substantial increases have occurred in other areas of the state.

Several factors have led to an increase in soybean acreage in the state. The Freedom-to-Farm Act greatly increased planting flexibility, allowing producers to shift acreage among crops (U.S. Department of Agriculture 1996). Also, current farm

program provisions for loan deficiency payments for soybeans have provided farmers with less price risk and greater revenue potential than found with other traditional crops in North Dakota. In addition, for numerous reasons, yield, price, and crop quality problems with traditional small grains in the 1990s have forced producers to seek alternative crops. Thus, during the 1990s, producers have sought to reduce their dependence upon traditional small grains. Row crops, particularly soybeans, have offered an attractive alternative to small grains for many producers in the eastern half of North Dakota.

## OBJECTIVE

The purpose of this report is to estimate the economic contribution (direct and secondary effects) of the soybean industry to North Dakota.



## PRODUCTION BACKGROUND

Soybeans are an extremely important crop in the United States. Based on acreage planted, soybeans rank third behind corn and wheat. However, among all agricultural commodities, including vegetables, soybeans rank second only to corn in acreage harvested and overall value of production.

Soybean acreage in the United States has been steadily increasing during the 1990s. Trends in soybean production in North Dakota have followed national trends. In 1990, North Dakota had about 500,000 acres of soybeans. In 1998, acreage had increased to about 1.5 million acres (Figure 1). Currently, North Dakota ranks 17th among soybean producing states.

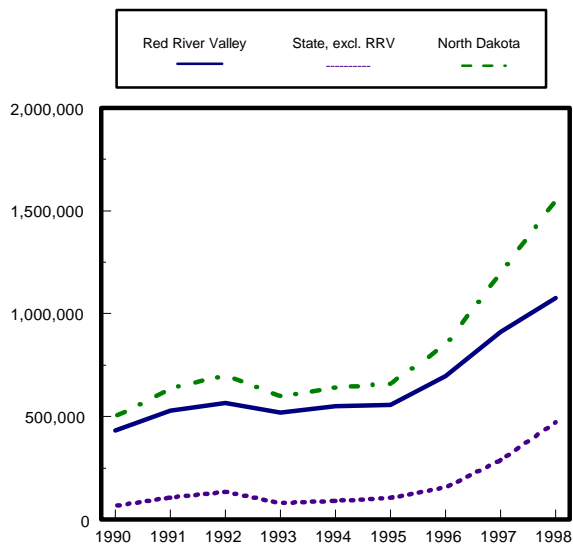


Figure 1. Planted Soybean Acreage, North Dakota, 1990 Through 1998  
Source: North Dakota Agricultural Statistics Service (*various years*).

The Red River Valley has historically been the primary soybean producing area of the state. However, soybean production has not been limited to the Red River Valley, as some soybean production has traditionally occurred in the eastern half of North Dakota. From 1990 to 1996, about 84 percent of soybean production in the state occurred in the Red River Valley. However, in 1997, the Red River Valley's share of state production dropped to 76 percent, and in 1998, it accounted for 70 percent of state production.

Soybean production in the state has increased both in the Red River Valley and outside the valley. Since 1995, soybean acreage in the Red River Valley has increased 94 percent or by 522,000 acres. In contrast, soybean acreage outside of the Red River Valley over the same period increased over 350 percent (368,000 acres). The increase has largely been in counties that have historically had some soybean production, as the number of counties in the state producing soybeans during the 1990s has remained steady (North Dakota Agricultural Statistics Service *various years*).

North Dakota, like most soybean producing states, has traditionally produced soybeans for commercial grain markets. However, a growing segment of soybean production, both in North Dakota and in the United States, has become focused on identity-preserved soybeans. Published information on acreage, prices, and yields for food quality and organic soybeans in North Dakota was unavailable; however, unofficial sources estimate that the state had about 20,000 acres of food quality and organically raised soybeans in 1998.

Domestically, soy-based food markets have been increasing at double digit rates in recent years (Lee 1997; Grooms

1997). Internationally, markets will continue to grow as Asian economies improve and reliable distribution and marketing arrangements are made between United States' producers and Asian markets. The long-term growth potential for food quality soybeans appears to be favorable, as domestic consumer markets are realizing the health benefits of soy-based foods (North Dakota Soybean Council 1998) and as Asian countries continue to seek reliable supplies of food quality soybeans.

### PROCEDURES

Analysis of the impacts associated with the soybean industry required several steps. Discussion of the procedures used in the study was divided into the following sections: (1) soybean production, (2) grain movement, (3) transportation, (4) processing, and (5) input-output analysis.

### Soybean Production

Soybean production was averaged to eliminate fluctuations in yearly production levels, thus providing a better indication of typical impacts generated by the industry. A three-year average (1996-1998) was used throughout the study to estimate the economic impacts from production, handling, and transportation activities.

The Red River Valley has historically been the primary soybean producing area of the state. However, soybean production has not been limited to the Red River Valley, as some soybean production has traditionally occurred in the eastern half of North Dakota (Figure 2). Soybean production in North Dakota averaged about 1.2 million planted acres and 36 million bushels per year from 1996 through 1998 (North Dakota Agricultural Statistics Service *various years*).

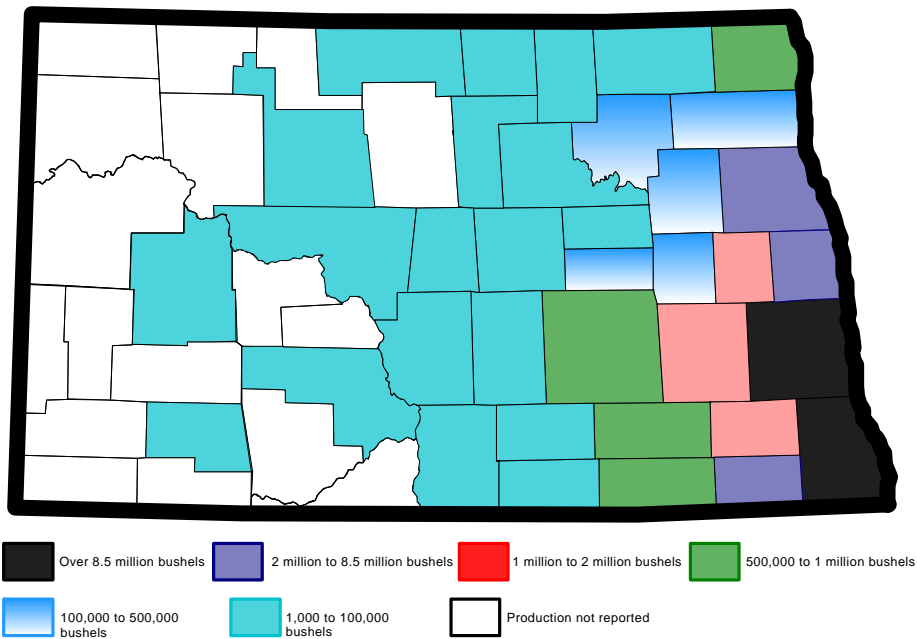


Figure 2. Average Soybean Production in North Dakota, by County, 1996 Through 1998

County average soybean yields in North Dakota during the period varied from 11.3 to 35 bushels per harvested acre, with an overall state average of 30.3 bushels per acre. Soybean yields were generally highest in the eastern third of the state and lowest in western regions of the state.

Production budgets were developed for the Red River Valley and for the remainder of the state. Expenditures were calculated from budgets obtained from the Farm Business Management Program (Adult Vocational-Agriculture Program) in North Dakota. Expenditures were averaged from 1996 through 1998. Revenues were based on average production and marketing-year statewide prices, loan deficiency payments, and insurance indemnities.

### **Grain Movement**

Grain movement included grain flow (i.e., logistics of grain movement from production to final markets) and grain handling (i.e., cleaning, mixing, storing, loading, and unloading).

#### Grain Flow

Grain flow is complex, involving several modes of transportation (e.g., truck, railroad, barge, vessel) and several possible destinations and handlers. For this study, grain movements were limited to shipments from (1) farms to country (local) elevators, (2) country elevators to in-state destinations, and (3) country elevators to out-of-state destinations (e.g., river port, terminal elevator, processor).

Grain flow statistics for soybeans in North Dakota were based on information from the Upper Great Plains Transportation Institute (Dalebout et al. 1997; Vachal et al. 1997, 1999; Domine and Benson 1998).

Grain flow, including the amount shipped by truck and railroad, was estimated for various production areas in the state to various destinations. Over 46 percent of soybean shipments by country elevators were to Minneapolis/St. Paul and Duluth destinations. Shipments to the Pacific Northwest accounted for nearly one-third of all shipments. Other destinations include the Southern/Midwest (2 percent) and miscellaneous markets (20 percent).

#### Grain Handling

Grain handling impacts were estimated by determining (1) a typical handling margin for country elevators in the state and (2) the amount of soybeans typically handled by country elevators. Grain handling budgets were used to allocate country elevator returns and expenses for handling soybeans. Country elevators in North Dakota handled approximately 35 million bushels of North Dakota produced soybeans annually.

### **Transportation**

Shipping and hauling costs (i.e., money spent on transporting soybeans to market destinations) were used to measure the economic impact of soybean transportation on the state economy. Transportation costs for soybeans were limited to truck and rail movements from country elevators to various out-of-state destinations.

Transportation costs of shipping soybeans from local elevators to market destinations required estimating (1) the amount of soybeans transported from counties to market destinations by mode of transport, (2) per unit expense for truck and rail transportation to move soybeans to various destinations, and (3) distances from

central locations within counties to market destinations. The amount of soybeans shipped from each county to market destinations (i.e., Duluth, Minneapolis/St. Paul, Pacific Northwest, etc.) was determined by applying grain flow information to county production.

Trucking rates were obtained from the Upper Great Plains Transportation Institute (1999). A truck operating budget was developed to estimate hauling expenses. Railroad companies' expenses incurred in rail transport were estimated using the Uniform Railroad Costing System (URCS), a microcomputer model developed by the Interstate Commerce Commission (1990). A railroad budget was developed to allocate the costs obtained from URCS to various economic sectors. Shipping rates (tariffs) charged to elevators for rail shipments were used to estimate net returns from rail shipments.

### **Processing**

The soybean is often called the miracle crop (American Soybean Association 1998). The type and amount of products produced from soybeans are numerous. However, despite the many products produced from soybeans, soybeans in the United States are primarily processed into soybean meal and oil. Little soybean processing (compared to production) has occurred in the state in recent years. Minor amounts of soybeans were processed during the 1990s, but few soybeans have been crushed in recent years. Small amounts of food quality soybeans are roasted and salted in the state. Also, some processing (i.e., sorting, cleaning, grading, and packaging) of food quality soybeans occur in the state.

Due to the inconsistent nature of soybean crushing within the state and the relatively small amounts of soybeans processed (i.e., those for crushing and direct human consumption), economic impacts from processing soybeans were not included in this study. Due to past volumes of soybeans processed, the omission of those activities would have a negligible effect on the estimated economic size of the industry.

### **Input-Output Analysis**

Economic activity from a project, program, or policy can be categorized into direct and secondary impacts. Direct impacts are those changes in output, employment, or income that represent the initial or direct effects of the project, program, or event. Secondary impacts (sometimes further categorized into indirect and induced effects) result from subsequent rounds of spending and respending within an economy. Input-output (I-O) analysis is a mathematical tool that traces linkages among sectors of an economy and calculates the total business activity resulting from a direct impact in a basic sector (Coon et al. 1985).

This process of spending and respending can be explained by using an example. A single dollar from an area farmer (**Households** sector) may be spent for a loaf of bread at the local store (**Retail Trade** sector); the store uses part of that dollar to pay for the next shipment of bread (**Transportation** and **Agricultural Processing** sectors) and part to pay the store employee (**Households** sector) who shelved or sold the bread; the bread supplier uses part of that dollar to pay for the grain used to make the bread (**Agriculture-Crops** sector) ... and so on (Hamm et al. 1993).

## RESULTS

The economic contribution from the soybean industry was estimated from production, grain handling, and transportation activities. Expenditures and returns from these activities represent direct economic impacts. Subsequently, the direct impacts were used with the North Dakota I-O Model to quantify the secondary impacts.

### Direct Economic Impacts

The direct impacts from the soybean industry include (1) expenditures and returns from soybean production, (2) expenditures and returns from grain handling, and (3) economic activity generated from transportation of soybeans from local collection points to in-state and out-of-state destinations.

Soybean production in North Dakota averaged 1.2 million planted acres from 1996 to 1998. The 1.2 million acres of soybeans generated about \$200.6 million in production expenditures and \$20.4 million in returns to unpaid labor, management, and equity annually during that period. Direct impacts (expenditures and returns) from soybean production in North Dakota averaged \$184 per acre or \$221 million annually (Table 1).

Local elevators in North Dakota handled approximately 35.5 million bushels of soybeans annually from 1996 through 1998. With a gross margin of about \$0.12 per bushel, grain handling at local elevators generated about \$4.3 million in annual direct impacts to the economy of North Dakota (Table 1).

Direct economic impacts from shipping activity were estimated for truck and rail transportation by developing budgets for each mode and estimating quantities and

distances shipped by each mode. Country elevators in North Dakota collectively spent about \$5.3 million to ship about 4.4 million bushels of soybeans by truck to various destinations; 82 percent of those expenses were allocated as direct impacts in North Dakota. Total direct impacts from truck transportation were about \$4.3 million annually. Country elevators spent about \$18.6 million to ship about 30.6 million bushels of soybeans by rail to various destinations. About 31 percent or \$5.8 million of the total amount spent was allocated as direct impacts. Railroad expenditures accounted for 57 percent of the direct impacts from soybean transportation in the state. Total transportation impacts were estimated at \$10.1 million annually (Table 1).

Total direct impacts from soybean industry expenditures and returns were estimated at \$235.4 million annually from 1996 through 1998. Soybean production accounted for about 94 percent of all direct impacts, transportation activities accounted for 4 percent, and grain handling activities accounted for 2 percent of all direct impacts. The economic areas of the state economy with the greatest direct economic impacts included the **Retail Trade** (\$110 million), **Households** (\$61 million), and **Finance, Insurance, and Real Estate** (\$44 million) sectors (Table 1).

### Secondary Impacts

Secondary economic impacts were estimated separately for soybean production, grain handling, and transportation. The direct impacts from each industry activity were allocated to various economic sectors of the North Dakota Input-Output Model. Total direct impacts of \$221 million from soybean production generated about \$358 million in secondary impacts. Total direct impacts of \$4.3 million from grain handling

**Table 1. Direct Impacts of the Soybean Industry to the North Dakota Economy, by Economic Sector and Industry Activity, 1996 Through 1998**

Economic Sector	Total Direct Impacts by Industry Activity			
	Soybean Production	Transportation	Grain Handling	Total Direct
	----- 000s \$ -----			
Transportation	3	1,472	0	1,475
Comm and Pub Util	2,672	174	261	3,107
Retail Trade	104,044	4,643	1,261	109,915
Fin, Ins, and R Estate	42,960	372	826	44,158
Bus and Pers Service	2,812	0	174	2,986
Prof and Soc Service	1,526	0	0	1,526
Households	56,089	3,260	1,522	60,871
Government	10,908	207	217	11,332
<b>Total Direct Impacts</b>	<b>220,981</b>	<b>10,128</b>	<b>4,261</b>	<b>235,370</b>

activities generated about \$7.5 million in secondary impacts. Total direct impacts of \$10.1 million from soybean transportation generated about \$16 million in secondary impacts. Total direct impacts of \$235.4 million from the soybean industry generated about \$381.6 million in secondary impacts in North Dakota.

The economic areas of the state economy with the greatest secondary impacts included the **Households** (\$138 million), **Retail Trade** (\$110 million), **Finance, Insurance, and Real Estate** (\$24 million), **Communication and Public Utilities** (\$19 million), **Agriculture-Livestock** (\$17 million), and **Government** (\$17 million) sectors. Overall, each dollar of direct impacts from the soybean industry generated about \$1.62 in secondary impacts.

### Total Economic Impacts

Annual total (direct and secondary) economic impacts from soybean production in the state were estimated at \$579 million. Grain handling and transportation activities

generated an additional \$38 million in annual economic impacts. All soybean industry activities generated a total economic impact of \$617 million annually in the state from 1996 through 1998 (Table 2).

The economic sectors with the greatest impacts (i.e., direct and secondary impacts) included **Retail Trade** (\$220 million), **Households** (\$199 million) (economy-wide personal income), **Finance, Insurance, and Real Estate** (\$68 million), **Government** (\$28 million), and **Communication and Public Utilities** (\$22 million) (Table 2).

### Employment

In North Dakota, about 3,405 farms or 11 percent of all farms raised some soybeans in 1997 (U.S. Department of Commerce 1999). Of the 22,923 farms in North Dakota that had sales over \$10,000 in 1997, about 3,331 farms (14.5 percent) raised some soybeans. However, direct employment (full-time equivalent jobs) in



**Table 2. Total (Direct and Secondary) Impacts of the Soybean Industry to the North Dakota Economy, by Economic Sector and Industry Activity, 1996 Through 1998**

Economic Sector	Total Economic Impacts by Industry Activity			
	Soybean Production	Transportation	Grain Handling	Total Impacts
	----- 000s \$ -----			
Agriculture-Livestock	15,974	729	282	16,985
Agriculture-Crops	6,488	276	117	6,881
Nonmetal Mining	811	46	18	875
Construction	12,296	567	269	13,132
Transportation	2,206	1,569	43	3,818
Comm and Pub Util	20,528	954	643	22,125
Ag Proc and Misc Mnfg	10,250	417	189	10,856
Retail Trade	206,720	9,473	3,489	219,682
Fin, Ins, and R Estate	65,328	1,438	1,321	68,087
Bus and Pers Service	11,819	390	372	12,581
Prof and Soc Service	13,847	564	274	14,685
Households	186,393	8,679	4,196	199,268
Government	26,284	1,179	559	28,022
<b>Total Economic Impacts</b>	<b>578,944</b>	<b>26,281</b>	<b>11,772</b>	<b>616,997</b>
Secondary Employment	7,148	410	145	7,703
Share of Total Economic Activity	93.8%	4.3%	1.9%	

soybean production is difficult to quantify. Direct employment in the grain handling and transportation industries is also difficult to quantify. Many of the positions (employment) affiliated with the soybean industry (i.e., those outside of production) exist in other industries. Employment at local elevators is part of the grain handling business; jobs in shipping and hauling soybeans are part of the transportation industry. Most of the jobs outside of soybean production are within industries that are supported only in part by the soybean industry, making employment estimates difficult to generate.

The soybean industry does directly affect jobs in grain handling and transportation; however, actual

quantification of those jobs was not estimated.

Secondary employment was estimated for soybean production, grain handling, and transportation activities. Secondary employment estimates represent the number of full-time equivalent (FTE) jobs generated based on the volume of business activity created by an industry. Soybean production indirectly supported about 7,148 FTE secondary jobs in the state. Grain handling activities indirectly supported about 145 FTE secondary jobs. Transportation of soybeans in the state generated about 410 FTE secondary jobs. All soybean activities in the state supported about 7,703 FTE secondary jobs.

## **Tax Collections**

Tax collections are another important measure of the economic impact of an industry on an economy. Some of the interest in estimating tax revenue generated by an industry stems from public awareness of the importance of tax revenue to local and state governments. In an era of reduced federal funding, revenue shortfalls, and growing public demand on governments to balance their budgets while providing constant or increased levels of services and benefits, tax collections are an important factor in assessing economic impacts.

Input-output analysis was used to estimate personal income, retail trade, and other business activity, which was used to estimate tax revenue. Estimated tax revenue generated by the soybean industry in the state included \$10.2 million in sales and use taxes, \$2.6 million in personal income taxes, and \$1.1 million in corporate income taxes annually from 1996 through 1998. Total collections from sales and use, personal income, and corporate income taxes in the state were about \$13.9 million annually. Soybean activities were directly responsible for about \$11.1 million in property taxes annually in the state. When property tax collections and revenues from sales and use, personal income, and corporate income taxes are combined, the soybean industry generated \$25 million in annual tax revenues in the state.

## **SUMMARY AND CONCLUSIONS**

The role of agriculture in the North Dakota economy is well documented. However, economic contribution of various

activities within the agricultural industry are less understood. The purpose of this study was to measure the economic contribution of the soybean industry to the North Dakota economy.

Soybeans have become an increasingly important crop in North Dakota. Soybean acreage in the state has increased from about 500,000 acres in 1990 to 1,550,000 in 1998 (a 210 percent increase). In 1998, soybeans accounted for over 25 percent of all row crops planted in the state and ranked second behind sunflowers in total row-crop acres planted. Most soybean production in the state occurs in the Red River Valley (nearly 70 percent); however, soybean acreage in the eastern half of North Dakota, excluding the Red River Valley, has increased over 600 percent (406,000 acres) since 1990. In the 1990s, soybeans expanded from being a crop almost exclusively limited to the Red River Valley to an enterprise adopted by farmers throughout the eastern half of the state.

Direct economic impacts from the soybean industry were estimated for crop production, grain handling, and transportation activities. Farmers and producers generate direct impacts to the state's economy through (1) expenditures for production inputs and (2) returns to unpaid labor, management, and equity. Grain handling and transportation activities similarly affect the economy through (1) expenditures for operating inputs and (2) net returns from operations.

Crop production budgets were used with estimates of soybean acreage and yields to determine the economic impacts from soybean production. Soybean production in

the state averaged 1.2 million planted acres and 35.9 million bushels from 1996 through 1998. Annual direct economic impacts from soybean production were estimated at \$221 million or about \$184 per planted acre.

Grain handling impacts were estimated for country elevators using grain handling budgets, typical handling margins, and estimates of the amount of soybeans handled. Annual direct economic impacts from grain handling were estimated at \$4.3 million.

The amount of soybeans shipped to various market destinations by mode of transport was used in conjunction with truck and rail budgets to estimate the direct economic impacts from soybean shipments. Annual direct economic impacts were \$4.3 million and \$5.8 million for truck and rail transportation, respectively. Collectively, of the \$23.9 million spent annually on soybean transportation, about \$10.1 million was retained within the state economy.

Total annual direct economic impacts from all soybean activities in the state were estimated at \$235.4 million. The North Dakota Input-Output Model was used to estimate the secondary economic impacts. The \$235.4 million in direct economic impacts generated another \$381.6 million in secondary economic impacts. Gross business volume (direct and secondary effects) was estimated at \$617 million annually. Each acre of soybeans planted was estimated to generate about \$514 annually in business activity in the state.

The economic sectors of the North Dakota economy with the greatest amount of economic activity from the soybean industry included **Retail Trade** (\$220 million), **Households** (which represents economy-wide personal income) (\$199 million),

**Finance, Insurance, and Real Estate** (\$68 million), **Government** (\$28 million), and **Communications and Public Utilities** (\$22 million). Since production is concentrated in the Red River Valley and in surrounding areas of North Dakota, impacts from the soybean industry are accentuated in those regions of the state.

Annual tax collections from the soybean industry were about \$13.9 million, which included \$10.2 million in sales and use, \$2.6 million in personal income, and \$1.1 million in corporate income taxes. When property taxes were included, the soybean industry generated about \$25 million in local and state tax revenues. Approximately 3,400 farms in 1997 raised soybeans in the state. Secondary employment supported by soybean production, grain handling, and transportation activities was estimated at about 7,700 jobs annually.

Soybeans are an important regional crop in North Dakota, as 70 percent of the state's production is concentrated in the Red River Valley. The importance of soybean production to North Dakota producers is evident in the crop's recent expansion in the Red River Valley and in other areas in the eastern half of the state. As producers have attempted to diversify production away from traditional small grains during the 1990s, soybeans have offered an attractive alternative to many producers. The North Dakota economy has benefitted from an expansion of soybean acreage, since the per acre impacts, thus far, have been greater than those of traditional small grains (e.g., wheat, barley). Currently, most (94 percent) of the impacts from the soybean industry are generated by soybean production.

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This document is a summary of a more comprehensive report which contains additional information. Additional copies of this summary and single copies of the main report, Economic Contribution of the Soybean Industry in North Dakota are available free of charge. Please address your inquiry to Carol Jensen, Department of Agricultural Economics, P.O. Box 5636, North Dakota State University, Fargo, ND 58105-5636, (Phone 701-231-7441, Fax 701-231-7400), E-mail: [cjensen@ndsnext.nodak.edu](mailto:cjensen@ndsnext.nodak.edu) or these documents are available on the world wide web at <http://agecon.lib.umn.edu/ndsu.html>

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