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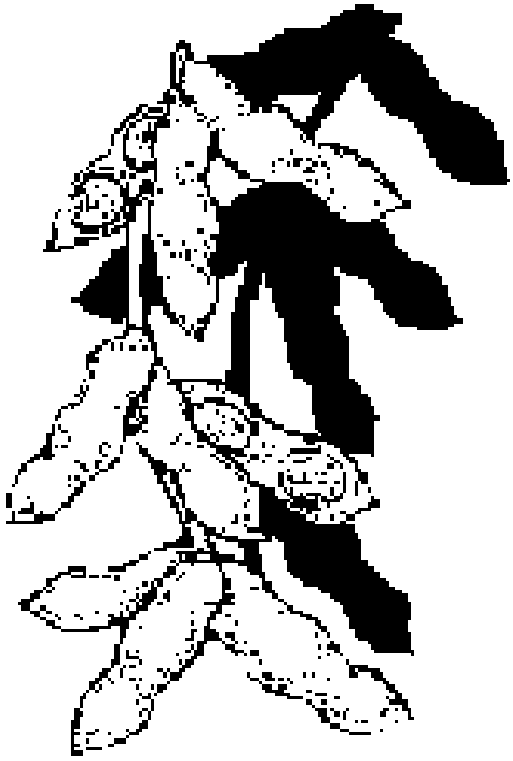
ECONOMIC CONTRIBUTION OF THE SOYBEAN INDUSTRY TO THE NORTH DAKOTA ECONOMY



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Abstract

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.

Soybean production in North Dakota has trended upward over the past three decades. Increases in acreage were relatively modest in the 1980s, but by the mid 1990s acreage was beginning to rapidly expand. In 1990, North Dakota had about 500,000 acres of soybeans. By 2000, acreage had increased to 1.9 million acres. By 2009, soybean acreage in the state was approaching 4 million acres.

Direct impacts (expenditures and returns) from soybean production averaged $312 per acre or $1.1 billion annually from 2007 through 2009. Average direct impacts from handling soybeans at North Dakota elevators were estimated at $27.5 million annually. Transportation of soybeans to market destinations was estimated to generate $49.8 million in annual direct impacts to the state. Total direct impacts from soybean production, grain handling, and transportation were estimated at $1.2 billion annually.

Total annual economic impacts (direct and secondary effects) from soybean production, grain handling, and transportation were estimated at $3 billion, $75.9 million, and $129 million, respectively. The total annual economic impact from all soybean activities was estimated at $3.2 billion. Soybean industry activities supported 11,400 full-time secondary jobs in North Dakota. Soybean activities were also responsible for $85 million in combined property tax, sales tax, individual income tax, and corporate income tax revenues.

Based on comparison to economic impact estimates from the 1996 through 1998 period, the economic contribution of the soybean industry in North Dakota increased by $2.4 billion or by 306 percent in real terms. Much of the increase in the gross business volume of the industry has come from a three-fold increase in soybean production combined with higher crop prices, handling margins, and transportation rates.

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 nearly 4 million acres in 2010. Averaged from 2007 to 2009, soybeans were second only to wheat in planted acreage.

The Red River Valley historically has been the primary soybean producing area in the state. From 1990 to 1999, about 82 percent of soybean production in the state occurred in the Red River Valley. The Red River Valley's share of state production dropped below 50 percent in 2004 and the Red River Valley currently accounts for about 41 percent of total state production. Since 2000, soybean acreage in the Red River Valley has increased 29 percent or by 360,000 acres. By contrast, soybean acreage outside of the Red River Valley over the same period increased by 247 percent or by 1.6 million acres. Soybean production has moved north and west into areas that had little-to-no soybean production only a decade ago.

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 3.6 million planted acres and about 110 million bushels from 2007 through 2009. Annual direct economic impacts from soybean production were estimated at $1.1 billion or about $312 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 $27.5 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 $10.9 million and $38.9 million for truck and rail transportation, respectively. Collectively, of the $138 million spent annually on soybean transportation, about $49.8 million was retained within the state economy.

Total annual direct economic impacts from all soybean activities in the state were estimated at $1.2 billion. The North Dakota Input-Output Model was used to estimate the

secondary economic impacts. The $1.2 billion in direct economic impacts generated another $2 billion in secondary economic impacts. Gross business volume (direct and secondary effects) was estimated at $3.2 billion annually. Each acre of soybeans planted was estimated to generate about $893 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 **Households** (which represents economy-wide personal income) ($1.15 billion), **Retail Trade** ($1.1 billion), **Finance, Insurance, and Real Estate** ($291 million), **Government** ($129 million), and **Communications and Public Utilities** ($112 million).

Annual tax collections from the soybean industry were about $51.2 million, which included $28.3 million in sales and use, $17.2 million in personal income, and $5.6 million in corporate income taxes. When property taxes were included, the soybean industry generated about $85 million in local and state tax revenues. Approximately 5,875 farms in 2007 raised soybeans in the state. Secondary employment supported by soybean production, grain handling, and transportation activities was estimated at 11,400 jobs annually.

Soybeans are no longer just a regionally important crop in North Dakota. Soybeans historically have ranked below wheat, barley, sunflowers, and corn in terms of acreage planted, but currently rank second only to wheat in planted acreage and third to corn and wheat in terms of bushels produced in North Dakota. The soybean industry is now a multi-billion dollar agricultural industry and recent trends suggest that acreage, and economic importance, will continue to increase in the future.

Economic Contribution of the Soybean Industry to the North Dakota Economy

Dean A. Bangsund, Frayne Olson, and F. Larry Leistritz*

INTRODUCTION

Agriculture remains a major component in the North Dakota economy (Coon and Leistritz 2010); 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 over the last decade in terms of acreage planted and value of production (U.S. Department of Agriculture 2010b). Although acreage of soybeans in the United States has increased, soybean production remains mostly concentrated in the Corn Belt and Upper Great Plains regions of the United States.

Soybean acreage has continued to expand into nontraditional row-crop regions, such as those found in some parts of North Dakota (U.S. Department of Agriculture 2010b). Soybeans have become an increasingly important crop in North Dakota over the last two decades. 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*). In 1998, soybeans accounted for 26 percent of all row crops and 8.3 percent of all crops grown in the state. In 2009, soybeans represented over 47 percent of all row crops in the state and nearly 20 percent of principal crops in the state. While soybean production has increased in the Red River Valley, the traditional soybean producing region in the state, greater gains in acreage have been observed in the central region of the state. Since the early 2000s, North Dakota has ranked among the top 10 soybean producing states in the U.S.

Several factors have led to an increase in soybean acreage in the state over the past several decades. In the 1990s, changes in farm policy greatly increased planting flexibility, allowing producers to shift acreage among crops (U.S. Department of Agriculture 1996). Also, farm program provisions over the period 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 soybean loan rates were more economically attractive than loan provisions for other program crops. Also prevalent during the period, yield, price, and crop quality problems with traditional small grains forced producers to seek alternative crops and reduce their dependence upon traditional small grains. Row crops, particularly soybeans, offered an attractive alternative to small grains for many producers in the eastern half of North Dakota.

In the 2000s, the increase in North Dakota soybean acreage has been primarily driven by the relative profitability of soybeans compared to traditional crops (i.e., small grains). Soybeans

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fit well into most North Dakota crop rotation systems because of the limited number of disease and insect pests that are shared with other crops. In addition, soybeans do not require high levels of fertilization which has been especially important in recent years when fertilizer prices have risen dramatically. Soybeans are a legume crop which fixes its own nitrogen and because North Dakota soils are naturally high in phosphorous and potassium, soybeans require very little additional fertilizer.

Improved soybean seed varieties have been an important factor in expanded production in North Dakota (Kandel 2010). Producers in northern growing regions are now using varieties much better adapted to growing conditions in North Dakota. Also, glyphosate resistant genetics (i.e., also known as Roundup-Ready soybeans) have made substantial improvements in weed control and enhanced yield potential. Several key cultural changes have been combined with glyphosate resistant genetics. The use of rock rollers has allowed soybean production to expand into rocky soils, which used to deter soybean production due to harvesting concerns. Further, the combined use of Roundup-Ready soybeans, rock rollers, and the use of either no-till or reduce-tillage production systems have allowed soybean acres to expand into the dryer central and western regions 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 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.

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 and value of production, soybeans currently rank second behind corn. Soybeans are produced in 31 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 based on total production, which include Iowa, Illinois, Minnesota, Nebraska, and Ohio, account for nearly 55 percent of U.S. production. The top ten states produce over 80 percent of domestic production (U.S. Department of Agriculture 2010b).

Soybean acreage in the United States increased substantially during the 1970s, only to have acreage decline over the next decade (Appendix A). However, soybean acreage increased again in the 1990s. Acreage has continued to increase in the 2000s, although at a much slower rate than observed in the previous decade. In 1970, the U.S. planted about 43 million acres of soybeans, by contrast, the U.S. planted 77.7 million acres in 2010. Average soybean yields also have increased over the same period. Average yields in the U.S. ranged from 25 to 26 bushels per acre in 1970 to around 44 bushels per acre in 2010 (U.S. Department of Agriculture 2010b) (Appendix A).

Soybean production in North Dakota has trended upward over the past three decades. Increases in acreage were relatively modest in the 1980s, but by the mid 1990s acreage was beginning to rapidly expand. Soybean acreage in the state continued to expand from the mid 1990s to the mid 2000s. In 1990, North Dakota had about 500,000 acres of soybeans. By 2000, acreage had increased to 1.9 million acres. By 2010, soybean acreage in the state was around 4.1 million acres (U.S. Department of Agriculture 2010b) (Figure 1).

The Red River Valley historically has been the primary soybean producing area of the state. However, even when soybeans were predominately grown in the Red River Valley, minor acreage of soybeans was present throughout the eastern half of North Dakota. From 1990 to 1999, about 82 percent of soybean production in the state occurred in the Red River Valley. However, the Red River Valley's share of state production dropped below 50 percent in 2004. Currently, the Red River Valley accounts for about 41 percent of total state production (Figure 1).

While soybean production in the state has increased both in the Red River Valley and outside the valley, the greatest increases in planted acreage and production since 2000 have occurred outside of the Red River Valley (Figure 1). Since 2000, soybean acreage in the Red River Valley increased 29 percent or by 360,000 acres. In contrast, soybean acreage outside of the Red River Valley over the same period increased by 247 percent or by 1.6 million acres. The increase has largely been in counties that have historically had some soybean production, although production has moved north and west into areas that, a decade ago, had little to no soybean production (North Dakota Agricultural Statistics Service *various issues*).

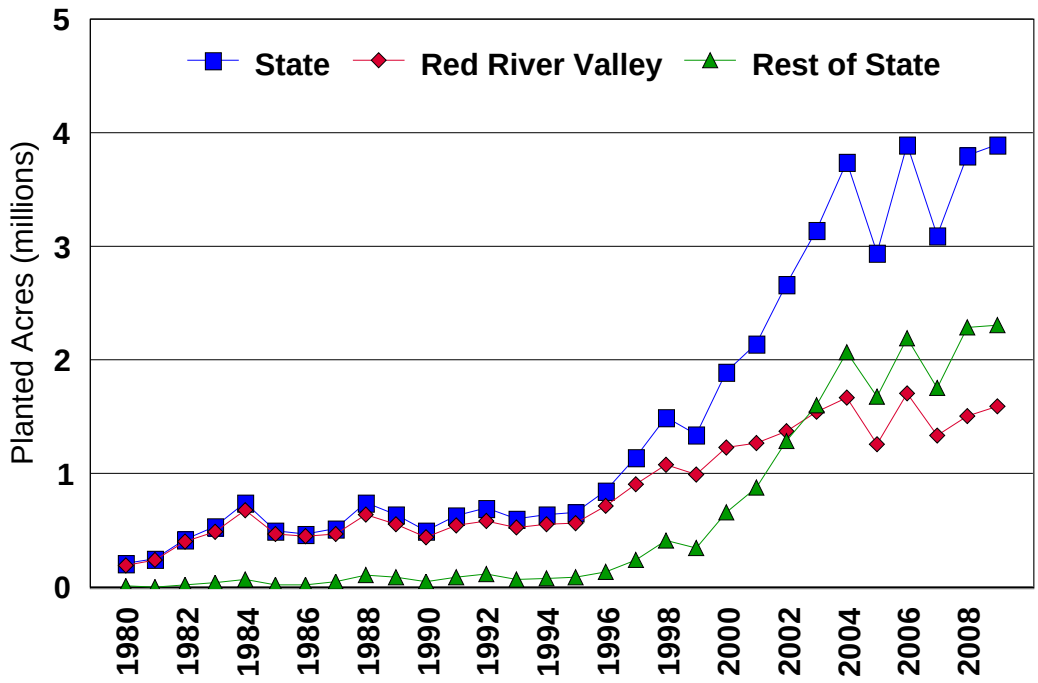

Figure 1. Planted Soybean Acreage, North Dakota, 1980 Through 2009
Source: North Dakota Agricultural Statistics Service (*various years*).

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.

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. 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).

Unfortunately, there is very limited information regarding the size and composition of the Identity Preserved (IP) soybean industry in North Dakota. Current industry estimates suggest that between five percent and eight percent of the soybeans produced in North Dakota are IP. This translates to between 200,000 and 325,000 planted acres of IP soybeans in 2010, which is approximately a ten-fold increase since 1998.

Identity preserved soybeans usually require specific varieties be produced which have unique traits desired by the end user. Some of these varieties have not been genetically modifie,

but have been adapted for use in food products such as tofu, natto, miso, soy-milk, soy sauce, soy sprouts, and roasted soy nuts. The bulk of the food quality soybeans produced in North Dakota is exported to Asian countries, although some production is sold in domestic markets.

Price premiums are normally offered for IP soybeans because of the additional management required to produce and segregate IP soybean varieties, and to compensate for lower average yields than glyphosate resistant soybean varieties (see NDSU Seed Variety Trials). Price premiums are typically quoted as a premium to the Chicago Board of Trade (CBOT) soybean futures contract prices. In 2000, these premiums ranged from zero, or equal to CBOT futures prices, to $1.25/bushel over the futures price. In 2010, these premiums have increased and range from $1.25/bushel to $3.50/bushel over the CBOT futures price. Commodity soybeans in North Dakota commonly sell for $0.60/bushel to $0.80/bushel below CBOT soybean futures prices.

The primary advantage of growing IP soybeans in North Dakota, versus other regions within the U.S., is the ability to maintain quality during extended storage periods, the low incidence of insect and disease damage, and the concentration of companies which contract and purchase IP soybeans within the region. The Northern Food Grade Soybean Association lists ten companies which purchase IP soybeans in North Dakota.

One of the greatest challenges facing continued expansion of the IP soybean industry is the cost of transportation from North Dakota to the final destination. The most common shipment method for IP soybeans is via trans-modal container vessels. Container vessels allow the seller to load and seal the container unit at the point of departure and preserve identity throughout the transportation process until it reaches its final destination. The availability and cost of container units have created logistical challenges for the IP soybean industry in the past. The addition of a trans-modal container shipping facility in Minot, N.D. may mitigate some of the transportation issues.

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 2005, 2004, 1998a, 1998b, 1995a, 1995b).

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 (2007-2009) 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, the majority of soybean production in North Dakota now occurs outside of the Red River Valley (Figure 2). Soybean production in North Dakota averaged about 3.6 million planted acres and 110 million bushels per year from 2007 through 2009 (North Dakota Agricultural Statistics Service *various years*) (Appendix A). County average soybean yields in North Dakota during the period varied from 16 to 40 bushels per planted acre, with an overall state average of 30.6 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.

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

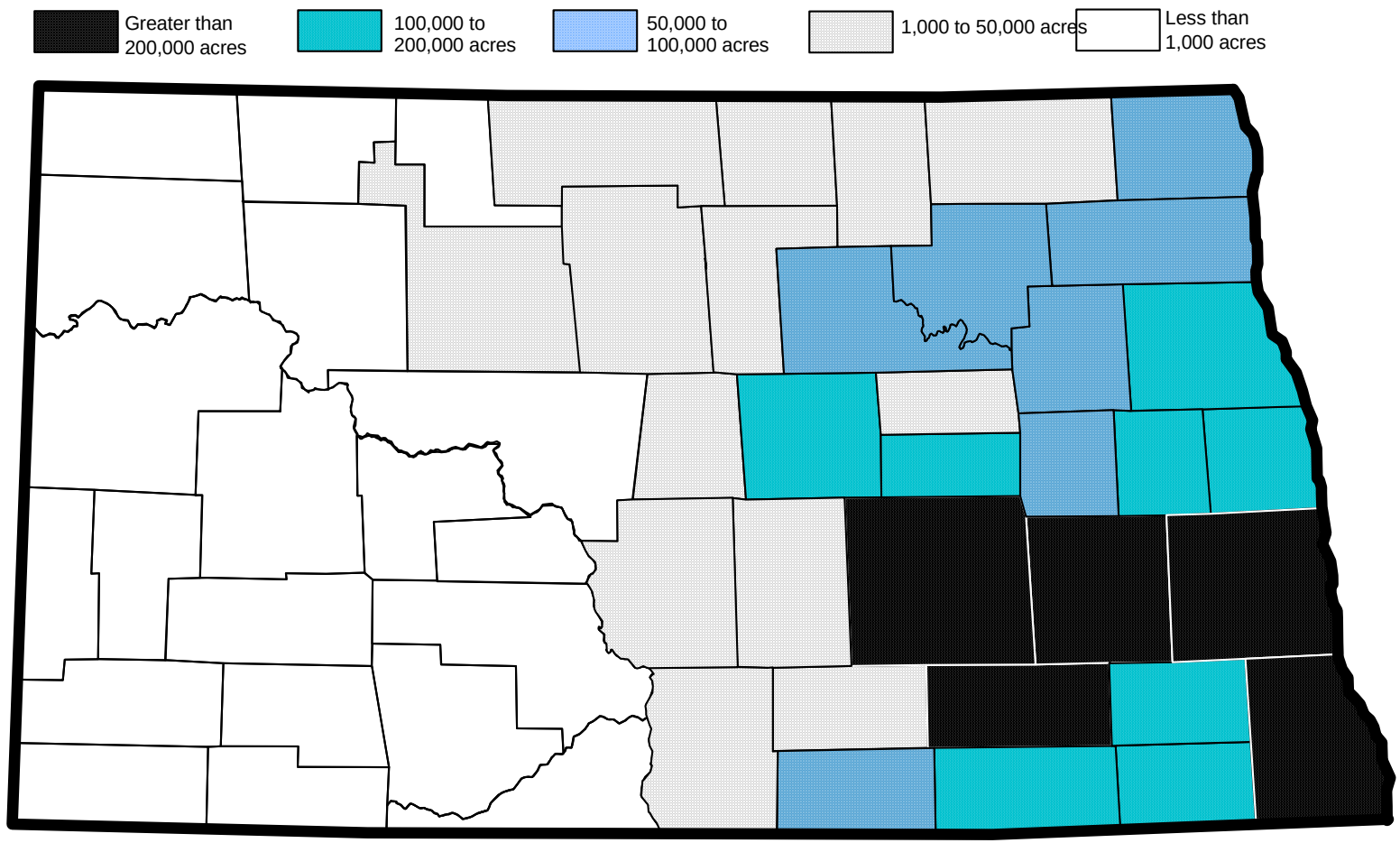

Figure 2. Average Planted Acreage of Soybeans in North Dakota, by County, 2007 to 2009

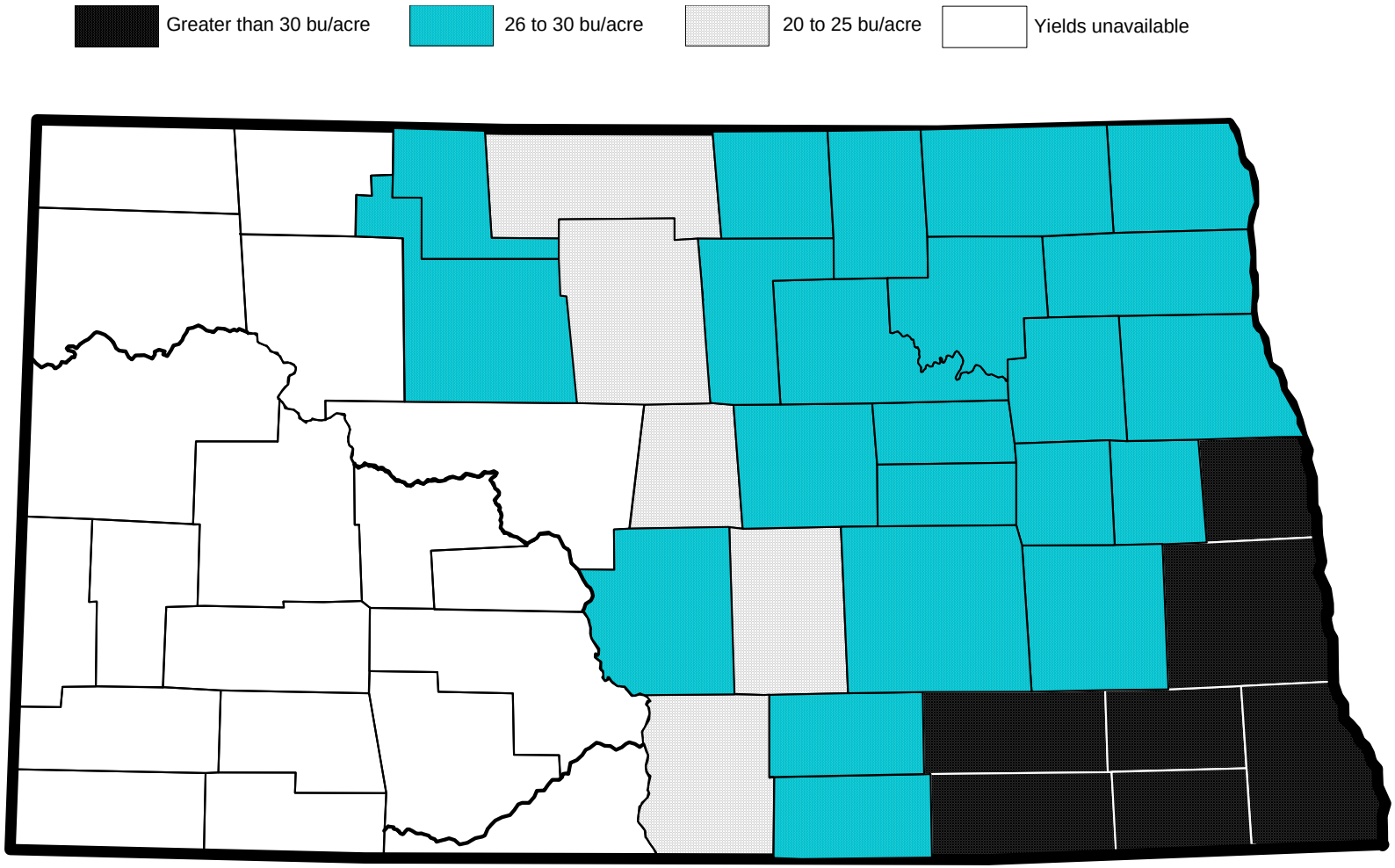

Figure 3. Average Soybean Yields in North Dakota, by County, 2007 to 2009

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 2010). Expenditures were averaged from 2007 through 2009. Revenues were based on average production, average prices, government payments, and insurance indemnities (Appendix B).

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 (Vachal and Benson 2008a, 2008b, 2009a, 2009b, 2010a, 2010b). 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 the Pacific Northwest (Table 1). About 10 percent of soybean shipments by country elevators were to Minneapolis/St. Paul and Duluth destinations. Shipments to the midland/southern markets accounted for about 2 percent of all shipments. Other destinations represented about 14 percent of soybean shipments (Table 1).

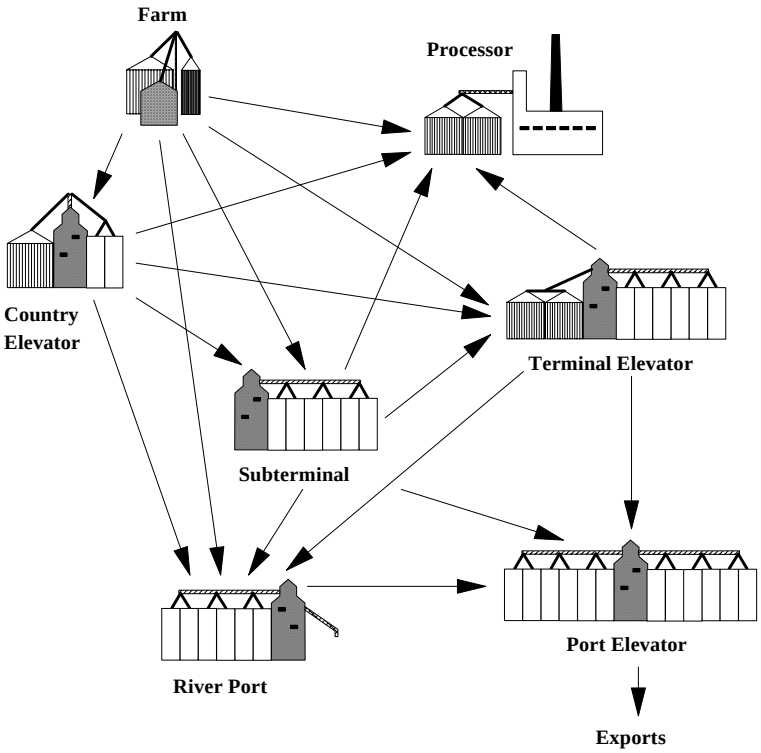

Figure 4. Typical Grain Movements in the United States Grain Marketing System
Source: U.S. Department of Agriculture (1990).

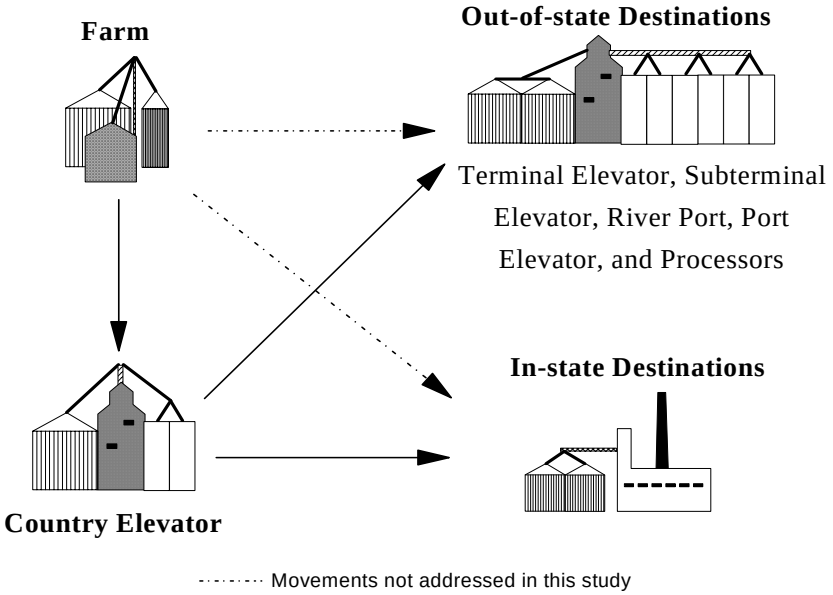

Figure 5.
Assumed Soybean Movements for Soybeans Produced in North Dakota, 2007 Through 2009

Table 1. Annual Soybean Movements From North Dakota Country Elevators to Various Market Destinations, 2007 Through 2009

Regions	Market Destinations				
	Duluth	Mpls/ St. Paul	Midwest/ Southern	Pacific Northwest	Other
	000s bu				
North Central	0	107.8	175.5	3,447.0	633.7
Northeast	228.8	1,486.3	0	5,644.2	6,388.3
Central	468.6	1,563.0	491.5	14,869.9	1,861.3
East Central	0	3,518.9	377.1	31,957.4	1,484.0
South Central	0	0	502.9	0	191.7
Southeast	0	3,153.2	804.9	24,462.9	4,411.7
Others[a]	2.2	1.1	0	249.2	43.9
All Shipments[b]	699.6	9,830.3	2,351.8	80,630.7	15,003.7
%	0.6	9.1	2.2	74.3	13.8

[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 109.9 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

[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.

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 (Appendix C).

The percentages of grain shipments to market destinations were estimated from Vachal and Benson (2008a, 2008b, 2009a, 2009b, 2010a, 2010b). 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 rates for soybeans shipped by truck were based on information obtained from Agricultural Marketing Service, United States Department of Agriculture (2007, 2008, 2009). The trucking rate was used with truck operating costs (adapted from Berwick and Dooley 1997) 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 and Bensen (2010b) 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 (2009, 2010). 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 (Bangsund and Leistritz 2005, Bangsund et al. 1994)..

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 operations to crush soybeans, market factors have prevented the switch to soybeans. Minor amounts of soybeans were processed during the 1990s, but no material amount of soybeans has 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, average prices, government payments, and insurance indemnities. Expenses were obtained from budgets compiled by the North Dakota Farm and Ranch Business Management Program (2010) (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. An additional concern is land rent paid to absentee landowners; although data to estimate the economic leakage is not available.

Soybean production in North Dakota averaged 3.6 million planted acres from 2007 to 2009 The 3.6 million acres of soybeans generated about $796 million in production expenditures annually and $328 million annually in returns to unpaid labor, management, and equity. Direct impacts (expenditures and returns) from soybean production in North Dakota averaged $312 per acre or $1.1 billion annually (Table 2).

Table 2. Average Direct Economic Impacts From Soybean Production in North Dakota, 2007 Through 2009

Expenses/Returns	Direct Impacts from Soybean Production		
	Red River Valley	Remainder of State	Total
	---------- 000s $ ----------		
Revenues			
Crop Sales	471,899	532,714	1,004,613
Other Revenues[a]	56,290	63,171	119,461
Total Revenue	528,189	595,885	1,124,074
Variable Expenses			
Seed	67,161	85,258	152,419
Fertilizer	8,931	18,471	27,402
Chemicals	37,595	37,900	75,495
Insurance	36,496	35,006	71,502
Fuel and Lubrication	26,555	28,978	55,533
Repairs and Maintenance	35,476	33,826	69,302
Hired and Custom Work	5,192	9,421	14,613
Interest	7,323	7,536	14,859
Cash Rent	48,902	34,549	83,451
Machinery Leases	0	851	851
Miscellaneous	467	767	1,234
Overhead			
Hired Labor	18,917	10,815	29,732
Machinery/Building Leases	3,691	4,097	7,788
Insurance	7,050	5,235	12,285
Utilities	5,186	4,018	9,204
Professional Dues/Fees	4,397	1,588	5,985
Interest	32,337	19,342	51,679
Property Taxes	22,136	12,168	34,304
Machinery Depreciation	35,231	31,440	66,671
Miscellaneous	4,110	7,301	11,411
Total Expenses	407,153	388,567	795,720
Returns to Unpaid Labor, Equity, and Management	121,036	207,318	328,354
Total Direct Impacts	528,189	595,885	1,124,074

[a]Government payments and insurance indemnities.

Sources: North Dakota Farm and Ranch Business Management (2010) 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 109.9 million bushels of soybeans annually from 2007 through 2009. With a gross margin of about $0.25 per bushel (Appendix B), grain handling at local elevators in North Dakota generated about $27.5 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, 2007 Through 2009

Expenses	Annual Direct Impacts
	-- 000s $ --
Labor	9,812
Utilities	1,682
Interest	2,523
Equip., Depr., and Repairs	4,205
Taxes and Licenses	1,402
Insurance	2,523
General Overhead	4,766
Services	561
Total Direct Impacts	27,474

Transportation

Truck and rail transportation generate 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 $13.1 million to ship about 6.4 million bushels of soybeans by truck to various destinations; 83 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 $10.9 million annually (Table 4). About 6 percent of all soybeans shipped by country elevators was moved by truck to market destinations. Trucking expenditures and returns accounted for about 22 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, 2007 Through 2009

Expenses	Annual Direct Impacts
	-- 000s $ –
Fuel and Lubrication	1,438
Labor	2,708
Tires	392
Repairs and Maintenance	784
Equipment	2,521
License and Taxes	280
Insurance	887
Mgt., Admin., and Comm.	1,261
Net Returns	654
Total Direct Impacts	10,925

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 $124.8 million to ship about 102.1 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 $38.9

million annually (Table 5). About 94 percent of all soybeans shipped by country elevators was shipped by rail to market destinations. Railroad expenditures accounted for 78 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, 2007 Through 2009

Expenses	Annual Direct Impacts
	-- 000s $ –
Train Crew	12,244
Locomotive	6,549
Rail Car	5,995
Transportation Charge	3,212
Maintenance of Way	4,931
Net Liquidation Value	4,931
Central Administration	220
Insurance	130
Property Taxes	639
Total Direct Impacts	38,851

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 $1.1 billion from soybean production generated about $1.9 billion in secondary impacts in the state (Table 6). Secondary impacts were greatest in the **Households** ($637 million) (**Households** sector represents economy-wide personal income) and **Retail Trade** ($573 million) sectors, followed by **Finance, Insurance, and Real Estate** ($126 million), and **Communication and Public Utilities** ($94 million) sectors. For every dollar in direct economic activity from soybean production, another $1.68 was generated in secondary economic activity. Total economic impacts from soybean production were $3 billion and included the indirect support of about 10,700 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, 2007 Through 2009

Economic Sectors	Economic Impacts From Soybean Production		
	Direct	Secondary	Total
	---------- 000s $ ----------		
Construction	0	69,064	69,064
Transportation	0	11,135	11,135
Comm and Public Utilities	9,203	94,455	103,658
Retail Trade	468,107	573,048	1,041,155
Fin, Ins, and R Estate	150,324	126,099	276,423
Business and Pers Service	14,613	48,645	63,258
Prof and Social Service	5,984	70,370	76,354
Households	441,538	637,425	1,078,963
Government	34,305	84,807	119,112
Other Sectors[a]	0	169,960	169,960
Total Impacts	1,124,074	1,885,008	3,009,082
Secondary Employment (full-time equivalent jobs)			10,700

[a] Includes mining, agriculture, and manufacturing sectors.

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 $27.5 million from handling activities generated about $48.4 million in secondary impacts (Table 7). Secondary impacts were greatest in the **Households** ($17 million) and **Retail Trade** ($14 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 $75.9million annually and included the support of about 260 secondary FTE jobs (Table 7).

Table 7. Annual Direct, Secondary, and Total Economic Impacts of Soybean Handling Activities in North Dakota, by Economic Sector, 2007 Through 2009

Economic Sectors	Economic Impacts From Grain Handling		
	Direct	Secondary	Total
	---------- 000s $ ----------		
Construction	0	1,732	1,732
Transportation	0	276	276
Comm and Public Utilities	1,682	2,462	4,144
Retail Trade	8,130	14,366	22,496
Fin, Ins, and R Estate	5,327	3,188	8,515
Business and Pers Service	1,121	1,275	2,396
Prof and Social Service	0	1,767	1,767
Households	9,812	17,242	27,054
Government	1,402	2,205	3,607
Other Sectors[a]	0	3,909	3,909
Total Impacts	27,474	48,422	75,896
Secondary Employment (full-time equivalent jobs)			260

[a] Includes mining, agriculture, and manufacturing sectors.

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 $49.8 million from soybean transportation generated about $79 million in secondary impacts (Table 8). Secondary impacts were greatest in the **Households** ($26 million) and **Retail Trade** ($24 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 $129 million annually and included the support of about 470 secondary FTE jobs (Table 8).

Table 8. Annual Direct, Secondary, and Total Economic Impacts of Soybean Transportation in North Dakota, by Economic Sector, 2007 Through 2009

Economic Sectors	Economic Impacts From Grain Transportation		
	Direct	Secondary	Total
	---------- 000s $ ----------		
Construction	0	2,767	2,767
Transportation	8,796	472	9,268
Comm and Public Utilities	464	3,800	4,264
Retail Trade	22,610	23,777	46,387
Fin, Ins, and R Estate	1,017	5,245	6,262
Business and Pers Service	0	1,904	1,904
Prof and Social Service	0	2,756	2,756
Households	15,968	26,460	42,428
Government	919	5,043	5,962
Other Sectors[a]	0	7,156	7,156
Total Impacts	49,774	79,380	129,154
Secondary Employment (full-time equivalent jobs)			470

[a] Includes mining, agriculture, and manufacturing sectors.

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 5,994 farms or 20 percent of all farms with cropland raised some soybeans in 2007 (U.S. Department of Agriculture 2010a). Of the 18,501 farms in North Dakota that had sales over $10,000 in 2007, about 5,875 farms (32 percent) raised some soybeans.

The number of full-time equivalent (FTE) positions that could be attributable to soybean production from the 29,378 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 supported about 10,700 FTE secondary jobs in the state. Grain handling activities indirectly supported about 260 FTE secondary jobs. Transportation of soybeans in the state generated about 470 FTE secondary jobs. All soybean activities combined in the state supported about 11,430 FTE secondary jobs.

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

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 $28.3 million in sales and use taxes, $17.2 million in personal income taxes, and $5.6 million in corporate income taxes annually from 2007 through 2009 (Table 9). Total collections from sales and use, personal income, and corporate income taxes in the state were about $51.2 million annually. Soybean production also was directly responsible for about $34.3 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 $85.5 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, 2007 Through 2009

Tax	Estimated Tax Collections
	------ 000s $ ------
Sales and Use	28,300
Personal Income	17,230
Corporate Income	5,630
Total Taxes	51,160

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 $1.1 billion annually from 2007 through 2009. Grain handling and transportation activities generated an additional $52.5 million in annual direct impacts. The soybean industry generated about $1.2 billion in annual direct impacts in North Dakota from 2007 through 2009. Business activity (i.e., direct impacts) was greatest in the **Retail Trade** ($499 million), **Households** ($467 million), and **Finance, Insurance, and Real Estate** ($157 million) sectors (Table 10).

Table 10. Direct Impacts of the Soybean Industry to the North Dakota Economy, by Economic Sector and Industry Activity, 2007 Through 2009

Economic Sector	Total Direct Impacts by Industry Activity			
	Soybean Production	Transpor-tation	Grain Handling	Total Direct
	000s $			
Construction	0	0	0	0
Transportation	0	8,796	0	8,796
Comm and Pub Util	9,203	464	1,682	11,349
Retail Trade	468,107	22,610	8,130	498,847
Fin, Ins, and R Estate	150,324	1,017	5,327	156,668
Bus and Pers Service	14,613	0	1,121	15,734
Prof and Soc Service	5,984	0	0	5,984
Households	441,538	15,968	9,812	467,318
Government	34,305	919	1,402	36,626
Other Sectors[a]	169,960	7,156	3,909	181,025
Total Direct Impacts	1,124,074	49,774	27,474	1,201,322

[a] Includes mining, agriculture, and manufacturing sectors.

Annual secondary impacts from soybean production in the state from 2007 through 2009 were estimated at $1.9 billion (Table 11). Grain handling and transportation activities generated an additional $127.8 million in annual secondary impacts. The soybean industry generated about $2 billion in annual secondary impacts in North Dakota from 2007 through 2009. The economic areas of the state economy with the greatest secondary impacts included the **Households** ($681 million), **Retail Trade** ($611 million), **Finance, Insurance, and Real Estate** ($135 million), **Communication and Public Utilities** ($101 million), and **Government** ($92 million) sectors (Table 11). Overall, each dollar of direct impacts from the soybean industry generated about $1.68 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 11,430 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 $3 billion. Grain handling and transportation activities generated an additional $205 million in annual economic impacts. All soybean industry activities generated a total economic impact of $3.2 billion annually in the state from 2007 through 2009 (Table 12).

The economic sectors with the greatest impacts (i.e., direct and secondary impacts) included **Retail Trade** ($1.1 billion), **Households** ($1.1 billion) (economy-wide personal income), **Finance, Insurance, and Real Estate** ($291 million), **Government** ($128 million), and **Communication and Public Utilities** ($112 million) (Table 12).

Table 11. Secondary Impacts of the Soybean Industry to the North Dakota Economy, by Economic Sector and Industry Activity, 2007 Through 2009

Economic Sector	Total Secondary Impacts by Industry Activity			
	Soybean Production	Transpor-tation	Grain Handling	Total Secondary
	---------- 000s $ ----------			
Construction	69,064	2,767	1,732	73,563
Transportation	11,135	472	276	11,883
Comm and Pub Util	94,455	3,800	2,462	100,717
Retail Trade	573,048	23,777	14,366	611,191
Fin, Ins, and R Estate	126,099	5,245	3,188	134,532
Bus and Pers Service	48,645	1,904	1,275	51,824
Prof and Soc Service	70,370	2,756	1,767	74,893
Households	637,425	26,460	17,242	681,127
Government	84,807	5,043	2,205	92,055
Other Sectors[a]	169,960	7,156	3,909	181,025
Total Secondary Impacts	1,885,008	79,380	48,422	2,012,810

[a] Includes mining, agriculture, and manufacturing sectors.

Table 12. Total (Direct and Secondary) Impacts of the Soybean Industry to the North Dakota Economy, by Economic Sector and Industry Activity, 2007 Through 2009

Economic Sector	Total Economic Impacts by Industry Activity			
	Soybean Production	Transpor-tation	Grain Handling	Total Impacts
	---------- 000s $ ----------			
Construction	69,064	2,767	1,732	73,563
Transportation	11,135	9,268	276	20,679
Comm and Pub Util	103,658	4,264	4,144	112,066
Retail Trade	1,041,155	46,387	22,496	1,110,038
Fin, Ins, and R Estate	276,423	6,262	8,515	291,200
Bus and Pers Service	63,258	1,904	2,396	67,558
Prof and Soc Service	76,354	2,756	1,767	80,877
Households	1,078,963	42,428	27,054	1,148,445
Government	119,112	5,962	3,607	128,681
Other Sectors[a]	169,960	7,156	3,909	181,025
Total Economic Impacts	**3,009,082**	**129,154**	**75,896**	**3,214,132**
Secondary Employment	10,700	470	260	11,430
Share of Total Economic Activity	93.6%	4.0%	1.9%	

[a] Includes mining, agriculture, and manufacturing sectors.

Each acre of soybeans planted in the state (2007 through 2009) generated about $893 in total economic activity (direct and secondary economic impacts) or, expressed alternatively, each bushel of soybeans produced resulted in $29.22 in total business activity in the state. For every 315 acres of soybeans planted or 9,623 bushels of soybeans harvested, one secondary FTE job was supported within the state. On average, each acre of soybeans planted generated about $23.74 in tax revenue within the state ($9.53 in property tax and $14.21 in combined sales and use, personal income, and corporate income taxes).

COMPARISON TO PREVIOUS INDUSTRY ESTIMATES

While economic assessments often represent snap shots in time, comparisons to past industry estimates can be helpful to see changes in economic activity within the industry and to assess the magnitude of changes over time. Bangsund and Leistritz (1999) examined the economic contribution of the soybean industry in North Dakota based on activity levels over the 1996 through 1998 period. Key physical and economic measures from that study were compared to similar data for this study. Financial figures were adjusted for inflation using the Gross Domestic Product Implicit Price Deflator (Bureau of Economic Analysis 2010).

Crop Production

One of the primary drivers of change in the economic contribution of the soybean industry in North Dakota over the past decade has been the substantial increase in soybean production (Table 13). Average planted acreage and overall production increased by 200 percent between the two periods. Planted acreage in the state averaged about 1.2 million acres from 1996 through 1998 whereas planted acreage averaged 3.6 million acres from 2007 through 2009. Production has grown from an average annual estimate of 35.9 million bushels to nearly 110 million bushels between the two periods (Table 13).

Gross revenue per planted acre increased by about 32 percent in real terms (i.e., effects of inflation removed). Net returns to unpaid labor, management, and equity increased over 300 percent in real terms largely due to substantial changes in gross revenues combined with modest increases in overall production expenses (Table 13).

Table 13. Soybean Production Statistics, North Dakota, 1996 Through 1998 and 2007 Through 2009

Economic Measure	2007 to 2009	1996 to 1998		Percent Change	
		Nominal	Real	Nominal	Real
Average Planted Acreage	3,600,000	1,200,000	na	200	na
Average Production (bu)	109,990,000	35,938,333	na	206	na
Average Annual Price ($/bu)	9.13	5.82	7.46	57	22
Per Planted Acre					
Gross Revenue	312.24	184.15	236.08	70	32
Variable Expenses	157.41	107.69	138.05	46	14
Fixed Expenses	63.63	59.44	76.21	7	-17
Total Expenses	221.03	167.13	214.26	32	3
Net Returns	91.21	17.02	21.82	436	318

na=not applicable.

Economic Impacts

In the previous assessment of the soybean industry in North Dakota, crop production was the dominant segment of the industry. In this assessment, direct impacts from crop production again dominate the segments of the soybean industry. As a result of a three-fold increase in acreage and production and an increase in real crop prices, direct impacts from soybean production were estimated to increase by nearly 300 percent between the two periods (Table 14). Total in-state direct impacts from production were estimated to average $1.1 billion annually from 2007 through 2009. By comparison, direct impacts from production averaged $283 million annually from 1996 through 1998.

Since impacts from the grain handling and transportation segments of the industry are also largely driven by crop volume, similar percentage changes in direct impacts were observed in those industry segments between the two periods as with crop production (Table 14). Direct impacts from grain handling went from $5.5 million (2009 dollars) annually from 1996 through 1998 to about $27.5 million annually between 2007 through 2009. Direct impacts from transportation went from about $13 million (2009 dollars) annually from 1996 through 1998 to about $50 million annually between 2007 through 2009 (Table 14).

Table 14. Direct and Total Economic Impacts from Soybean Production, Handling, and Transportation, North Dakota, 1996 Through 1998 and 2007 Through 2009

Economic Measure	2007 to 2009	1996 to 1998		Percent Change	
		Nominal	Real	Nominal	Real
	---------- 000s $ ----------				
Direct Impacts					
Crop Production	1,124,074	220,981	283,302	409	297
Grain Handling	27,474	4,261	5,463	545	403
Transportation	49,774	10,128	12,984	391	283
Total	1,201,322	235,370	301,749	410	298
Total Impacts (Direct and Secondary Impacts)					
Crop Production	3,009,082	579,944	742,218	420	305
Grain Handling	75,896	11,772	15,092	545	403
Transportation	129,154	26,281	33,693	391	283
Total	3,214,132	616,997	791,003	421	306
Tax Revenues[a]	51,160	13,890	17,807	268	187

na=not applicable.
[a] Corporate income, personal income, and sales and use tax collections.

Gross business volume, which represents a combination of direct and secondary economic impacts, for the industry increased by over 300 percent between the two periods in real

terms (Table 14). The gross business volume was estimated to average $791 million (2009 dollars) from 1996 through 1998 compared to $3.2 billion annually over the 2007 to 2009 period. The largest percentage change in gross business volume for the soybean industry came from grain handling, which increased over 400 percent in real terms between the two periods. In relative comparison, transportation impacts increased the least, growing by about 280 percent in real terms between the two periods (Table 14). Secondary tax collections stemming from the soybean industry increased by 187 percent in real terms between the two periods.

Other observed changes between the two studies were the number of farms raising soybeans in the state. Based on the 1997 Census of Agriculture, the number of farms raising soybeans was estimated around 3,400 or about 11 percent of the estimated 30,500 farms in the state. By comparison, the 2007 Census of Agriculture, the number of farms raising soybeans was estimated at 5,994 or about 20 percent of the 29,378 farms in the state. If only farms with $10,000 or more in sales are examined, the number of farms raising soybeans went from 3,331 in 1997 to 5,875 in 2007; a 76 percent increase.

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 4.1 million in 2010. Soybeans are no longer a regional crop only raised in the eastern portion of the state. Since 2004, over 50 percent of soybean production in North Dakota has occurred outside of the Red River Valley. Soybeans are now prevalent over a large portion of North Dakota, suggesting that the crop is not limited in regional importance as was the case a decade ago. Soybean production has increased to the point that soybeans now rank second only to wheat in gross value of crop production.

The importance of soybean production comes not only from the magnitude of the crop's impacts, but from the distribution of those impacts. Soybeans are produced abundantly throughout the eastern and central region of the state, which correspondingly implies the impacts are distributed throughout much of North Dakota. In addition, much of the impacts from soybean production are generated in local and rural economies through the purchase of production inputs, which are not concentrated in any particular region or city.

The importance of soybean production to North Dakota producers is evident in the crop's expansion over the last two decades. As could be expected, the rapid and sustained growth of the soybean industry has been the result of several important factors. Farm policy changes and weather related factors dominated the changes observed in the 1990s. Technology and changing market conditions have been the primary catalysts responsible for the continued growth of the industry in the state in the 2000s. 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.

When economic activity associated with soybean handling and transportation are included as part of the overall economic impact, soybeans are now a multi-billion dollar industry in the state. When measured in terms of secondary employment, economy-wide personal income, retail sales, tax revenues, and overall economic activity, the soybean industry in North Dakota can be considered among the largest basic sector industries in the state.

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APPENDIX A

Soybean Production, Yield, and Acreage by County,
North Dakota, 2007 Through 2009
and
National Soybean Acreage and Yields

Appendix Table A1. Average Soybean Production, by County and Production Region, North Dakota, 2007 Through 2009

County/Production Region	Acres		Production	Yield per Planted Acre
	Planted	Harvested		
Burke	0	0	0	0
Divide	0	0	0	0
Mountrail	0	0	0	0
Renville	733	700	19,667	26.8
Ward	10,433	10,367	277,333	26.6
Williams	0	0	0	
NORTHWEST[a]	12,200	12,000	324,333	26.6
Benson	83,667	83,067	2,393,000	28.6
Bottineau	4,667	4,567	112,000	24.0
McHenry	12,900	12,767	317,667	24.6
Pierce	46,167	45,800	1,224,333	26.5
Rolette	11,933	7,873	327,000	27.4
NORTH CENTRAL	159,333	154,073	4,374,000	27.5
Cavalier	34,333	32,567	892,000	26.0
Grand Forks	120,667	119,933	3,638,333	30.2
Nelson	77,667	76,467	2,039,000	26.3
Pembina	91,667	90,233	2,795,333	30.5
Ramsey	74,333	72,700	2,055,333	27.7
Towner	35,667	35,433	1,007,667	28.3
Walsh	60,667	59,200	1,818,000	30.0
NORTHEAST	495,000	486,533	14,215,667	28.8
Dunn	0	0	0	0
McKenzie	0	0	0	0
McLean	0	0	0	0
Mercer	0	0	0	0
Oliver	0	0	0	0
WEST CENTRAL	0	0	0	0
Eddy	40,667	40,033	1,195,333	29.4
Foster	100,000	99,267	2,949,000	29.5
Kidder	16,000	15,683	411,000	25.7
Sheridan	18,667	18,250	466,667	25.0
Stutsman	348,000	346,333	10,348,333	29.7
Wells	118,333	118,100	3,569,667	30.2
CENTRAL	641,667	637,667	18,940,000	29.5

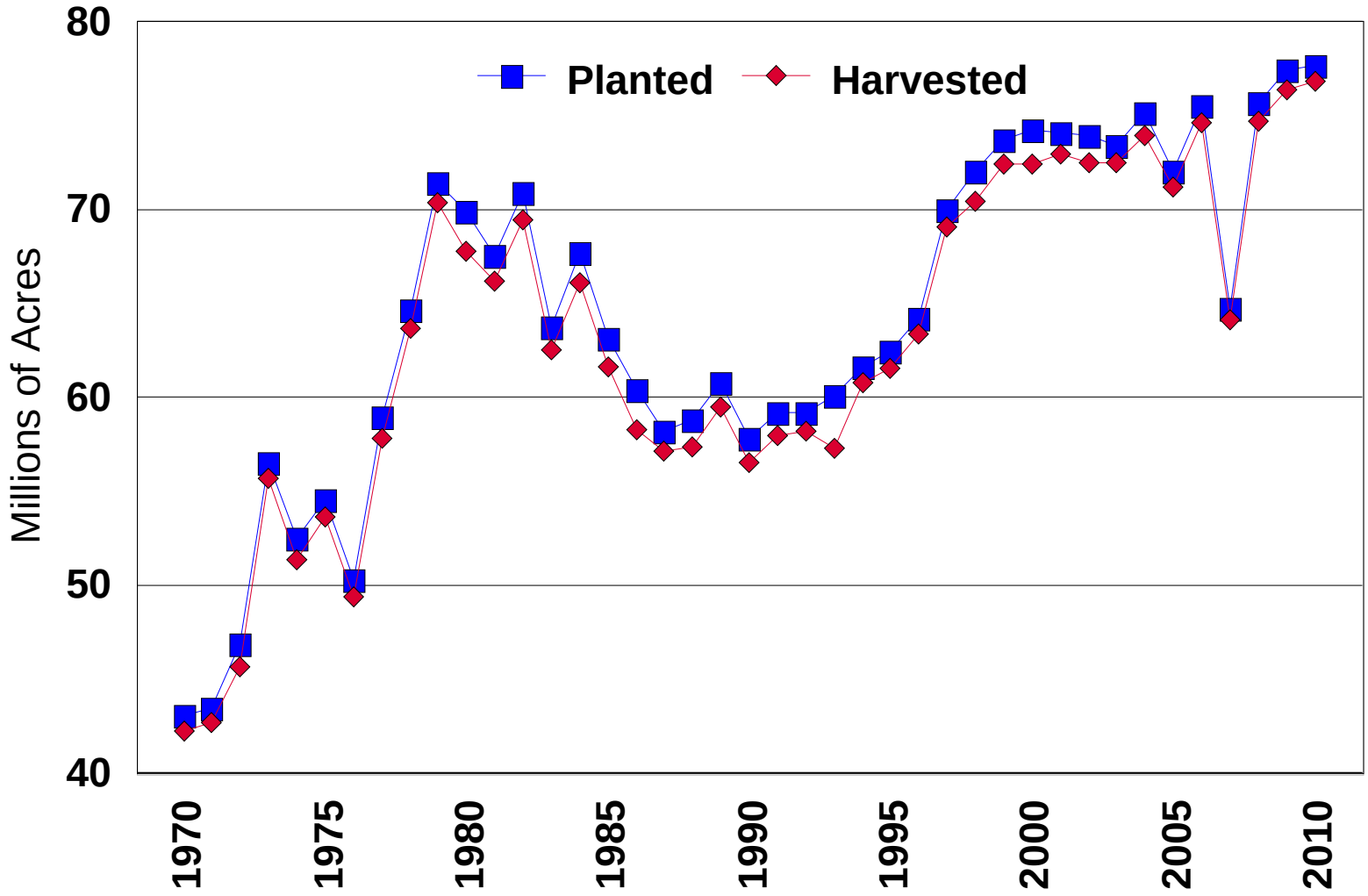
- continued -

Appendix Table A1. Continued

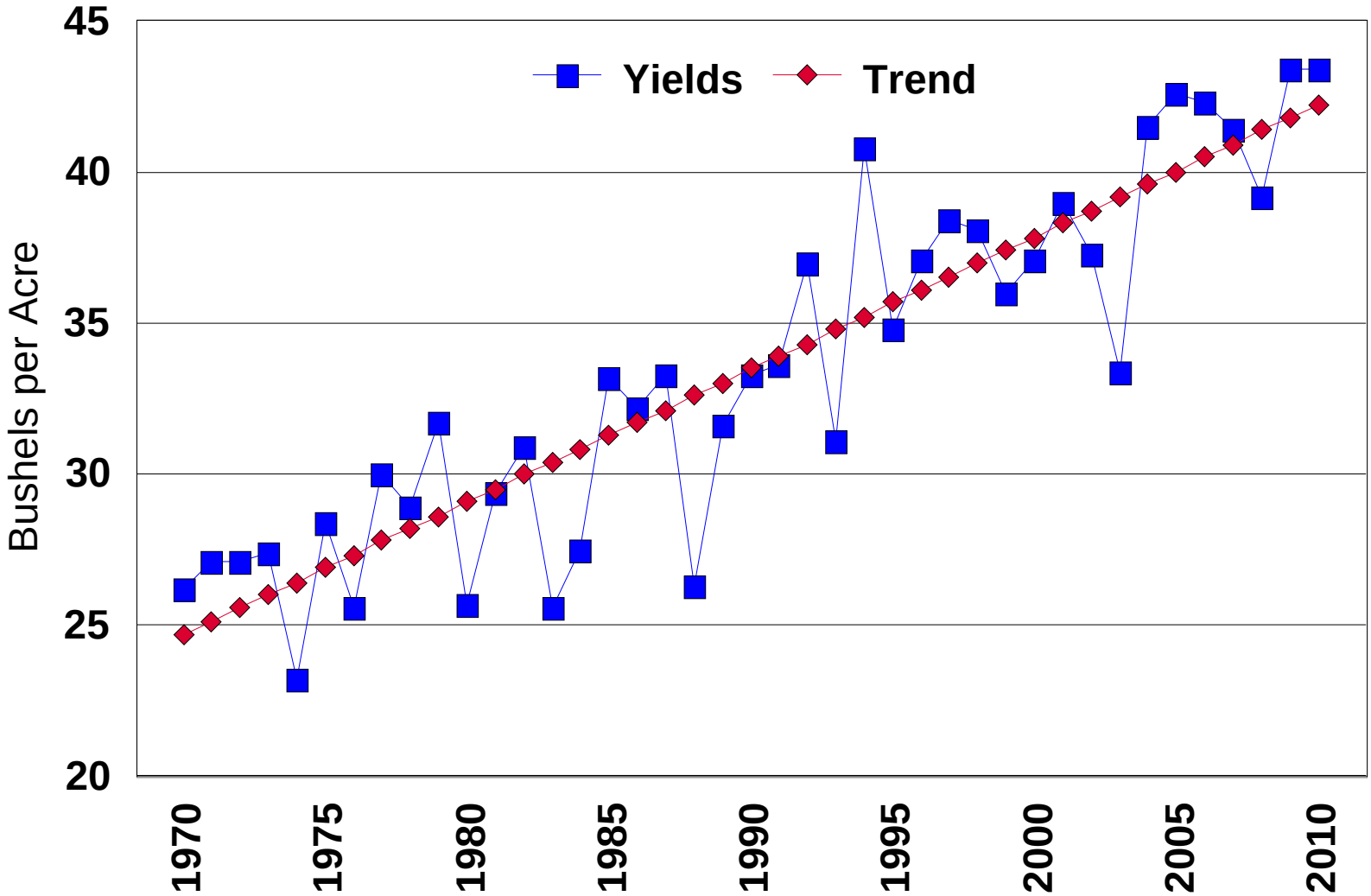
County/Production Region	Acres		Production	Yield per Planted Acre
	Planted	Harvested		
Barnes	316,000	314,833	9,764,667	30.9
Cass	484,333	475,667	15,347,000	31.9
Griggs	97,000	96,667	2,877,667	29.7
Steele	137,333	136,033	4,141,667	30.2
Traill	188,667	188,133	6,009,000	31.8
EAST CENTRAL	1,223,333	1,211,333	38,230,000	31.3
Adams	0	0	0	0
Billings	0	0	0	0
Bowman	0	0	0	0
Golden Valley	0	0	0	0
Hettinger	0	0	0	0
Slope	0	0	0	0
Stark	0	0	0	0
SOUTHWEST	0	0	0	0
Burleigh	1,333	1,267	37,667	28.3
Emmons	9,133	8,967	236,333	25.9
Grant	0	0	0	0
Morton	0	0	0	0
Sioux	0	0	0	0
SOUTH CENTRAL[a]	25,533	25,033	695,000	27.2
Dickey	140,667	138,667	4,885,667	34.7
LaMoure	245,000	243,667	7,843,667	32.0
Logan	37,000	36,833	976,333	26.4
McIntosh	61,667	61,133	1,733,000	28.1
Ransom	103,333	102,467	3,409,667	33.0
Richland	295,000	291,000	9,224,000	31.3
Sargent	149,000	148,233	4,843,667	32.5
SOUTHEAST	1,031,667	1,022,000	32,916,000	31.9
Other Non-Disclosed	11,267	10,767	265,000	23.5
STATE	3,600,000	3,559,407	109,990,000	30.55

[a] Region totals include combined statistics for unreported counties.

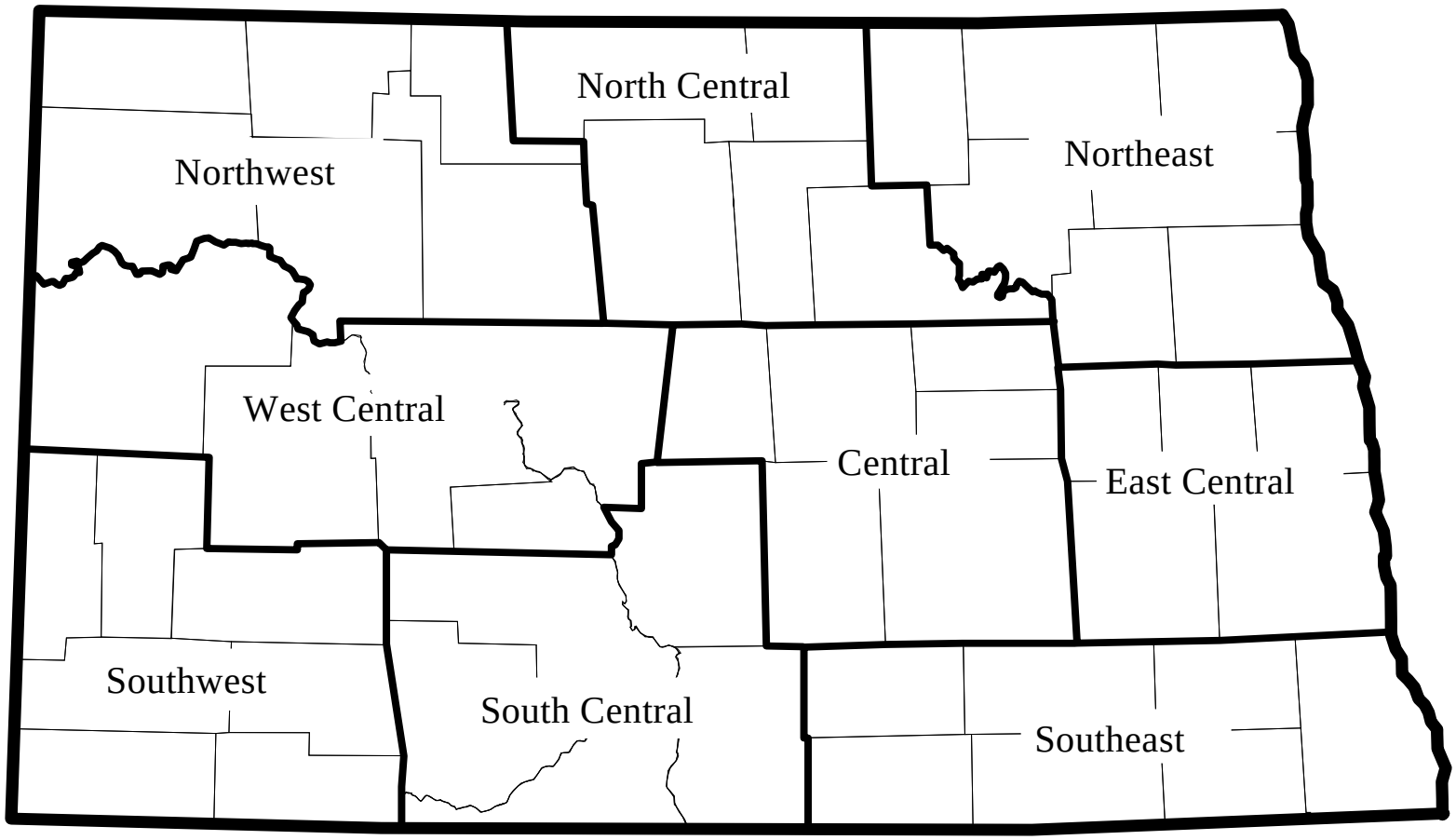
Source: North Dakota Agricultural Statistics Service.



Appendix Figure A1. United States Soybean Acreage, 1970 Through 2010



Appendix Figure A2. United States Soybean Yields, 1970 Through 2010



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 2007 through 2009 (North Dakota Agricultural Statistics Service *various years*). Average marketing-year prices, government payments, and insurance indemnities were obtained from the North Dakota Farm and Ranch Business Management (2010).

Crop expenses were obtained from the Farm Business Management Program in North Dakota (North Dakota Farm and Ranch Business Management 2010). 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 2010). Budgets representing average yearly expenses (owned and rented operations) were then averaged (weighted by acreage planted each year) from 2007 through 2009.

Appendix Table B1. Soybean Production Budgets, North Dakota, 2007 Through 2009

Budget Items	Region: Red River Valley	Region: All Other Regions
Acreage	1,630,667	1,969,333
Yield (bu/acre)	31.47	29.79
Price ($/bu)	9.20	9.08
Government Payments ($/acre)	12.68	10.86
Miscellaneous ($/acre)*	21.84	21.21
Total Revenue ($/acre)	323.91	302.58
Variable Expenses ($/acre)		
Seed	41.19	43.29
Fertilizer	5.48	9.38
Chemicals	23.06	19.25
Crop Insurance	22.38	17.78
Fuel and Oil	16.28	14.71
Repairs	21.76	17.18
Custom Hire	3.18	4.78
Cash Rent**	29.99	17.54
Machinery Leases	0	0.43
Interest	4.49	3.83
Miscellaneous	0.29	0.39
Total Variable Expenses	168.09	148.56
Fixed Expenses		
Hired Labor	11.60	5.49
Machinery Leases	2.26	2.08
Property Taxes	13.57	6.18
Insurance	4.32	2.66

- continued -

Appendix Table B1. Continued

Budget Items	Region: Red River Valley	Region: All Other Regions
Utilities	3.18	2.04
Professional Dues/Fees	2.70	0.81
Interest	19.83	9.82
Machinery Depreciation	21.61	15.96
Miscellaneous	2.52	3.71
Total Fixed Expenses	81.60	48.75
Net Returns	74.22	105.27

* Includes insurance indemnities.
** Property tax was subtracted from cash rent for rented land budgets. Cash rent represents a weighted average expense between soybeans raised on owned land and rented land.

Sources: North Dakota Agricultural Statistics Service and North Dakota Farm and Ranch Business Management (2010).

Appendix Table B2. Truck Transportation Budget, Soybean Shipments, Upper Great Plains, 2007 Through 2009

	$/mile[a]
Gross Revenue[b]	2.43
Variable Costs	
Tires	0.17
Labor	0.37
Maintenance and Repairs	0.17
Fuel	0.51
Total Variable Costs	1.23
Fixed Costs	
Equipment Costs/Tractor	0.56
License and Taxes/Tractor	0.06
Insurance	0.20
Mgmt and Overhead	0.28
Total Fixed Costs	1.10
Total Costs	2.34
Net Returns	0.09

[a] Developed from Berwick and Dooley (1997).
[b] Agricultural Marketing Service (2009, 2008, 2007). 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, 2007 Through 2009

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 and Leistritz 2005). 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, 2007 Through 2009

Expenses	--$/bu--
Labor	0.089
Taxes and Licenses	0.013
Insurance	0.023
Utilities	0.015
Services	0.006
Interest	0.023
Equip. Depr. and Repairs	0.038
General Expense	0.043
Gross Margin	0.250

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 (2005). The gross margin was based upon information received from personal contact with industry representatives at local grain elevators in North Dakota. Soybeans retained by producers for use as seed soybeans were subtracted from county production (Swenson 2010).

APPENDIX C

Grain Flow Statistics

Appendix Table C1. Mode of Transportation for All Soybean Shipments, North Dakota, 2007 Through 2009

	Mode of Transportation		Ratio of Mode	
Market Destination	Truck	Rail	Truck	Rail
Duluth	25,000	675,000	3.6%	96.4%
Minneapolis/St. Paul	69,000	9,762,000	0.7%	99.3%
Midland/Southwest	1,016,000	1,336,000	43.2%	56.8%
Pacific Northwest	219,000	80,411,000	0.3%	99.7%
Other	5,110,000	9,894,000	34.1%	65.9%
Total Shipments	6,439,000	102,078,000	5.9%	94.1%
	5.93%	94.07%		

Reported yearly soybean shipments from country elevators by crop production regions in North Dakota were obtained from Vachal and Benson (2008b, 2009b, 2010b). 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 Vachal and Benson (2008b, 2009b, 2010b) 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 (Swenson 2010) were subtracted from county production for purposes of estimating grain shipments.