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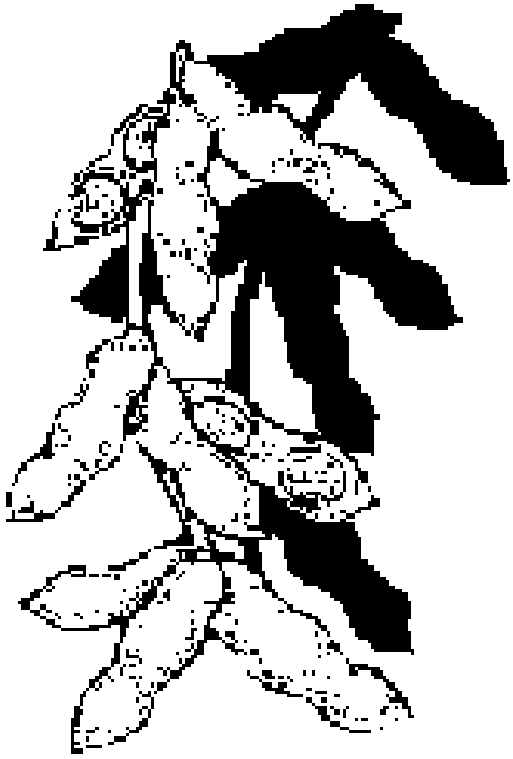
ECONOMIC CONTRIBUTION OF THE SOYBEAN INDUSTRY TO NORTH DAKOTA



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Abstract

Agriculture remains a major component in the North Dakota economy, yet many activities within the agricultural industry remain unquantified. The purpose of this study was to measure the economic contribution of the soybean industry to the North Dakota economy. Expenditures and returns from soybean production, grain handling, and transportation were estimated to calculate the direct economic impacts from soybean activities. Secondary economic impacts were estimated using the North Dakota Input-Output Model.

Since 1995, soybean acreage in the United States has increased substantially in nontraditional row-crop regions, such as those found in some parts of North Dakota. Soybean acreage in the state has increased 135 percent since 1995, and 210 percent since 1990. The expansion of soybean production in North Dakota has been limited to the eastern half of the state, with the largest concentration of production occurring in the Red River Valley. Soybean production in North Dakota averaged 1.2 million planted acres from 1996 to 1998.

Direct impacts (expenditures and returns) from soybean production averaged $184 per acre or $221 million annually from 1996 through 1998. Average direct impacts from handling soybeans at North Dakota elevators were estimated at $4.3 million annually. Transportation of soybeans to market destinations was estimated to generate $10.1 million in annual direct impacts to the state. Total direct impacts from soybean production, grain handling, and transportation were estimated at $235.4 million annually.

Total annual economic impacts (direct and secondary effects) from soybean production, grain handling, and transportation were estimated at $579 million, $11.7 million, and $26.3 million, respectively. The total annual economic impact from all soybean activities was estimated at $617 million. Soybean industry activities supported 7,700 full-time secondary jobs in North Dakota. Soybean activities were also responsible for $25 million in combined property tax, sales tax, individual income tax, and corporate income tax revenues.

Key Words: soybeans, North Dakota, economic impact

Executive Summary

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. Expenditures and returns from soybean production, grain handling, and transportation were estimated to calculate the direct economic impacts from soybean activities. Secondary economic impacts were estimated using the North Dakota Input-Output Model.

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 in the state. 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 regions of North Dakota, impacts from the soybean industry are accentuated in those geographic 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 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.

Economic Contribution of the Soybean Industry in North Dakota

Dean A. Bangsund and F. Larry Leistritz*

INTRODUCTION

Agriculture remains a major component in the North Dakota economy (Coon and Leistritz 1998); and most people familiar with the state realize the importance of agriculture to the state's economy. However, the economic significance of the various activities within the agricultural industry are less understood.

Nationally, soybeans consistently have been one of the top three commodities in terms of acreage planted and value of production (U.S. Department of Agriculture 1999). Soybeans are one of the few traditional crops to increase in acreage annually since 1990. Although acreage of soybeans in the United States has increased, soybean production remains mostly concentrated in the Corn Belt region of the United States.

Recently, soybean acreage has 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 recent years. 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. Previous farm policies were more restrictive in their planting allowances, thereby maintaining a more consistent year-to-year acreage of program crops, and current soybean loan rates are more economically attractive than loan provisions for other program crops. Also, 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.

Information from an economic impact or contribution study can be valuable for educational and public relations efforts. Determining the economic contribution of a given industry provides information about its importance to local economies. Not only can the impacts

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on local economies be measured, but the impacts on specific economic sectors and industries also can be identified. Providing economic information on how an industry affects related industries can be valuable to policy makers and business leaders.

In the case of the soybean industry in North Dakota, an impact study is beneficial, not only for identifying specific economic impacts to various economic sectors and quantifying impacts to local economies, but also because it can draw attention to an increasingly important regional crop, demonstrate the economic importance of soybean production to the state's economy, and indicate the economic impacts that could result from potential changes in policies which affect the soybean industry. Considering the recent expansion of soybean production in North Dakota, the industry can benefit in numerous ways from quantifying the economic impacts of this expanding industry. Given recent problems associated with small grain quality and trade issues involving agricultural commodities, an economic study can highlight the importance of allocating resources to promote this important regional crop and the consequences of various trade policies affecting soybean markets.

OBJECTIVES

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

1) estimate the direct and secondary impacts of soybean production,

2) estimate the direct and secondary impacts of soybean handling activities, and

3) estimate the direct and secondary impacts of soybean transportation.

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. Soybeans are produced in 29 states ranging from the Great Plains to the Atlantic Ocean. However, the majority of soybean production is concentrated in the Corn Belt region of the United States. The top five soybean producing states, which include Iowa, Illinois, Minnesota, Indiana, and Missouri, account for over 50 percent of U.S. production. The top ten states produce over three-quarters of domestic production (U.S. Department of Agriculture 1999).

Soybean acreage in the United States has been steadily increasing during the 1990s (Appendix A). Average soybean yields have increased in recent decades, ranging from 25 to 26 bushels per acre in 1970 to nearly 40 bushels per acre in 1997 (Appendix A). 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 (North Dakota Agricultural Statistics Service *various issues*).

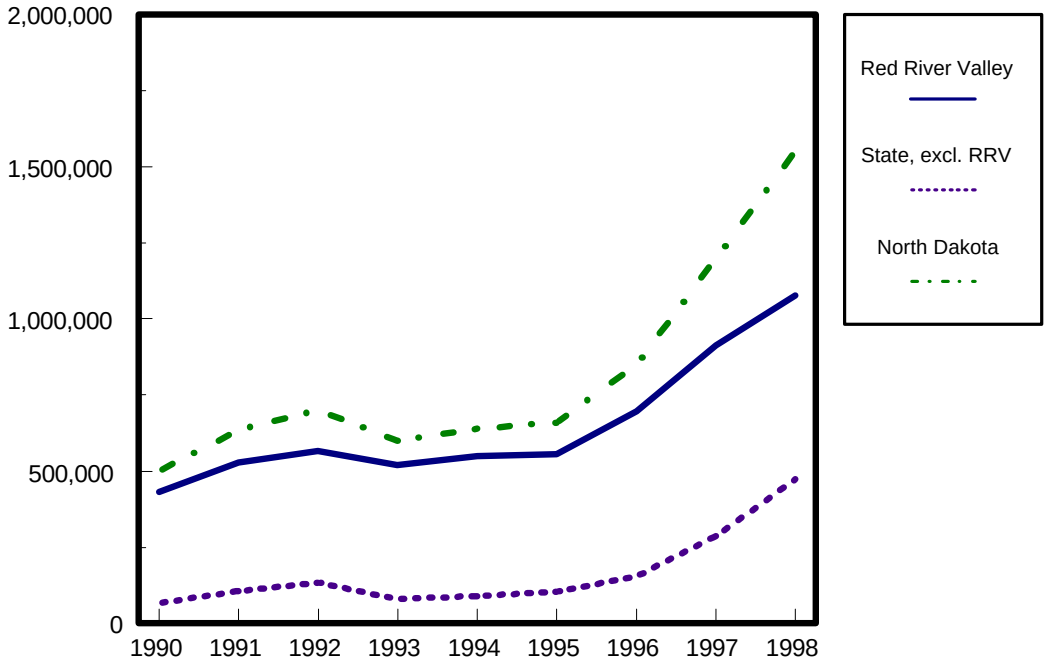

Figure 1. Planted Soybean Acreage, North Dakota, 1990 Through 1998
Source: North Dakota Agricultural Statistics Service (*various years*).

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 issues*).

North Dakota, like most soybean producing states in the United 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. Generally, identity-preserved grains are referred to as specialty, high value, niche market, or premium grains (Massey 1999).

In the case of soybeans, identity-preserved usually includes, but is not limited to, non-genetically modified (non-GMO), organic, and food quality soybeans. Usually premium prices rather than physical appearance provide the motivation to keep specialty grains separate from commercial grains (Massey 1999). However, in the case of some identity-preserved soybeans, seed characteristics (e.g., color, seed size) can differ substantially from commercial soybeans and may be difficult to sell in conventional markets (assuming the identity-preserved soybeans do not meet their speciality market requirements).

Some soybeans in North Dakota are produced for a number of niche markets, although the current acreage of identity-preserved soybeans is minor compared to the overall acreage of soybeans in the state. Published information on acreage, prices, and yields for food quality and organic soybeans in North Dakota was unavailable. However, individuals involved with identity-preserved soybeans estimate that the state had about 20,000 acres of food quality and organically raised soybeans in 1998. Identity-preserved soybeans have been produced in North Dakota for nearly a decade; however, acreage of identity-preserved soybeans has nearly doubled in recent years. Estimates of the acreage of non-GMO soybeans was not available.

Food quality soybeans are generally raised for soy food markets. The bulk of food quality soybeans produced in North Dakota is predominately exported to Asian countries, although some production is sold in domestic markets. Food quality soybeans produced in North Dakota are generally classified as either tofu- or natto-type beans. These soybeans are produced under contract with strict stipulations for meeting specific end user characteristics. These specific characteristics vary by the type of food quality soybean produced. Because of the specific characteristics of the soybeans (i.e., seed size, seed shape, seed coat, protein content, color, variety, taste), both the tofu- and natto-type soybeans generally yield less than soybeans produced for conventional markets. Yield trials conducted by North Dakota State University suggest that food quality soybean varieties, grown in the Red River Valley, yield about 15 percent less than conventional soybeans (Bergland and Helms 1999). Plant breeding programs currently are being conducted to produce varieties capable of producing the characteristics sought by soy food markets, while incorporating yield capabilities of conventional hybrids.

Although food quality soybeans yield less than conventional soybeans, they usually receive a premium over conventional soybean prices. However, management requirements for producing food quality soybeans are usually higher than the requirements for conventional soybeans. Much of the increase in management in food quality soybean production is in preserving crop identity and implementing production techniques to insure the crop will meet the end user specifications.

Organic soybeans are also produced in North Dakota for a variety of niche markets. Organic soybeans are generally produced for human consumption and are classified as organic based on production guidelines eliminating the use of chemicals (e.g., herbicides, insecticides) and synthetic fertilizers. Organic soybeans generally command a premium above non-organically produced food-grade soybeans of similar quality.

Recent developments in genetically-modified soybeans (e.g., Roundup Ready soybeans) have created niche markets for soybeans lacking genetic modification. Markets are emerging in Europe for soybeans that are non-GMO. Many of the management requirements for identity-preserved status must also be met with non-GMO soybeans.

Identity-preserved soybeans are marketed through a variety of distribution channels. However, many foreign buyers stipulate specific handling and processing techniques required to satisfy particular markets. Arrangements to connect food quality soybean producers, manufacturers (processors), importers, foreign brokers, and food buyers requires substantial investment in time and communication. Many purchasers of food quality soybeans in foreign countries have strict guidelines that must be met to ensure market acceptance.

Domestically, soy-based food markets have been increasing at double digit rates in recent years (Lee 1997; Groom 1997; Minnesota Soybean Growers Association 1998). 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

An economic contribution analysis, as defined in this study, represents an estimate of all relevant expenditures and returns associated with an industry (i.e., economic activity from producing, handling, transporting, and processing soybeans within a geographic area). The economic contribution approach to estimating economic activity has been used for several similar studies (Bangsund and Leistritz 1998a, 1998b, 1995a, 1995b; Bangsund et al. 1994).

Analysis of the impacts associated with the soybean industry[1] 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) application of input-output analysis to estimate secondary impacts.

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

[1]The soybean industry, as described and analyzed in this report, is limited to activities associated with soybeans produced in North Dakota.

soybean production has traditionally occurred in the eastern half of North Dakota. 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*) (Appendix A). 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 (Figure 3).

Identity-preserved soybeans (e.g., tofu, natto, organic, non-GMO) were not handled separately from conventional soybean production. The limited acreage of identity-preserved soybeans in the state and the lack of production-specific information (e.g., prices, yields, input costs) prevented separate budgets from being developed for those crops. However, due largely to the limited acreage (relative to conventional soybeans) of identity-preserved soybeans, separate handling of those soybeans was not warranted in this study and would not materially affect the estimated economic size of the industry.

Production budgets were developed for the Red River Valley and for the remainder of the state (Appendix B). Expenditures were calculated from budgets obtained from the Farm Business Management Program (Adult Vocational-Agriculture Program) in North Dakota (North Dakota Farm and Ranch Business Management 1999, 1998, 1997). Expenditures were averaged from 1996 through 1998. Revenues were based on average production and marketing-year statewide prices, loan deficiency payments, and insurance indemnities (Appendix B).

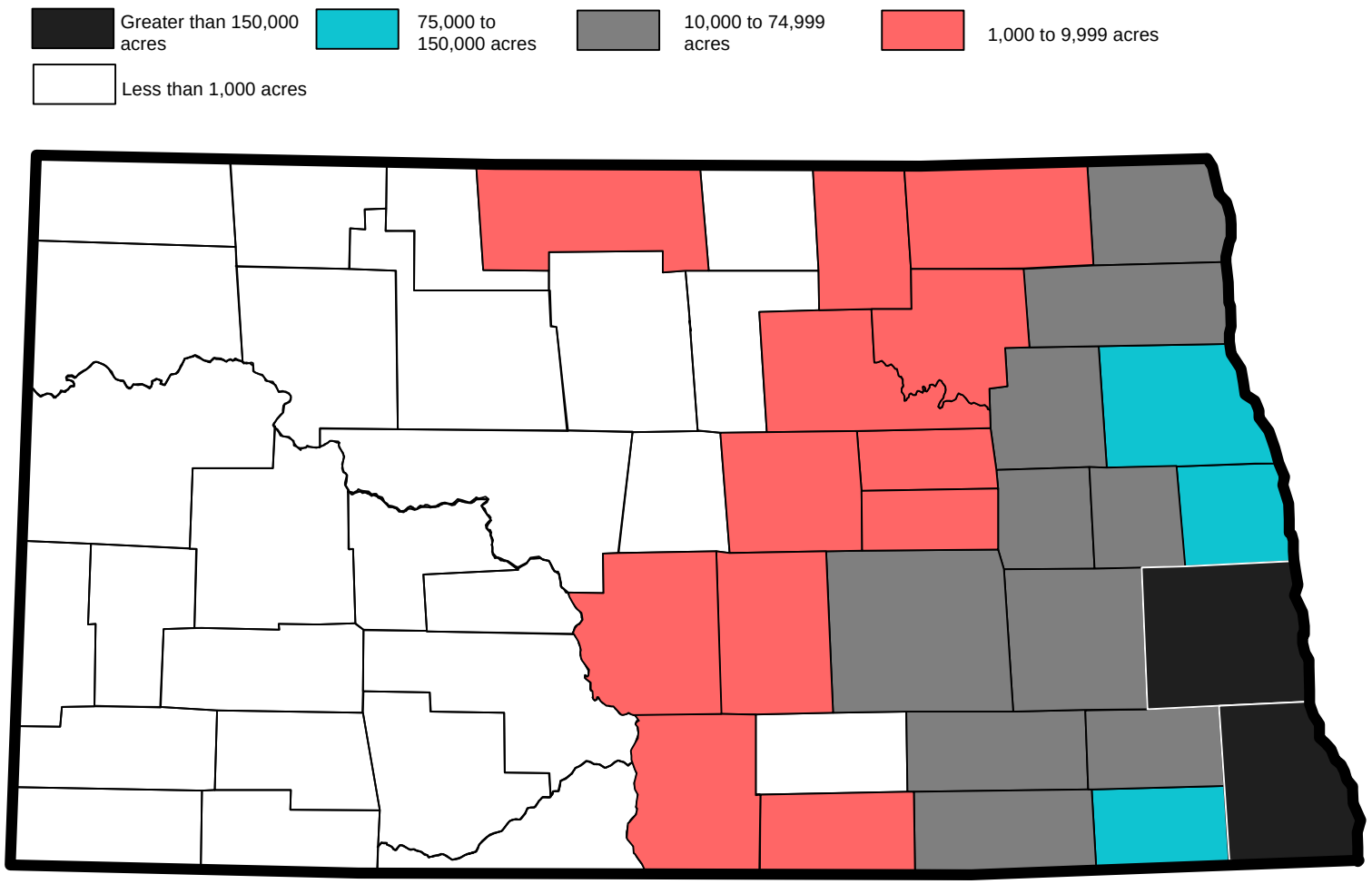

Figure 2. Average Planted Acreage of Soybeans in North Dakota, by County, 1996 to 1998

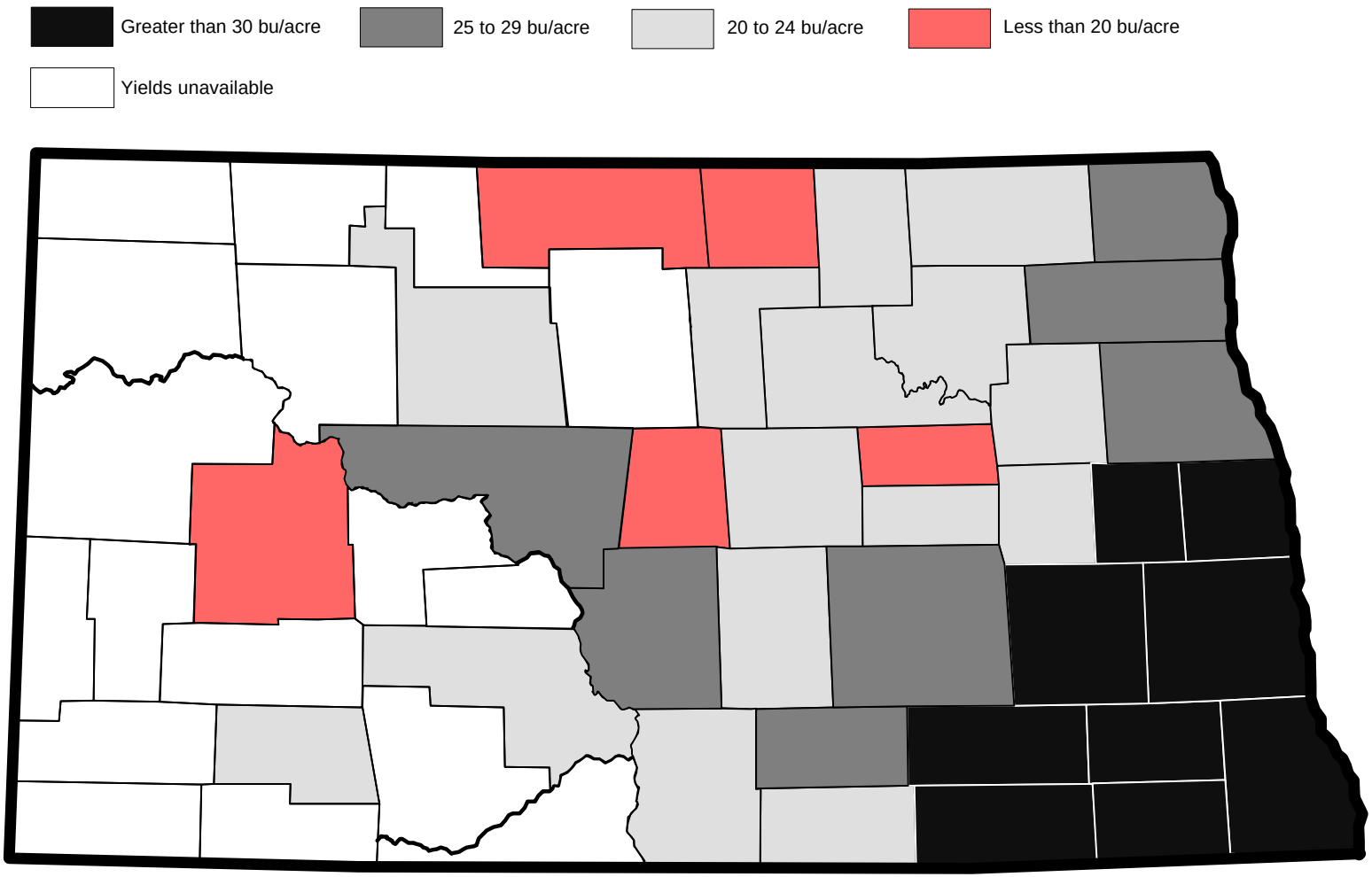

Figure 3. Average Soybean Yields in North Dakota, by County, 1996 to 1998

Grain Movement

Grain movement was defined to include grain flow (i.e., logistics of grain movement from production to final markets) and grain handling (i.e., cleaning, mixing, storing, loading, and unloading). The following section is divided into (1) grain flow and (2) grain handling.

Grain Flow

Tracking grain flow is usually complex, involving several modes of transportation (e.g., truck, railroad, barge, vessel) and several possible destinations and handlers (Figure 4). 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 (i.e., river port, terminal elevator, subterminal elevator, another country elevator, processor) (Figure 5).

This study did not address direct shipments of soybeans by producers to processors or market destinations other than an in-state country elevator. After delivery to a country elevator, soybeans were assumed to be primarily delivered to out-of-state destinations. A small percentage of soybean shipments went to North Dakota destinations; however, those shipments were included with miscellaneous market shipments.

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). Estimates of average soybean production were used with grain flow statistics to identify the volume of soybeans shipped from crop reporting districts in the state to various destinations. The amount of soybeans shipped by mode of transportation (i.e., truck and rail) for each destination was estimated from the above sources. Shipping characteristics (i.e., amount shipped by truck and rail to each destination) for each crop reporting district were applied to county-level soybean production to estimate grain flow from each county. Changes in on-farm storage of soybeans during the study period were not addressed.

Soybeans produced in North Dakota are predominately shipped to destinations within the Upper Midwest (Table 1). 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).

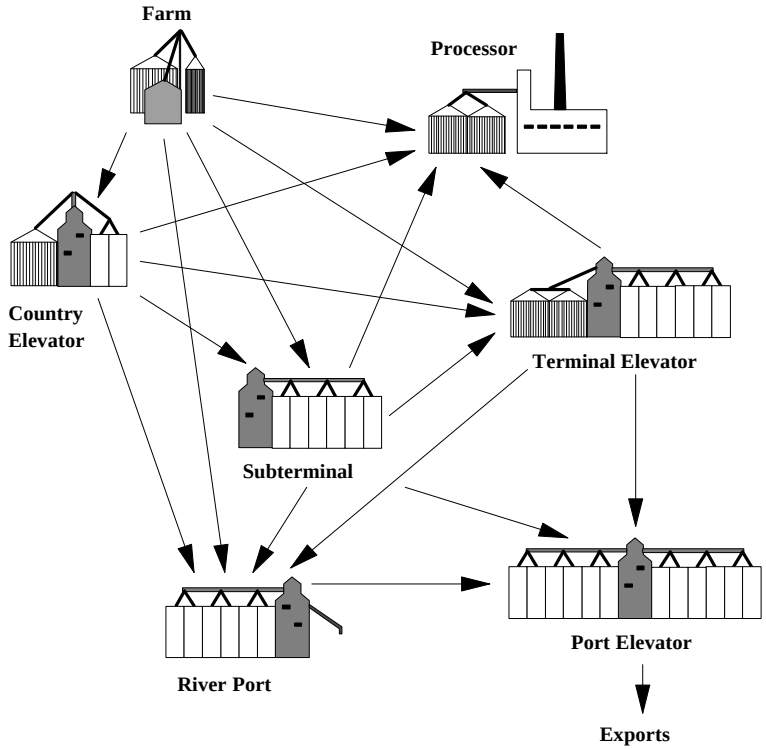

Figure 4. Typical Grain Movements in the United States Grain Marketing System
Source: U.S. Department of Agriculture (1990).

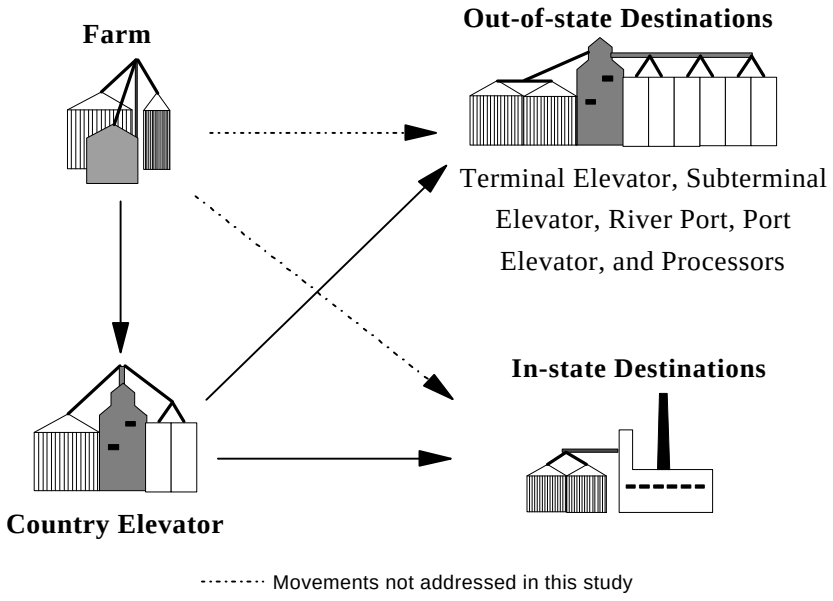

Figure 5. Assumed Soybean Movements for Soybeans Produced in North Dakota, 1996 Through 1998

Table 1. Annual Soybean Movements From North Dakota Country Elevators to Various Market Destinations, 1996 Through 1998

Regions	Market Destinations				
	Duluth	Mpls/ St. Paul	Midwest/ Southern	Pacific Northwest	Other
	000s bu				
North Central	17.3	30.9	0.7	0.6	76.2
Northeast	1,551.7	563.3	183.1	750.8	529.8
Central	213.5	243.5	5.0	65.0	264.2
East Central	5,442.6	1,732.3	456.5	5,619.3	1,517.9
South Central	0	38.9	0	0	58.3
Southeast	3,876.5	2,526.3	139.0	4,657.1	2,523.7
Others[a]	0.9	5.3	1.5	1.6	30.5
All Shipments[b]	11,102.2	5,140.4	785.8	11,094.5	6,921.7
%	31.7	14.7	2.2	31.7	19.7

[a]Includes the Northwest, West Central, and Southwest regions.
[b]Columns may not add due to rounding.

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 (Appendix B). Country elevators in North Dakota handled approximately 35 million bushels of North Dakota produced soybeans annually[2].

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. The remaining section is divided into transportation by country elevators and truck and railroad transportation.

Transportation from Country Elevators

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

[2]Soybeans shipped from neighboring states to country elevators in North Dakota (e.g., soybeans produced in Minnesota and marketed in North Dakota), shipments of soybeans from Canada to North Dakota elevators, and intra-state shipments between North Dakota elevators were not addressed in this study.

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 (Appendix C).

The percentages of grain shipments to market destinations were estimated from Dalebout et al. (1997), Vachal et al. (1997, 1999), and Domine and Benson (1998). Percentage movements by rail and truck were estimated from the above sources. The percentages of grain hauled by truck and railroad were applied to county grain movements to estimate the amount of grain shipped by each mode of transportation (Appendix C).

Shipping points (i.e., a central town or location) within each county were selected to calculate transportation costs for the entire county. Shipping points for each county were selected based on location within the county and on whether they contained an elevator with access to a major railroad. Shipping points were used to determine transportation distances to market destinations for both truck (highway miles) and rail (rail line miles).

Truck Transportation

Trucking costs for soybeans were based on information obtained from Berwick and Dooley (1997). Trucking rates were obtained from the Upper Great Plains Transportation Institute (1999). The trucking rate was used with truck operating costs to construct a trucking budget to estimate operation expenses and returns (Appendix B). Total trucking costs for each county to each destination were estimated by multiplying mileage by cost per mile by the number of shipments. Economic impacts from truck transportation were estimated based on allocation of truck expenses and returns retained in the state (Appendix B).

Railroad Transportation

Railroad transportation costs required estimating the railroad companies' costs of rail shipments, developing a railroad expense budget to allocate shipment costs to expense categories, and estimating charges levied by the railroad companies on elevators for rail car shipments (shipping tariffs). 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).

URCS estimates variable and total costs (i.e., expenses incurred by the railroad companies, not to be mistaken for the cost incurred by elevators) of railroad transportation based on a data base of financial and rail shipment information obtained from major railroad companies. The proportions of soybeans shipped by single car, multiple car, and unit train rates in the state were obtained from Vachal et al. (1999) and were used with URCS and grain flow information to estimate an overall cost structure of rail shipments in North Dakota.

URCS provides an estimate of the total variable costs and total allocated costs for rail shipments; however, the model does not provide an adequate breakdown of the costs. Thus, a

railroad budget was developed to allocate the variable and fixed costs obtained from URCS to various expense categories which were subsequently allocated to economic sectors (Appendix B).

After estimating the expenses incurred by the railroad companies, the rates charged elevators for rail shipments were determined. Shipping tariffs are rates charged elevators per rail car to ship grain. Tariffs for rail shipments from North Dakota origins to various destinations were obtained from the Burlington Northern-Santa Fe Corporation (1999). Total railroad costs were subtracted from shipping tariffs to estimate railroad net returns.

Railroad net returns generated from shipments of soybeans were assumed to leave the region and were not considered part of the economic impact. However, not all of the economic activity of rail transportation leaves the state (e.g., fuel, repairs, track maintenance, property tax, labor, etc.). About 60 percent of the variable and fixed costs was assumed to remain within the state's economy.

Processing

The soybean is often called the miracle crop (American Soybean Association 1998). The type and amount of products produced from soybeans are numerous. Both edible and nonedible (i.e., industrial) products are produced from refined soybean oil, whole soybeans, and soybean protein products. However, despite the many products produced from soybeans, soybeans in the United States are primarily processed into soybean meal and oil. Soybean oil is used primarily for human consumption, and soybean meal is used primarily for livestock feed. Small amounts of whole soybeans are processed for human consumption, such as food quality soybeans for direct human consumption (e.g., traditional soy foods, soy flour, sprouts, roasted soybeans).

However, little soybean processing (compared to production) has occurred in the state in recent years. Oilseed crushing facilities in the state are primarily crushing sunflower and canola. Although those facilities could easily convert to crush soybeans, market factors have prevented such actions. Minor amounts of soybeans were processed during the 1990s, but no material amount of soybeans have been crushed in recent years.

Small amounts of food quality soybeans are roasted and salted in the state. Also, some food quality soybeans are processed for direct consumption in export and domestic markets. Minor amounts of 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) in the state, 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. This process of spending and respending is sometimes termed the multiplier process, and the resultant secondary effects are sometimes referred to as multiplier effects (Leistritz and Murdock 1981).

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). The North Dakota I-O Model has 17 economic sectors, is closed with respect to households (households are included in the model), and was developed from primary (survey) data from firms and households in North Dakota.

ECONOMIC IMPACTS

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. The following section is divided into five major parts: (1) direct impacts, (2) secondary impacts, (3) employment, (4) tax revenue, and (5) total economic impacts.

Direct Impacts

From an economic perspective, direct impacts are those changes in output, employment, or income that represent the initial or direct effects of a project, program, or activity. The direct impacts from the soybean industry on the North Dakota economy include (1) expenditures and returns from soybean production, (2) expenditures and returns from handling soybeans at local (country) elevators, and (3) economic activity generated from the transportation of soybeans from local collection points to out-of-state markets. The following sections describe these direct economic impacts.

Soybean Production

Farmers and producers generate direct economic impacts to the area economy through (1) expenditures for production outlays (e.g., fuel, machinery, chemicals, fertilizer) and (2) returns to unpaid labor, management, and equity (e.g., money used to cover family living expenses or reinvestment in the business). Direct economic impacts from soybean production (i.e., production outlays and producer returns) were estimated by developing crop production budgets.

Soybean production budgets were based on average revenues and expenses for the Red River Valley and the remainder of the state. Revenues were calculated from average county yields, state-wide prices, loan deficiency payments, and insurance indemnities. Expenses were obtained from budgets compiled by the North Dakota Farm and Ranch Business Management Program (1999, 1998, 1997) (Appendix B).

Total direct impacts per acre from soybean production should be equal to the gross revenue per acre, providing all economic activity (production expenses and net returns) remains in the state economy. All expenses and returns associated with soybean production were assumed to remain within the state economy (i.e., there were no economic leakages associated with the production of soybeans), even though some inputs, such as fertilizer, seed, and machinery, may be purchased in neighboring states.

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 annually and $20.4 million annually in returns to unpaid labor, management, and equity. Direct impacts (expenditures and returns) from soybean production in North Dakota averaged $184 per acre or $221 million annually (Table 2).

Table 2. Average Direct Economic Impacts From Soybean Production in North Dakota, 1996 Through 1998

Expenses/Returns	Direct Impacts from Soybean Production: Red River Valley	Remainder of State	Total
	---------- 000s $ ----------		
Revenues			
Crop Sales	181,481	27,680	209,161
Other Revenues[a]	9,882	1,937	11,819
Total Revenue	191,363	29,617	220,980
Variable Expenses			
Seed	15,826	2,984	18,810
Fertilizer	2,476	1,439	3,915
Chemicals	26,426	4,062	30,488
Insurance	9,071	1,361	10,432
Fuel and Lubrication	8,436	1,449	9,885
Repairs and Maintenance	15,945	2,295	18,240
Hired and Custom Work	2,276	761	2,812
Interest	5,528	1,053	6,581
Cash Rent	29,887	3,144	33,031
Machinery Leases	39	0	39
Miscellaneous	293	31	324
Overhead			
Hired Labor	6,926	1,037	7,963
Machinery/Building	15,852	2,754	18,606
Insurance	2,468	464	2,932
Utilities	2,274	398	2,672
Interest	21,059	1,957	23,016
Property Taxes	4,932	442	5,374
Miscellaneous	4,692	543	5,235
Total Expenses	174,406	26,174	200,580
Returns to Unpaid Labor, Equity, and Management	16,957	3,443	20,400
Total Direct Impacts	191,363	29,617	220,980

[a]Loan deficiency payments and insurance indemnities.

Sources: North Dakota Farm and Ranch Business Management (1999, 1998, 1997) and North Dakota Agricultural Statistics Service (*various years*).

Grain Handling

Country (local) elevators generate direct economic impacts to the area economy through (1) expenditures for grain handling and (2) returns on grain merchandising. Direct economic impacts from grain handling were estimated by developing a country elevator budget for grain handling operations (Appendix B).

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 (Appendix B), grain handling at local elevators in North Dakota generated about $4.3 million in annual direct impacts to the economy of North Dakota (Table 3).

Table 3. Annual Direct Economic Impacts in North Dakota From Soybean Handling Activities, 1996 Through 1998

Expenses	Annual Direct Impacts
	-- 000s $ --
Labor	1,522
Utilities	261
Interest	391
Equip., Depr., and Repairs	652
Taxes and Licenses	217
Insurance	391
General Expenses	739
Services	87
Net Returns	0
Total Direct Impacts	4,260

Transportation

Truck and rail transportation generates direct economic impacts to the area economy through (1) expenditures for operating inputs and (2) operator returns. Direct economic impacts from grain hauling were estimated separately for truck and rail transportation.

Truck Transportation

A trucking rate was used in conjunction with hauling distances and the number of loads to develop an estimate of the economic impacts from truck transportation. Economic activity from intrastate (i.e., shipments that start and end within the same state) and interstate (i.e., shipments

that start and end in different states) truck shipments was allocated differently. All trucking costs associated with intrastate shipments in North Dakota were assumed to remain within the state's economy. Fuel is an important portion of the expense in trucking, but on interstate shipments some fuel would be purchased in other states. Also, some repairs are incurred on out-of-state trips. Furthermore, some trucking is conducted by out-of-state trucking firms, which incur most of their expenses in other states. Thus, 80 percent of the interstate trucking expenses was assumed to remain in the originating state's economy.

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 economic impacts from truck transportation of soybeans in the state were about $4.3 million annually (Table 4). About 13 percent of all soybeans shipped by country elevators was moved by truck to market destinations. Trucking expenditures and returns accounted for about 43 percent of the direct impacts from soybean transportation in the state.

Table 4. Annual Direct Economic Impacts From Truck Transportation of North Dakota Soybeans to Market Destinations, 1996 Through 1998

Expenses	Annual Direct Impacts
	-- 000s $ –
Fuel and Lubrication	572
Labor	1,077
Tires	156
Repairs and Maintenance	312
Equipment	1,002
License and Taxes	111
Insurance	353
Mgt., Admin., and Comm.	501
Net Returns	260
Total Direct Impacts	4,344

Railroad Transportation

Railroads and rail transportation play major roles in the economies of most western states; North Dakota is no exception. The availability and use of railroads are important to most industries, especially agriculture. Railroads can provide economical transportation of production inputs and commodities. Their impacts can be felt by the service they provide (i.e., the complex movement of production inputs and shipment of commodities to and from all areas of the United States) and by the economic activity they create in operation. The economic impacts of railroad

transportation were estimated by determining expenses and returns generated in the transportation process.

Country elevators in North Dakota spent about $18.6 million to ship about 30.6 million bushels of soybeans by rail to various destinations. Roughly 31 percent of all rail expenditures (i.e., dollars spent by country elevators) was allocated as direct impacts in North Dakota. Total direct economic impacts from rail transportation of soybeans in the state were about $5.8 million annually (Table 5). About 87 percent of all soybeans shipped by country elevators was shipped by rail to market destinations. Railroad expenditures accounted for 57 percent of the direct impacts from soybean transportation in the state.

Table 5. Annual Direct Economic Impacts From Rail Transportation of Soybeans From North Dakota Elevators to Market Destinations, 1996 Through 1998

Expenses	Annual Direct Impacts
	-- 000s $ –
Train Crew	1,823
Locomotive	975
Rail Car	892
Transportation Charge	478
Maintenance of Way	734
Net Liquidation Value	734
Central Administration	33
Insurance	19
Property Taxes	95
Total Direct Impacts	5,783

Secondary Impacts

Secondary economic impacts result from subsequent rounds of spending and respending within an economy. Input-output (I-O) analysis traces linkages (i.e., the amount of spending and respending) among sectors of an economy and calculates the total business activity resulting from a direct impact in a basic sector (Coon et al. 1985). An economic sector is a group of similar economic units (e.g., communications and public utilities, retail trade, construction).

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).

Secondary economic impacts were estimated separately for soybean production, grain handling, and transportation. The following sections discuss the allocation of direct impacts to various economic sectors of the North Dakota Input-Output Model and the amount of secondary impacts generated in those economic sectors.

Soybean Production

Soybean production expenditures and returns were allocated to various economic sectors of the North Dakota Input-Output Model. Seed, herbicide, chemicals, fertilizer, fuel, lubrication, repairs, equipment expenses (depreciation and leases), building depreciation, and miscellaneous expenses were allocated to the **Retail Trade** sector. Insurance and interest expenses were allocated to the **Finance, Insurance, and Real Estate** (FIRE) sector. Custom hire expenses were allocated to the **Business and Personal Services** sector. The **Communication and Public Utilities** sector contained utility expenses. Dues and professional fees were allocated to the **Professional and Social Services** sector. Property taxes were allocated to the **Government** sector. Hired labor, cash rent, and returns to unpaid labor, management, and equity were allocated to the **Households** sector.

Total direct impacts of $221 million from soybean production generated about $358 million in secondary impacts in the state (Table 6). Secondary impacts were greatest in the **Households** ($130 million) (**Households** sector represents economy-wide personal income) and **Retail Trade** ($103 million) sectors, followed by **Finance, Insurance, and Real Estate** ($22 million), **Communication and Public Utilities** ($18 million), and **Agriculture-Livestock** ($16 million) sectors. For every dollar in direct economic activity from soybean production, another $1.62 was generated in secondary economic activity. Total economic impacts from soybean production were about $564 million and included the indirect support of about 7,150 secondary full-time equivalent (FTE) jobs (Table 6). Secondary jobs represent employment outside of activities and services directly involved with soybean production, but employment that is dependent on the existence of those activities.

Table 6. Annual Direct, Secondary, and Total Economic Impacts of Soybean Production in North Dakota, by Economic Sector, 1996 Through 1998

Economic Sectors	Economic Impacts From Soybean Production		
	Direct	Secondary	Total
	---------- 000s $ ----------		
Agriculture-Livestock	0	15,974	15,974
Agriculture-Crops	0	6,488	6,488
Nonmetal Mining	0	811	811
Construction	0	12,296	12,296
Transportation	3	2,203	2,203
Comm and Public Utilities	2,672	17,856	20,528
Ag Proc and Misc Mnfg	0	10,250	10,250
Retail Trade	104,011	102,709	206,720
Fin, Ins, and R Estate	42,960	22,368	65,328
Business and Pers Service	2,812	9,007	11,819
Prof and Social Service	1,526	12,321	13,847
Households	56,089	130,304	186,393
Government	10,908	15,376	26,284
Total Impacts	220,981	357,963	578,944
Secondary Employment (full-time equivalent jobs)			7,148

Grain Handling

Grain handling expenditures and returns were allocated to various economic sectors. Equipment depreciation and repairs and general expenses were allocated to the **Retail Trade** sector. Taxes were allocated to the **Government** sector. Insurance, interest, and lease expenses were allocated to the **Finance, Insurance, and Real Estate** sector. Utilities and communication expenses were allocated to the **Communications and Public Utilities** sector. Accounting, advertising, and grain testing expenses were allocated to the **Business and Personal Services** sector. Labor expense was allocated to the **Households** sector.

Total direct impacts of $4.3 million from handling activities generated about $7.5 million in secondary impacts (Table 7). Secondary impacts were greatest in the **Households** ($2.7 million) and **Retail Trade** ($2.2 million) sectors. For every dollar in direct economic activity from grain handling, another $1.76 was generated in secondary economic activity. Total economic impacts from grain handling were about $11.8 million annually and included the support of about 145 secondary FTE jobs (Table 7).

Table 7. Annual Direct, Secondary, and Total Economic Impacts of Soybean Handling Activities in North Dakota, by Economic Sector, 1996 Through 1998

Economic Sectors	Economic Impacts From Grain Handling		
	Direct	Secondary	Total
	---------- 000s $ ----------		
Agriculture-Livestock	0	282	282
Agriculture-Crops	0	117	117
Nonmetal Mining	0	18	18
Construction	0	269	269
Transportation	0	43	43
Comm and Public Utilities	261	382	643
Ag Proc and Misc Mnfg	0	189	189
Retail Trade	1,261	2,228	3,489
Fin, Ins, and R Estate	826	495	1,321
Business and Pers Service	174	198	372
Prof and Social Service	0	274	274
Households	1,522	2,674	4,196
Government	217	342	559
Total Impacts	4,261	7,511	11,772
Secondary Employment (full-time equivalent jobs)			145

Transportation

Expenditures and returns associated with soybean transportation were allocated to various economic sectors. Fuel, lubrication, tires, repairs and maintenance, equipment, locomotive operation, rail car expenses, rail car and locomotive depreciation, supplies, and other expenses were allocated to the **Retail Trade** sector. Labor and central administration expenses were allocated to the **Households** sector. Property taxes and licenses were allocated to the **Government** sector. Insurance expense was allocated to the **Finance, Insurance, and Real Estate** sector. Communication expenses were allocated to the **Communications and Public Utilities** sector. General transportation expenses, maintenance-of-way costs, and net returns from truck transportation were allocated to the **Transportation** sector.

Total direct impacts of $10 million from soybean transportation generated about $16 million in secondary impacts (Table 8). Secondary impacts were greatest in the **Households** ($5.4 million) and **Retail Trade** ($4.8 million) sectors. For every dollar in direct economic activity from transportation activities, another $1.59 was generated in secondary economic

activity. Total economic impacts from soybean transportation were about $26.3 million annually and included the support of about 410 secondary FTE jobs (Table 8).

Table 8. Annual Direct, Secondary, and Total Economic Impacts of Soybean Transportation in North Dakota, by Economic Sector, 1996 Through 1998

	Economic Impacts From Grain Transportation		
Economic Sectors	Direct	Secondary	Total
	---------- 000s $ ----------		
Agriculture-Livestock	0	729	729
Agriculture-Crops	0	276	276
Nonmetal Mining	0	46	46
Construction	0	567	567
Transportation	1,472	97	1,569
Comm and Public Utilities	174	780	954
Ag Proc and Misc Mnfg	0	417	417
Retail Trade	4,643	4,830	9,473
Fin, Ins, and R Estate	372	1,066	1,438
Business and Pers Service	0	390	390
Prof and Social Service	0	564	564
Households	3,260	5,419	8,679
Government	207	972	1,179
Total Impacts	10,128	16,153	26,281
Secondary Employment (full-time equivalent jobs)			410

Employment

The soybean industry benefits the economy by creating and supporting direct and secondary employment. Direct employment is a measure of the number of full-time jobs within an industry. Secondary jobs are an estimate of employment outside of an industry, but employment that is created from the industry's economic activity.

Direct Employment

Direct employment in the soybean industry, like many commodity-based industries, is extremely 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. In each case, some jobs might disappear without the soybean industry, while others may not be affected. For example, an elevator that relies on soybeans for a major portion of its grain handling activities might reduce its work force if it no longer handled soybeans, providing it could not make up for the loss in grain handling with other commodities or agricultural activities.

However, the issue is not that simple. If soybeans were no longer produced, some alternative commodity(s) likely would be raised in its place and likely would be marketed and handled by grain elevators. Thus, local elevators would change from handling and shipping soybeans to handling and shipping the alternative commodity(s). The effects on employment are unclear.

Employment-related questions in transportation are similar. For example, independently employed truck drivers who haul farm commodities likely would remain employed in the absence of soybeans, but seek alternative hauling opportunities with other commodities. Even in the case where soybeans are the only commodity hauled, alternative commodities raised in the place of soybeans likely would provide similar shipping opportunities. Thus, most of the jobs outside of soybean production are within industries that are supported only in part by the soybean industry. This makes estimating direct employment extremely difficult. The soybean industry does directly affect jobs in grain handling and transportation; however, no strong basis exists for quantification of those jobs.

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.

The number of full-time equivalent (FTE) positions that could be attributable to soybean production from the 30,504 farms in the state is nearly impossible to estimate, given the scope of this study. Unless those farms raised only soybeans each year, the time spent raising soybeans usually would be less than a full-time job. The degree of time or fraction of employment for any particular farmer raising soybeans varies nearly every year. An estimate of the number of full-time jobs would require knowing the number of people employed by those farms and the fraction of employment devoted to soybean production for each worker. Also, many farmers, even in the absence of soybeans, likely would remain employed raising other crops.

Secondary Employment

Secondary employment estimates represent the number of full-time jobs generated based on the volume of business activity created by an industry. Productivity ratios[3] were used with estimates of business activity to obtain secondary employment. Soybean production indirectly

[3]A measure of the amount of economic activity needed in an economic sector to support one full-time job within that sector.

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 combined in the state supported about 7,703 FTE secondary jobs.

Tax Revenue

Tax collections are another important measure of the economic impact of an industry on an economy. Tax implications are an increasingly important measure of local and state-level impacts. 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.

Business activity alone does not directly support local government functions; however, taxes on personal income, retail trade, real estate property, and corporate income are important revenue sources for local and state governments. Total economic impacts in the **Retail Trade** sector were used to estimate revenue from sales and use taxes. Economic activity in the **Households** sector was used to estimate personal income tax collections. Similarly, corporate income tax revenue was estimated from the economic activity in all business sectors (excluding the **Households**, **Government**, and **Agriculture** sectors).

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 (Table 9). Total collections from sales and use, personal income, and corporate income taxes in the state were about $13.9 million annually. Soybean production also was directly responsible for about $10.9 million in property taxes annually in the state. Property tax collections from transportation activities were estimated at $207 thousand annually. 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. Property taxes were included as part of the direct impacts.

Table 9. Estimated Annual Tax Collections Generated From the Economic Activity Created by the Soybean Industry in North Dakota, 1996 Through 1998

Tax	Estimated Tax Collections
	------ 000s $ ------
Sales and Use	10,170
Personal Income	2,590
Corporate Income	1,130
Total Taxes	13,890

Total Economic Impacts

The general objective of the study was to measure the economic activity of the soybean industry in North Dakota. The following section is divided into cumulative impacts by industry activity.

Total annual direct impacts from soybean production in the state were estimated at $221 million annually from 1996 through 1998. Grain handling and transportation activities generated an additional $14.4 million in annual direct impacts. The soybean industry generated about $235 million in annual direct impacts in North Dakota from 1996 through 1998. Business activity (i.e., direct impacts) was greatest in the **Retail Trade** ($110 million), **Households** ($61 million), and **Finance, Insurance, and Real Estate** ($44 million) sectors (Table 10).

Table 10. 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	Transpor-tation	Grain Handling	Total Direct
	000s $			
Agriculture-Livestock	0	0	0	0
Agriculture-Crops	0	0	0	0
Nonmetal Mining	0	0	0	0
Construction	0	0	0	0
Transportation	3	1,472	0	1,475
Comm and Pub Util	2,672	174	261	3,107
Ag Proc and Misc Mnfg	0	0	0	0
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
Total Direct Impacts	220,981	10,128	4,261	235,370

Annual secondary impacts from soybean production in the state from 1996 through 1998 were estimated at $358 million (Table 11). Grain handling and transportation activities generated an additional $23.7 million in annual secondary impacts. The soybean industry generated about $382 million in annual secondary impacts in North Dakota from 1996 through 1998. 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 (Table 11). Overall, each dollar of direct impacts from the soybean industry generated about $1.62 in secondary impacts.

Secondary employment estimates represent the number of full-time jobs generated based on the volume of business activity created by the industry. Soybean activities in North Dakota indirectly supported about 7,703 FTE secondary jobs in the state.

Annual total (direct and secondary) economic impacts from soybean production expenditures and returns 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 12).

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 12).

Table 11. Secondary Impacts of the Soybean Industry to the North Dakota Economy, by Economic Sector and Industry Activity, 1996 Through 1998

Economic Sector	Total Secondary Impacts by Industry Activity			
	Soybean Production	Transpor-tation	Grain Handling	Total Secondary
	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	2,203	97	43	2,343
Comm and Pub Util	17,856	780	382	19,018
Ag Proc and Misc Mnfg	10,250	417	189	10,856
Retail Trade	102,709	4,830	2,228	109,767
Fin, Ins, and R Estate	22,368	1,066	495	23,929
Bus and Pers Service	9,007	390	198	9,595
Prof and Soc Service	12,321	564	274	13,159
Households	130,304	5,419	2,674	138,397
Government	15,376	972	342	16,690
Total Secondary Impacts	357,963	16,153	7,511	381,627

Table 12. 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
Total Economic Impacts	**578,944**	**26,281**	**11,772**	**616,997**
Secondary Employment	7,148	410	145	7,703
Share of Total Economic Activity	93.8%	4.3%	1.9%	

Each acre of soybeans planted in the state (1996 through 1998) generated about $514 in total economic activity (direct and secondary economic impacts) or, expressed alternatively, each bushel of soybeans produced resulted in $17.17 in total business activity in the state. For every 156 acres of soybeans planted or 4,665 bushels of soybeans harvested, one secondary FTE job was supported within the state. On average, each acre of soybeans planted generated about $20.67 in tax revenue within the state ($9.09 in property tax and $11.58 in combined sales and use, personal income, and corporate income taxes).

CONCLUSIONS

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.

The importance of soybean production to North Dakota producers is evident in the crop's recent expansion. As producers have attempted to diversify production away from traditional small grains during the 1990s, soybeans have offered an attractive alternative to many producers. Part of the expansion of soybean acreage can be attributed to relaxed planting restrictions and favorable loan rate provisions in the current farm policy and recent problems associated with crop quality in small grain production. 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, nearly all of the impacts from the soybean industry are generated by soybean production, as very little processing activity has occurred in the state.

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APPENDIX A

Soybean Production, Yield, and Acreage by County,
North Dakota, 1996 Through 1998
and
National Soybean Acreage and Yields

Appendix Table A1. Average Soybean Production, by County and Production Region, North Dakota, 1996 Through 1998

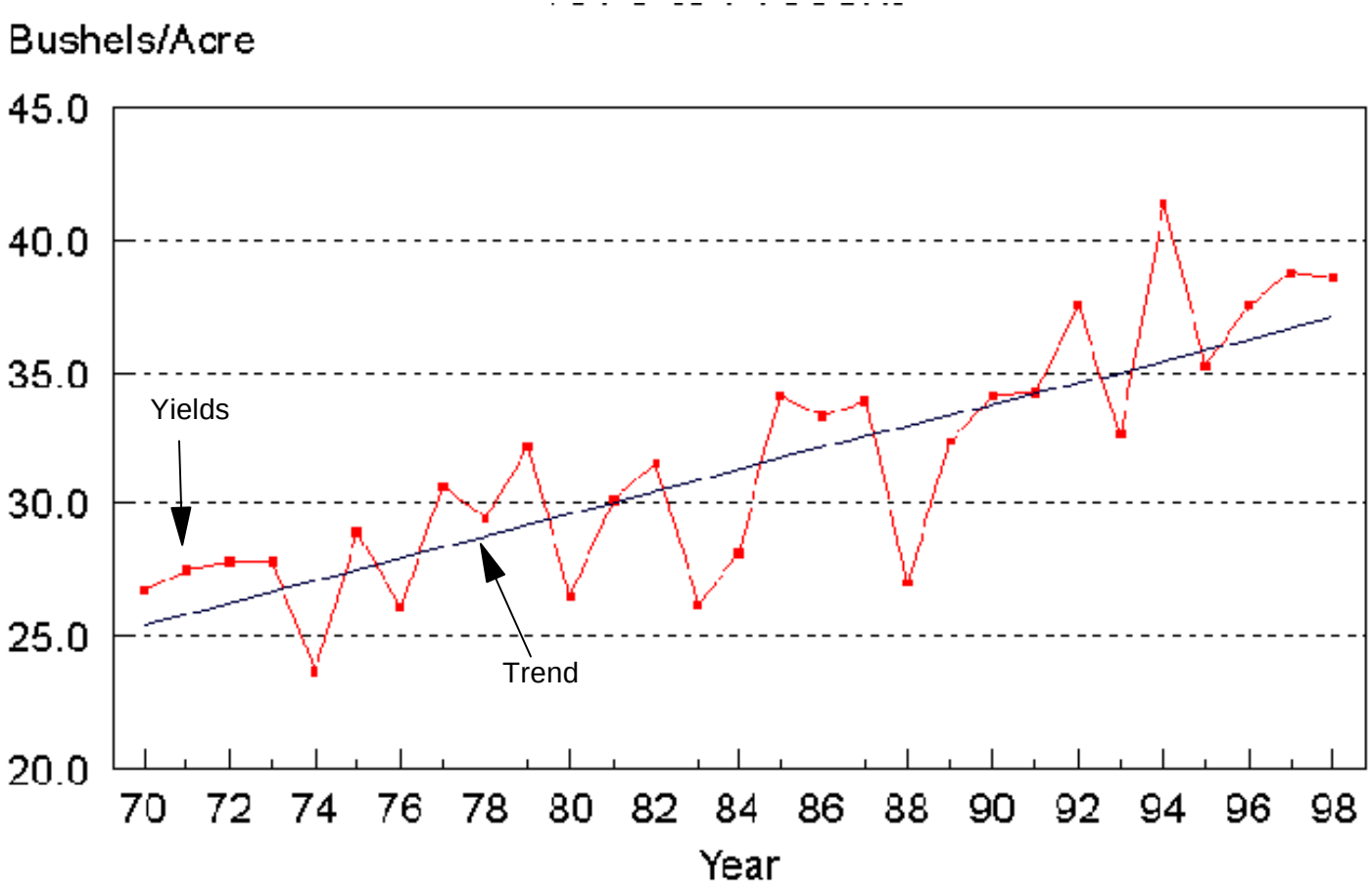
County/Production Region	Acres		Production	Yield per Planted Acre
	Planted	Harvested		
			bu	
Burke	0			
Divide	0			
Mountrail	0			
Renville	0			
Ward	500	500	11,133	22.3
Williams	0			
NORTHWEST	500	500	11,133	22.3
Benson	3,850	3,522	84,321	23.9
Bottineau	1,091	1,052	15,574	14.8
McHenry	0			
Pierce	926	926	21,071	22.8
Rolette	667	667	8,733	13.1
NORTH CENTRAL	6,533	6,167	129,700	21.0
Cavalier	3,567	3,300	71,500	21.7
Grand Forks	77,333	75,533	2,023,667	26.8
Nelson	12,833	12,833	297,733	23.2
Pembina	25,400	25,233	734,467	29.1
Ramsey	4,600	4,533	102,133	22.5
Towner	3,267	3,033	68,867	22.7
Walsh	15,667	15,500	415,200	26.8
NORTHEAST	142,667	139,967	3,713,567	26.5
Dunn	333	333	4,667	14.0
McKenzie	0			
McLean	567	467	12,967	27.8
Mercer	0			
Oliver	0			
WEST CENTRAL	900	800	17,633	22.0
Eddy	1,567	1,567	27,600	17.6
Foster	6,900	6,833	146,133	21.4
Kidder	2,433	2,433	52,900	21.7
Sheridan	333	333	5,900	17.7
Stutsman	18,633	18,333	516,400	28.2
Wells	2,767	2,767	57,400	20.7
CENTRAL	32,633	32,267	806,333	25.0

Appendix Table A1. Continued

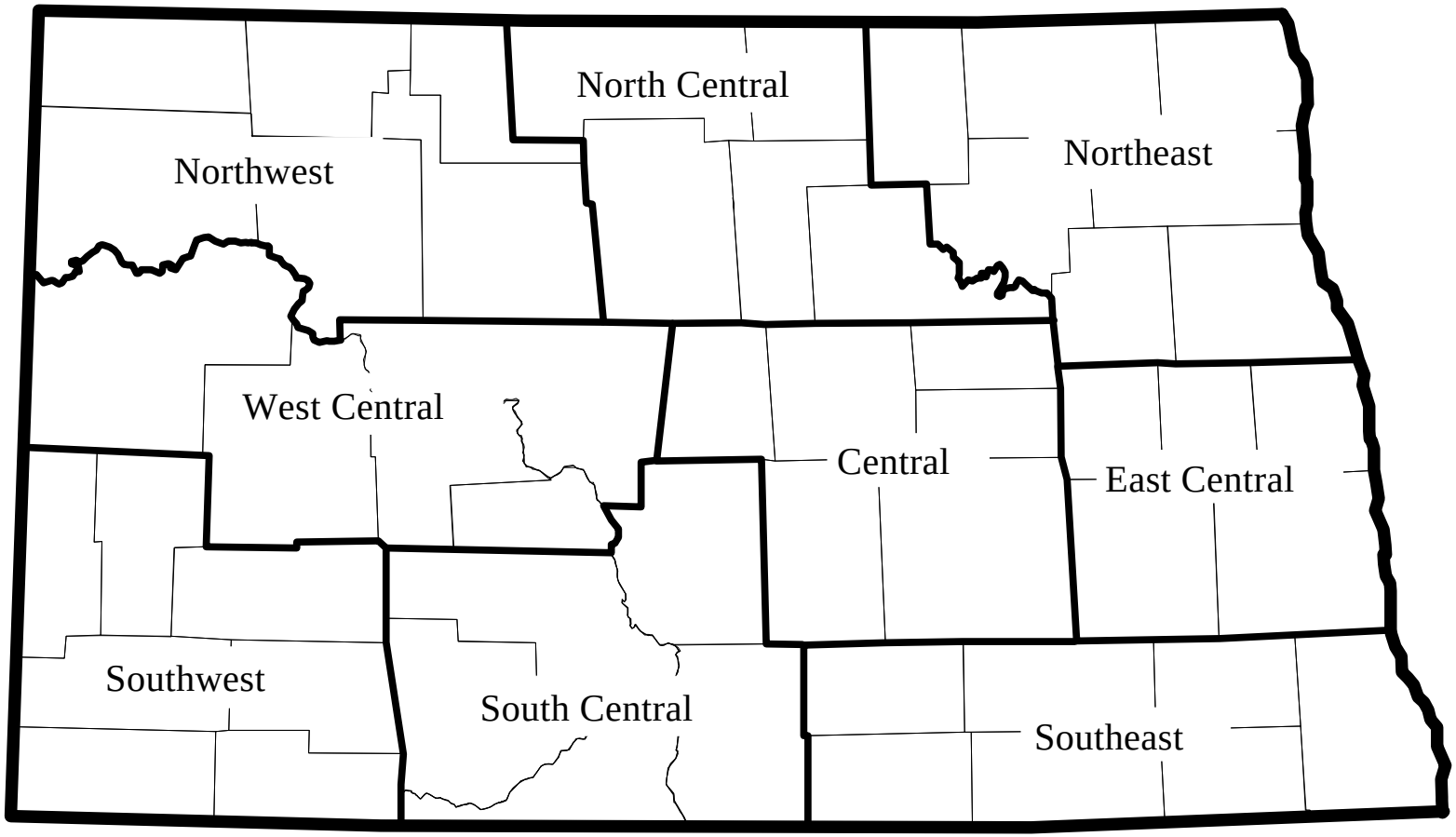
County/Production Region	Acres			Yield per
	Planted	Harvested	Production	Planted Acre
			bu	
Barnes	43,500	43,033	1,354,200	31.5
Cass	328,333	327,733	10,588,167	32.3
Griggs	11,833	11,767	288,000	24.5
Steele	44,333	44,200	1,336,767	30.2
Traill	122,000	120,500	3,658,933	30.4
EAST CENTRAL	550,000	547,233	17,226,067	31.5
Adams	0			
Billings	0			
Bowman	0			
Golden Valley	0			
Hettinger	567	500	12,267	24.5
Slope	0			
Stark	0			
SOUTHWEST	567	500	12,267	24.5
Burleigh	1,547	1,523	44,444	29.2
Emmons	2,120	2,010	48,456	24.1
Grant	0			
Morton	400	367	7,367	20.1
Sioux	0			
SOUTH CENTRAL	4,067	3,900	100,267	25.7
Dickey	18,867	18,133	555,400	30.6
LaMoure	27,500	26,233	853,633	32.5
Logan	833	800	20,833	26.0
McIntosh	2,967	2,767	57,000	20.6
Ransom	34,500	34,233	1,089,200	31.8
Richland	281,667	278,700	8,511,267	30.5
Sargent	95,333	94,000	2,824,667	30.0
SOUTHEAST	461,667	454,867	13,912,000	30.6
Other	467	467	9,367	20.1
STATE	1,200,000	1,186,667	35,938,333	30.3

Source: North Dakota Agricultural Statistics Service.

Appendix Figure A1. United States Soybean Acreage, 1979 Through 1998



Appendix Figure A2. United States Soybean Yields, 1970 Through 1998



Appendix Figure A3. North Dakota Agricultural Crop Production Regions
Source: North Dakota Agricultural Statistics Service.

APPENDIX B

Crop Production, Truck, Railroad, and Country Elevator Budgets

Soybean production budgets were compiled from a variety of secondary sources. Acreage and yields were averaged from 1996 through 1998 (North Dakota Agricultural Statistics Service *various years*). Average marketing-year prices were obtained from the North Dakota Agricultural Statistics Service (*various years*) and weighted by production each year from 1996 through 1998. Farm program payments (loan deficiency payments), averaged from 1996 through 1998, were collected from North Dakota Consolidated Farm Services (1999). Insurance indemnities and premiums were obtained from National Crop Insurance Services (1999).

Crop expenses were obtained from the Farm Business Management Program in North Dakota (North Dakota Farm and Ranch Business Management 1999, 1998, 1997). Budgets obtained were divided into operations on owned land and rented land. Expenses were first averaged between budgets for soybeans produced on owned land and rented land by the ratio of owned and rented farm land in North Dakota (U.S. Department of Commerce 1999). Budgets representing average yearly expenses (owned and rented operations) were then averaged (weighted by acreage planted each year) from 1996 through 1998.

Appendix Table B1. Soybean Production Budgets, North Dakota 1996 Through 1998

Budget Items	Region: Red River Valley	Region: All Other Regions
Acreage	1,024,567	175,433
Yield (bu/acre)	30.43	27.11
Price ($/bu)	$5.82	$5.82
Miscellaneous*	$9.65	$11.04
Total Revenue ($/acre)	$186.78	$168.82
Variable Expenses ($/acre)		
Seed	15.45	17.01
Fertilizer	2.42	8.20
Crop Chemicals	25.79	23.15
Crop Insurance	8.85	7.76
Fuel and Oil	8.23	8.26
Repairs	15.56	13.08
Custom Hire	2.00	4.34
Hired Labor	0.22	0.00
Cash Rent**	24.19	15.30
Machinery Leases	0.04	0.00
Hauling and Trucking	0.00	0.01
Interest	5.40	6.00
Miscellaneous	0.28	0.16
Total Variable	108.44	103.28
Fixed Expenses ($/acre)		
Hired Labor	6.76	5.91
Machinery Leases	3.01	2.24
Property Taxes	9.77	5.13
Insurance	2.41	2.65
Utilities	2.22	2.27
Professional Dues/Fees	1.41	0.47
Interest	20.55	11.15
Machinery Depreciation	12.46	13.46
Miscellaneous	3.17	2.63
Total Fixed	61.76	45.90
Returns to Unpaid Labor, Management, and Equity ($/acre)	16.58	19.65

*Includes insurance indemnities and loan deficiency payments.
**Property tax was subtracted from cash rent and added to property tax expenses.

Sources: North Dakota Agricultural Statistics Service and North Dakota Farm and Ranch Business Management (1999, 1998, 1997).

Appendix Table B2. Truck Transportation Budget, Soybean Shipments, Upper Great Plains, 1996 Through 1998

	$/mile[a]
Gross Revenue[b]	1.17
Variable Costs	
Tires	0.042
Labor	0.290
Maintenance and Repairs	0.084
Fuel	0.154
Total Variable Costs	0.57
Fixed Costs	
Equipment Costs/Tractor	0.270
License and Taxes/Tractor	0.030
Insurance	0.098
Mgmt and Overhead	0.0054
Total Fixed Costs	0.53
Total Costs	1.10
Net Returns	0.07

[a] Developed from Berwick and Dooley (1997).
[b] Upper Great Plains Transportation Institute (1999). Rate per mile traveled.

Total trucking revenues (i.e., expenses incurred by country elevators) were estimated by multiplying total trip mileage by trucking rate per mile by the number of shipments. Because some trucking expenses are incurred in other states on interstate shipments and because some soybeans are shipped by out-of-state trucking firms (which incur most of their operating expenses in other states), only 80 percent of the economic activity generated from interstate shipments of soybeans was allocated as direct impacts to the state. The remaining expenses were treated as economic leakages, such as shipments of grain from North Dakota to the Pacific Northwest. All economic activity from truck shipments of soybeans to in-state destinations was included as direct impacts (in-state destinations were grouped with other/miscellaneous market destinations).

Appendix Table B3. Railroad Cost Breakdown, Soybean Shipments, Upper Great Plains, 1996 Through 1998

Variable Expenses	Percent of Variable Costs
Train Crew[a]	43.73
Locomotive[b]	23.39
Railroad Car[c]	21.41
Transportation Charge[d]	11.47
Total Variable	100.00

Fixed Expenses	Percent of Fixed Costs
Maintenance-of-Way	45.44
Net Liquidation Value	45.44
Central Administration	2.03
Insurance and Other	1.20
Property Tax	5.89
Total Fixed	100.00

[a] Includes wages, fringe benefits, and crew overnight costs.
[b] Includes locomotive repairs, depreciation/rent/ leases, return on investment, servicing, fuel, and machinery overhead.
[c] Includes car-day and car-mile costs.
[d] Includes train inspection/lubrication, dispatching, crossing protection, and signal/interlockers costs.

Source: Tolliver et al. (1987).

Rail shipment expenditures (expenses incurred by railroad companies) vary by shipment size, carrier, distance, cargo type, and shipment type (Bangsund et al. 1994). Shipment costs for elevators also vary by cargo type, distance, carrier, and size. However, the expense incurred or paid by shippers on rail lines are usually based on shipping tariffs that are set by railroad companies. Shipping tariffs do not correspond with shipping expenditures incurred by railroad companies.

The amount of variable and fixed costs for rail shipments of soybeans in the state was determined using the Uniform Railroad Costing Model (URCS). Grain flow statistics (i.e., amounts of soybeans shipped to various destinations from various points in the state) were used in

conjunction with URCS to generate an estimate of overall railroad company expenditures by variable and fixed cost categories. The railroad operating budget above was used to divide costs obtained from URCS into expense categories and subsequently allocate those expenditures to various economic sectors. The cost structure (total variable and fixed costs) of soybean shipments was subtracted from shipping tariffs to determine railroad company net returns. Railroad net returns were not allocated as direct impacts, since they were assumed to leave the state economy. Sixty percent of the variable and fixed costs of rail shipments was assumed to remain within the state's economy and resulted in direct economic impacts. The remaining transportation expenses were not allocated as direct impacts and represented an economic leakage from the state.

Appendix Table B4. Country Elevator Grain Handling Budget, Upper Great Plains, 1996 Through 1998

Expenses	--$/bu--
Labor	0.043
Taxes and Licenses	0.006
Insurance	0.011
Utilities	0.007
Services	0.003
Interest	0.011
Equip. Depr. and Repairs	0.018
General Expense	0.021
Gross Margin	0.120

Country elevators typically handle grain and provide a variety of agricultural services; however, the above budget only represents likely expenses and returns for soybean handling activities for country elevators in North Dakota. Expense categories and percentages of gross margin were obtained from Bangsund and Leistritz (1998a). The gross margin was based upon information received from St. Paul Bank of Cooperatives (1999). Soybeans retained by producers for use as seed soybeans were subtracted from county production (Aakre 1999; Swenson 1999).

APPENDIX C

Grain Flow Statistics

Appendix Table C1. Mode of Transportation for All Soybean Shipments, North Dakota, 1996 Through 1998

Market Destination	Mode of Transportation		Ratio of Mode	
	Truck	Rail	Truck	Rail
	---------- bu ----------			
Duluth	471,000	10,631,000	4.2%	95.8%
Minneapolis/St. Paul	791,000	4,350,000	15.4%	84.6%
Midland/Southwest	319,000	467,000	40.6%	59.4%
Pacific Northwest	19,000	11,075,000	0.2%	99.8%
Other	2,809,000	4,113,000	40.6%	59.4%
Total Shipments	4,409,000	30,636,000	12.6%	87.4%
	12.58%	87.42%		100.00%

Reported yearly soybean shipments from country elevators by crop production regions in North Dakota were obtained from Dalebout et al. (1997) and Vachal et al. (1997, 1999). However, those shipments did not account for the source of the soybeans shipped. Soybeans delivered to country elevators in North Dakota from out-of-state sources (neighboring states or Canada) was not addressed by Dalebout et al. (1997) and Vachal et al. (1997, 1999) and was not addressed in this study.

To obtain estimates of average shipments of soybeans produced in North Dakota over the study period, grain flow statistics were applied to county-level soybean production. Estimates of soybeans produced for seed (North Dakota State Seed Department *various years*) and estimates of soybeans retained by producers for seed (Aakre 1999; Swenson 1999) were subtracted from county production for purposes of estimating grain shipments.