Staff Paper P02-8 **May 2002**

STAFF PAPER SERIES

AN ANALYSIS OF THE

AGRICULTURAL TRANSPORTATION DATABASE

7/99 - 6/00

Executive Summary

by
Jerry Fruin and Douglas G. Tiffany

DEPARTMENT OF APPLIED ECONOMICS

COLLEGE OF AGRICULTURAL, FOOD, AND ENVIRONMENTAL SCIENCES

UNIVERSITY OF MINNESOTA

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This project was conducted with funding provided by the Minnesota Department of Transportation and the Agricultural Experiment Station of the University of Minnesota.

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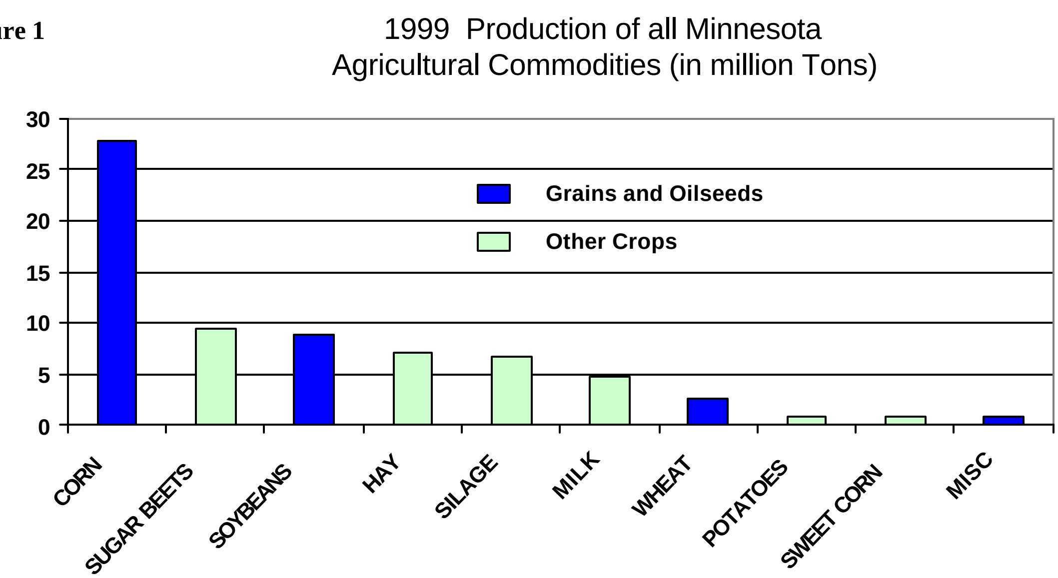
Chapter 1. Introduction

Background

In a typical year Minnesota farmers produce about 70 million tons of agricultural commodities. This includes over 36 million tons (1.3 billion bushels) of grains and oilseeds[1] (Figure 1). All of this grain must be moved from fields to storage, either on farm sites or at local elevators. Some is used locally but 24 to 25 million tons enters commercial channels and has to be transported significant distances to domestic users or export ports.

In order to better understand the transportation and infrastructure requirements of this movement, development of an "Agricultural Transportation Database" was undertaken.

Figure 1



Note, however, that there are other major commodities such as sugar beets, milk, sweet corn and peas that have to be moved on local and regional roads for processing. In addition, hay and silage frequently are transported on the rural road system. The total annual volume of these commodities typically exceeds that of grains and oilseeds. These movements of over 40 tons of nongrain commodities as well as those of processed and semi-processed agricultural products, although extremely important to the state's economy, are not included in the Agricultural Transportation Database at this time.

The Minnesota Agricultural Transportation Database

This report summarizes the results of the Minnesota Agricultural Transportation database project. There were two distinct but closely related phases of the project. Detailed results of each phase have been recorded in two reports. The first report (#02-12), "Where Does Minnesota's Grain Crop Go? An Analysis of Minnesota Elevator Grain Shipments for the Period, 7/99-6/00,"[2] analyzes the grain shipment survey data received from Minnesota grain elevators for the period July 1999 through June 2000. This information, provided monthly on a voluntary basis by the participating elevators, includes volumes, type of grain, transportation modes, and destinations. Members of the Agricultural Transportation Database Advisory Committee selected the nine destinations and the transportation modal breakdown in early 1999. This advisory committee was comprised of approximately 20 representatives from private firms, government agencies and interest groups participating in the Agricultural Transportation Database Consortium.

This information about the transportation mode used and the destinations of shipments from Minnesota grain elevators will be useful to transportation planners, policy analysts, and decision makers in both the public and private sectors. A second year of data now being analyzed should establish further information about grain transportation demand and trends.

The second report (#2-13) entitled, "Filling the Feed Troughs of Minnesota and Beyond,"[3] utilizes published data on livestock numbers and the expertise of livestock specialists to estimate the consumption of feed grains and soybean meal by species of livestock in each county of the state in 1999. The goals of the study were to identify the production levels of each of the grains along with the numbers of livestock available to consume corn, barley, oats, and soybean meal in each Minnesota county. Local production levels were reduced by the aggregated quantities of feed required by the livestock in each of the countries. Quantities of grain available to be shipped out of each county were calculated. Feed grain deficits and surpluses were determined for each of the counties in the state in order to provide a basis for understanding demands on highway infrastructure as well as the patterns for siting corn ethanol plants and soybean crushing plants. A review of the historical data revealed that livestock populations have expanded, but not enough to consume the additional grain and soybeans being produced in the state.

The combined results of these studies will aid in plant location efforts, in determining the future transportation needs for agricultural processing industries, and in siting large scale livestock operations. In addition, the databases and methodologies will have transference to potential future studies on fertilizer and animal waste transportation needs.

Chapter 2. Results from the Grain Flow Survey

Elevator Sample

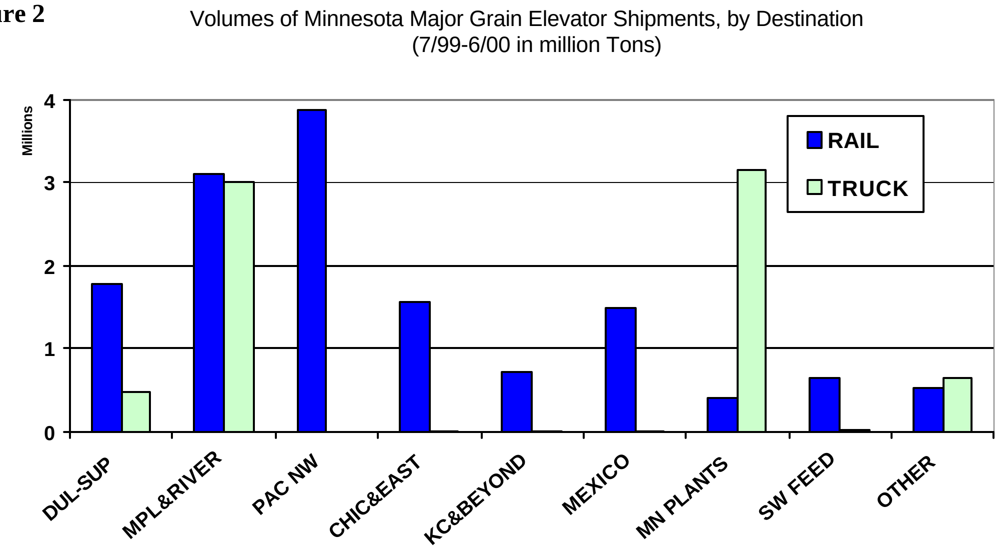
A sample of about 100 (20%) Minnesota elevators reported their monthly grain shipments by mode to 9 destinations from July 1999 through June of 2000. Because the elevator monthly shipment was proprietary, absolute confidentiality about individual elevator shipments was maintained. The participating elevators mailed a survey form directly to the Upper Great Plains Transportation Institute (UGPTI) in Fargo, North Dakota each month for processing. The UGPTI is part of North Dakota State University (required by law to maintain high standards of confidentiality) and has been processing similar monthly data from North Dakota elevators for 30 years. Because of the proprietary nature of the data, the research did not have access to individual elevators report but were furnished a monthly list of the elevators reporting along with shipment data for each of Minnesota's 9 Crop Reporting Districts (CRDs).

The survey form required reporting elevators to report their shipments as rail or truck. Rail reporting was further divided by shipment sizes of 1-24 cars, 24-49 cars, 50-99 cars and 100+ cars. Grain transportation terminology sometimes refers to trains 50 cars or longer as shuttle trains or unit trains. Data from the sample was used to estimate total elevator shipments of all grain and oilseeds by mode to each of the nine destinations for the period July 1999 - June 2000, a period that corresponds closely to the 1999 crop year. When the sample size allowed, estimates were made of shipments of individual grains by mode to destination from the state and individual CRDs.

Elevator Shipments of All Grains and Oilseeds

It was estimated that about 768 million (M) bushels or 21.5 M tons were shipped from Minnesota elevators to the 9 destinations. This included 418 M bushels of corn (11.7 M tons), 244 M bushels of soybeans (7.3 M tons), and 84.6 M bushels of wheat (2.4 M tons) (Figure 2).

Figure 2



The total value of Minnesota elevator shipments based on 1999-2000 farmgate prices was $2.1 billion dollars.[4, 5] Corn accounted for $711 M, soybeans $1,109 M, and wheat $258 M. Note that the total farmgate value of Minnesota crops is substantially higher than $2.1 billion because much grain is fed or sold through channels other than elevators (Figure 3).

Rail shipments accounted for 505 M bushels (14.1 M tons) or 64% of all grains. Shipments in 100-car shuttle trains accounted for 28% of all grain shipments and 50-car unit trains accounted for an additional 19% of all shipments. Truck shipments accounted for 263 M bushels (7.4 M tons) (Figure 4).

Figure 3

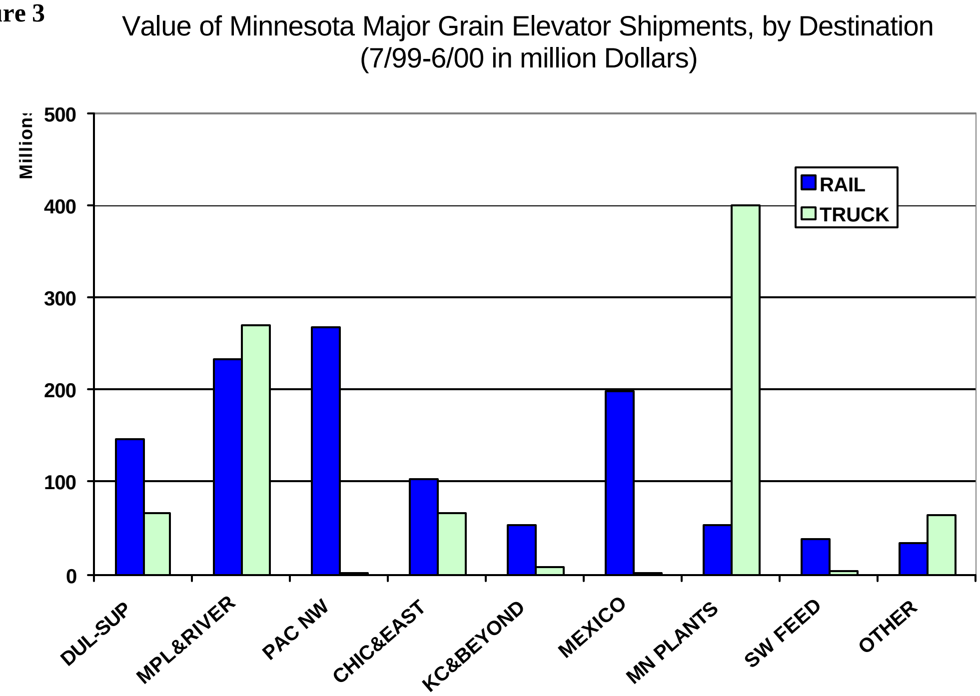
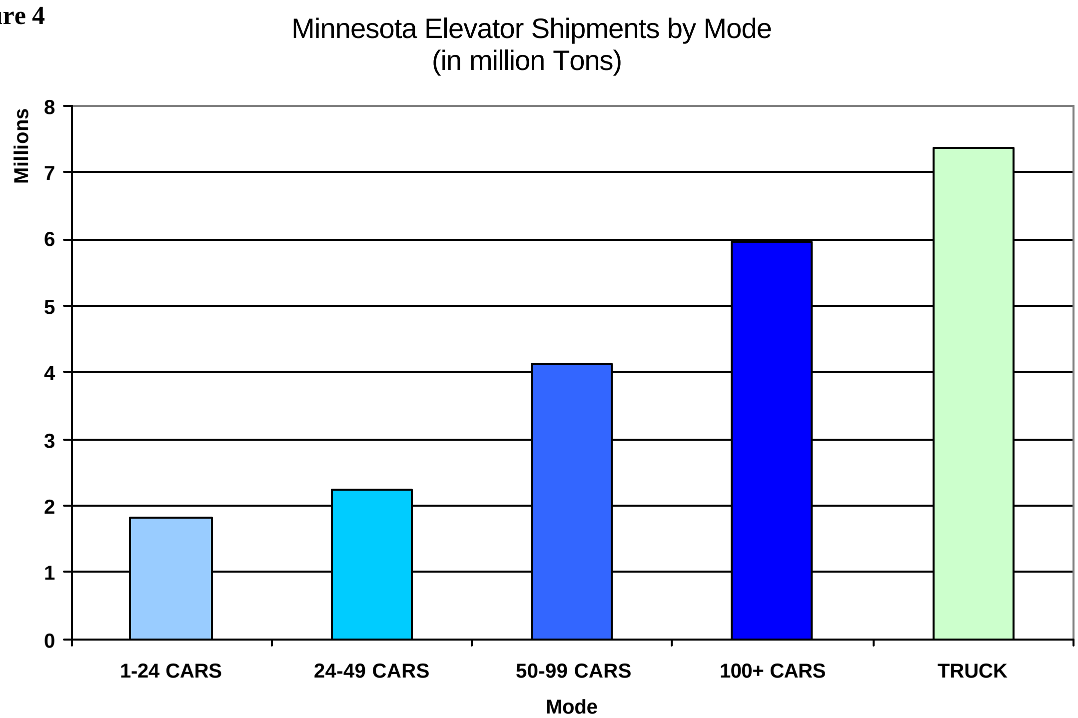


Figure 4



Duluth/Superior, which includes port elevators in the Duluth, Minnesota/Superior, Wisconsin area, received 80 M bushels (2.3 M tons) or 10.5% of Minnesota grain shipments. Rail shipments accounted for 79% of Minnesota elevator shipments to Duluth/Superior. Duluth/Superior received $250 million or 12% of the value of Minnesota grain shipments.

The most important destination for all grains shipped from Minnesota county elevators is **Minneapolis and the River**. This destination includes the river ports and rail switching area of the Twin Cities. It also includes downstream river ports in Minnesota as well as ports in northern Iowa that receive grains shipped on railroads in southern Minnesota. Minneapolis and the River was the destination for 270 M bushels (5.9M tons) or 27.5 % of total Minnesota elevator shipments. Minneapolis and the River received grain valued at $535 million or 26.8% of the total elevator shipments.

Pacific Northwest includes the states of Oregon, Washington and Idaho. These destinations consist primarily of Columbia River and Seattle-Tacoma export elevators. Shipments were all by rail and accounted for 135 M bushels (3.8 M tons) or 17.8% of all shipments. These were valued at $268 million or 12.9% of Minnesota shipments.

Chicago and Beyond includes flour millers and corn and soybean processors in Illinois and eastern states as well as feed markets in the east and southeastern United States. Shipments were 56 million bushels (1.6 M tons) valued at $169 million or 8.1% of total value.

Kansas City and Beyond includes the milling and processing destinations and feeding operations on the central and high plains states such as Kansas, Colorado, and Oklahoma and Texas. This destination received 26.7 million bushels (.75 M tons) valued at $62 million or 3% of the value of Minnesota shipments.

Mexico includes points on, or beyond, the Mexican border. This destination received 54 million bushels (1.5 M tons). The value of shipments to Mexico was $200 million or 9.6% of all shipments.

Minnesota Processors, which includes soybean processors, ethanol and corn sweetener plants and flourmills, etc., was the third largest destination of Minnesota elevators receiving 127 M bushels (3.6 M tons). Trucks accounted for over 88% of shipments to Minnesota Processors. Farmgate value of shipments to Minnesota Processors was $452 million or 21.8% of the value of all Minnesota elevator shipments.

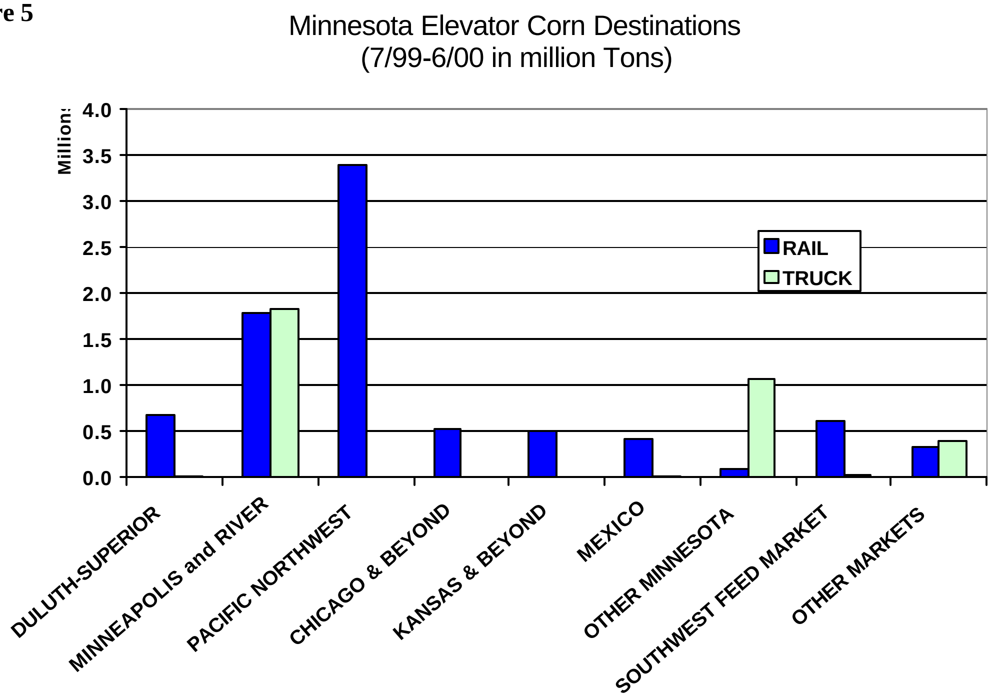
Southwest Feed Markets are primarily domestic shipments to California, Arizona and New Mexico. They received 24 million bushels (.68 M tons) with a farmgate value of $40 million (1.9%).

Other and Unknown includes shipments to Iowa, Canada, Wisconsin and North and South Dakota, as well as unknown destinations, amounted to 42.8 million bushels (1.2 M tons) or $101 million, 4.9% of farmgate value.

Elevator Shipments by Commodity

Thirty-one percent of elevator shipments of corn are to the Minneapolis and the River, 29% go to the Pacific Northwest, and 10% to Minnesota Processors. Rail shipments account for 49% to Minneapolis and the River, 100% to the Pacific Northwest, and 8% to Minnesota Processors (Figure 5).

Figure 5



Thirty-four percent of elevator shipments of soybeans go to Minnesota Processors, 21% to Minneapolis and the River, and 11% to Duluth/Superior. Rail shipments account for 12% of soybean shipments to Minnesota Processors, 52% to Minneapolis and the River, and 87% to Duluth/Superior (Figure 6).

Thirty-four percent of Minnesota wheat shipments go to Duluth/Superior, 31% to Minneapolis and the River, and 26% to Chicago and Beyond. Rail accounts for 56% of shipments to Duluth/Superior, 58% of shipments to Minneapolis and the River, and 99% of shipments to Chicago and Beyond (Figure 7).

Figure 6

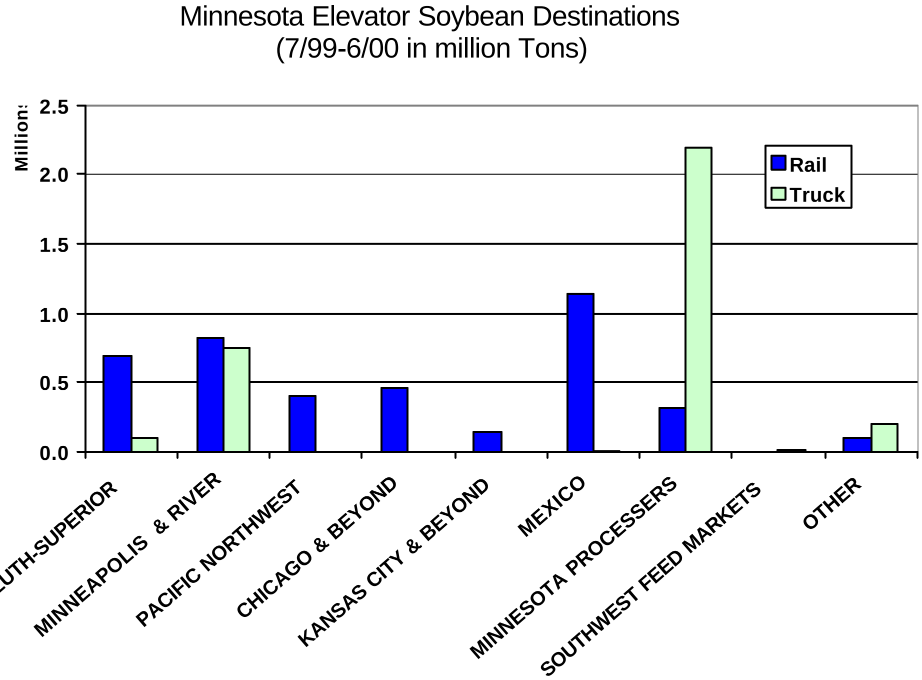
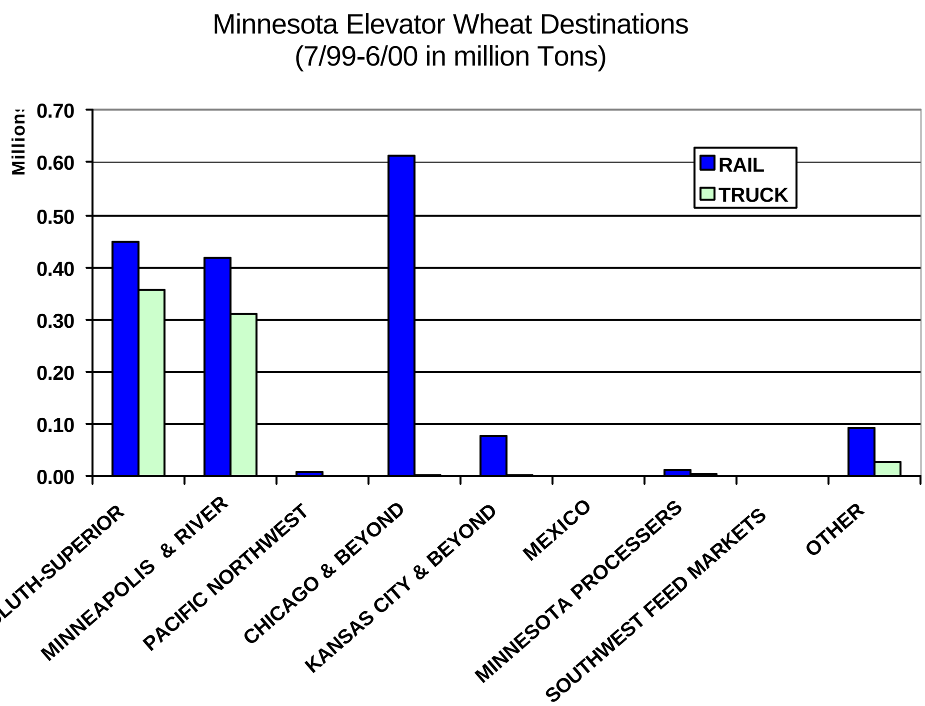


Figure 7



A significant finding is that Mexico has become an important market for Minnesota soybeans and to a lesser extent corn. The Mexican market was not a destination for Minnesota soybeans before NAFTA, but it received over 38 M bushels of soybean and 15M bushels of corn in the 1999-2000 crop year. This is a rail market served by 50 and 100-car trains.

Historically, Duluth/Superior had not been an export port for soybeans. However, this has changed and it has become a major destination for Minnesota and North Dakota soybeans in the last few years. One reason for this is that the soybean growing area has expanded to the north and west from its traditional area in southern Minnesota as a result of the Freedom to Farm Bill and genetic improvements that have expanded the soybean growing area.

Differences in Modes and Destinations by Crop Reporting Districts

Destination and modal patterns vary greatly by CRD. These variations are due to combination of relative locations, existing transportation infrastructure, and crop mix. The most striking example of such contrasts is between southeast Minnesota (CRD 9), which borders the Mississippi River, and CRD 7 in the southwestern corner of Minnesota. Seventy-eight percent of all elevator shipments from CRD 9 are by truck to Minneapolis and the River while 88% of all CRD 7 shipments are by rail to the distant markets of the Pacific Northwest, Mexico and Southeast Feed Markets.

Sixty-seven percent of all shipments from northwest Minnesota (CRD 1) are to Duluth/Superior and Minneapolis and the River and 35% of all shipments are by truck while 31% of all shipments from western Minnesota (CRD 4) are by rail to the Pacific Northwest. Fifty-four percent of all grain shipped from west central Minnesota (CRD 5) goes to Minneapolis and the River and 21% goes to Minnesota Processors. Fifty-six percent of all grain from CRD 5 is shipped by truck. Thirty-four percent of all grain shipped from south central Minnesota (CRD 8) goes to Minneapolis and the River and 32% to Minnesota Processors. Forty-three percent of all grain from CRD 8 is shipped by truck.

It is important to recognize that North Dakota elevators ship approximately 424 M bushels (11.9 M tons) of all grain or about 55% as much grain as Minnesota elevators. Two-thirds or more of this grain is shipped through Minnesota to domestic users and requires the use of the same transportation infrastructure as Minnesota grains. For example, Minneapolis and the River and Duluth/Superior receive 26.5% and 15.7% of the total North Dakota shipments, respectively.

Figure 8

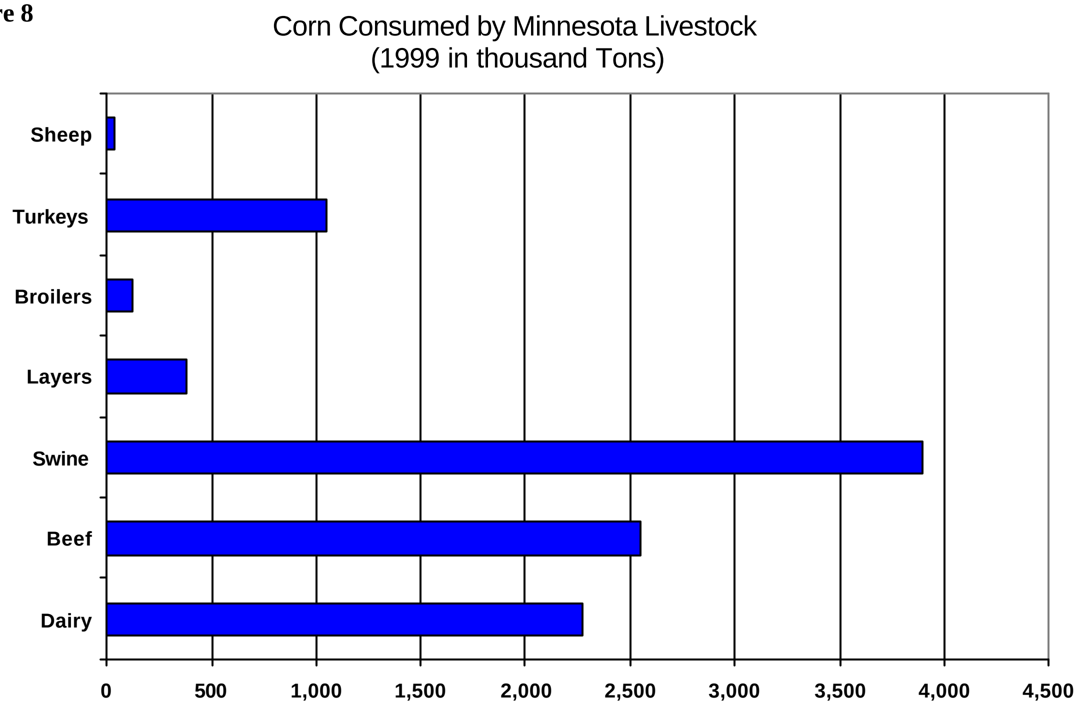
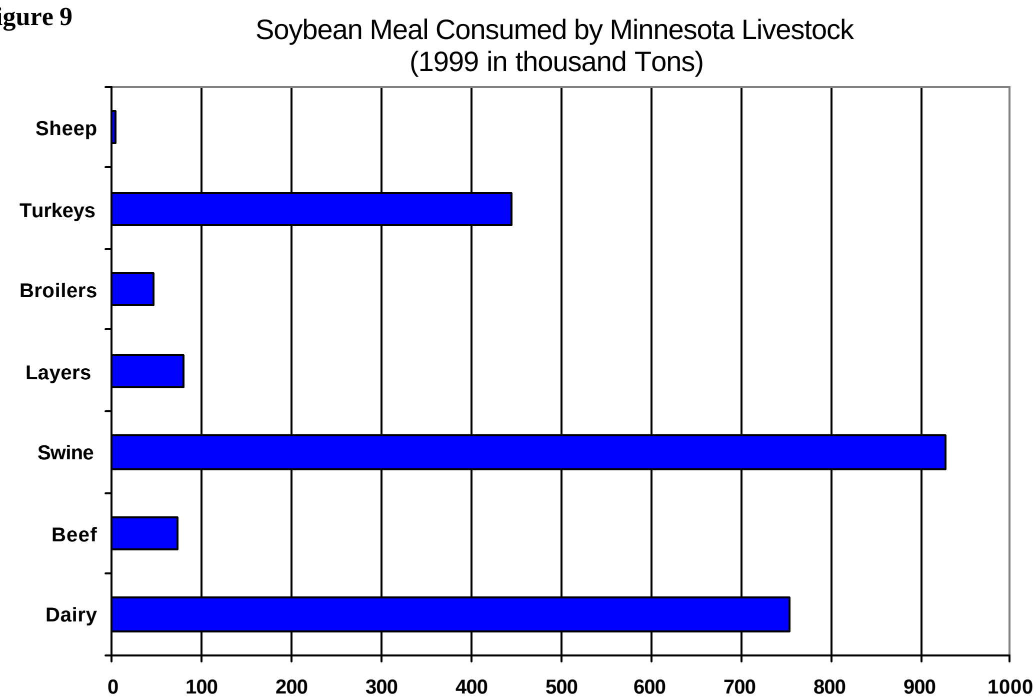


Figure 9



Chapter 3. Livestock Utilization

The second part of the study determined 1999 levels of grain and oilseed production and identified and enumerated livestock populations in individual counties of the state. Animal scientists were consulted to ascribe typical consumption levels by the various livestock living in particular counties. A series of assumptions were required in order to determine the number of additional animals required to maintain sufficient breeding herds and flocks of livestock from year to year. Tables that provide detailed data to describe the consumption of feed grains and soybean meal by livestock in each county were developed. Use of electronic spreadsheets allowed the authors to determine the extent of feed grain surplus or deficits in particular counties. Geographic Information System (GIS) software allowed the portrayal of several variables by mapping. These included grain production, corn or barley consumption, feed grain surplus or deficit level by county, net grain available for movement out of the county, and net grain available for movement expressed in "tons per square mile of farms."

Figures 8 and 9 show the estimated consumption of corn in bushels and soybean meal in tons on Minnesota farms by seven categories of livestock.

Figure 10 shows the percentage of the corn and soybean meal consumed in Minnesota by seven categories of livestock. Figure 11 shows deficits or surplus of corn and barley by county. In 1999 there were 11 counties that produced at least 18 million bushels (500,000 tons) more than was required for livestock feed in that county. The 18 million bushels, is before processing for ethanol, etc., which required a total of 133 million bushels (3.8 million tons) of the 1999 crop.

Figure 12 shows soybean meal consumption by county for the 1999 crop year. The livestock industries of 8 counties required more than 60,000 tons of soybean meal. There are no soybeans processing plants in these 8 counties utilizing the most soymeal.

Figure 10

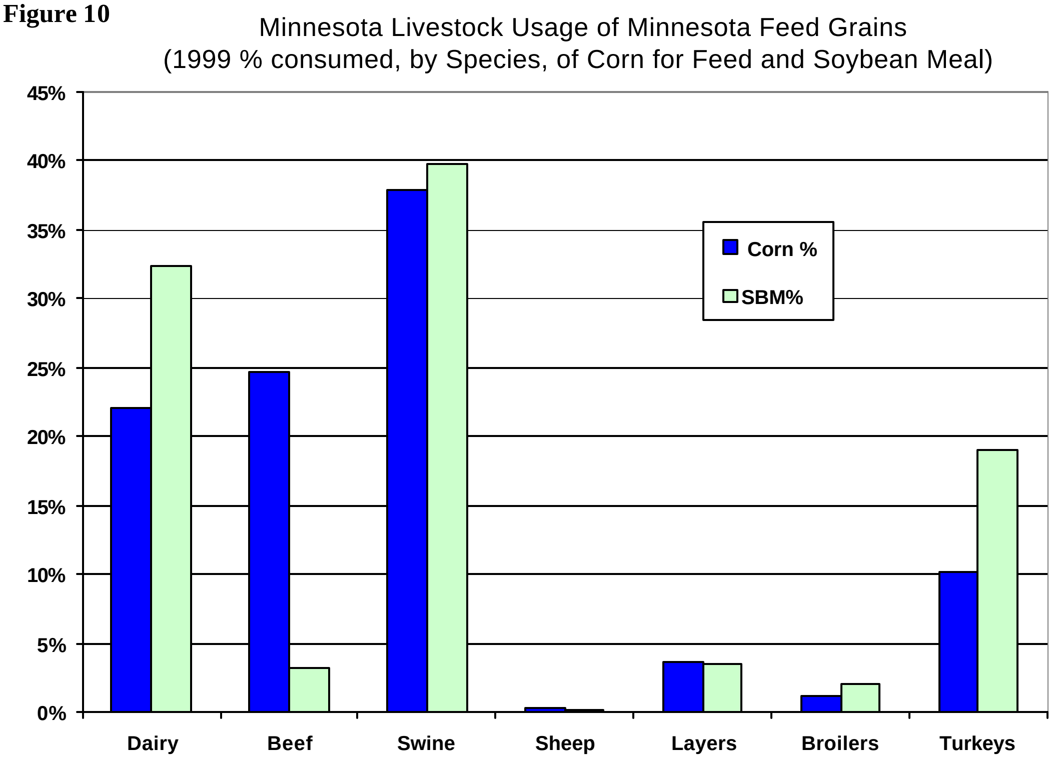


Figure 11

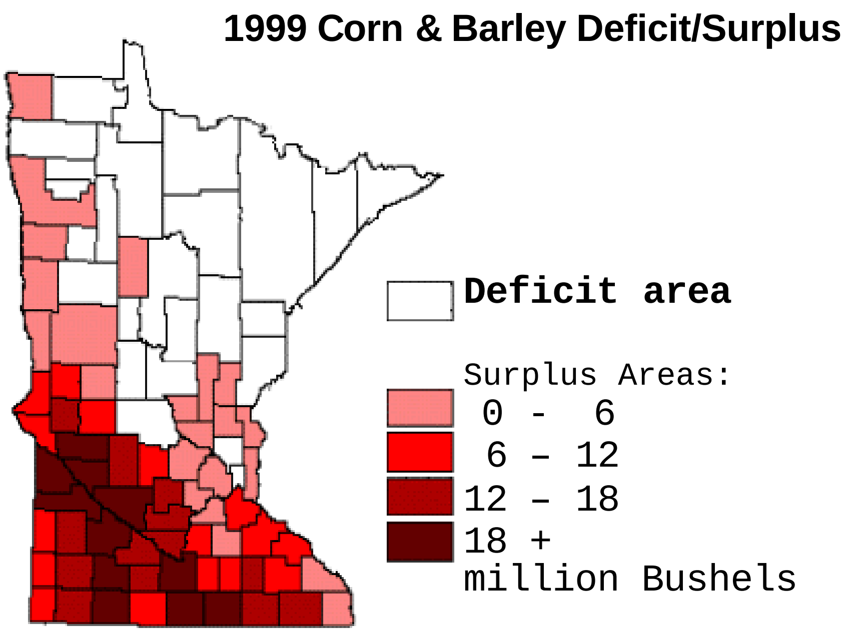


Figure 12

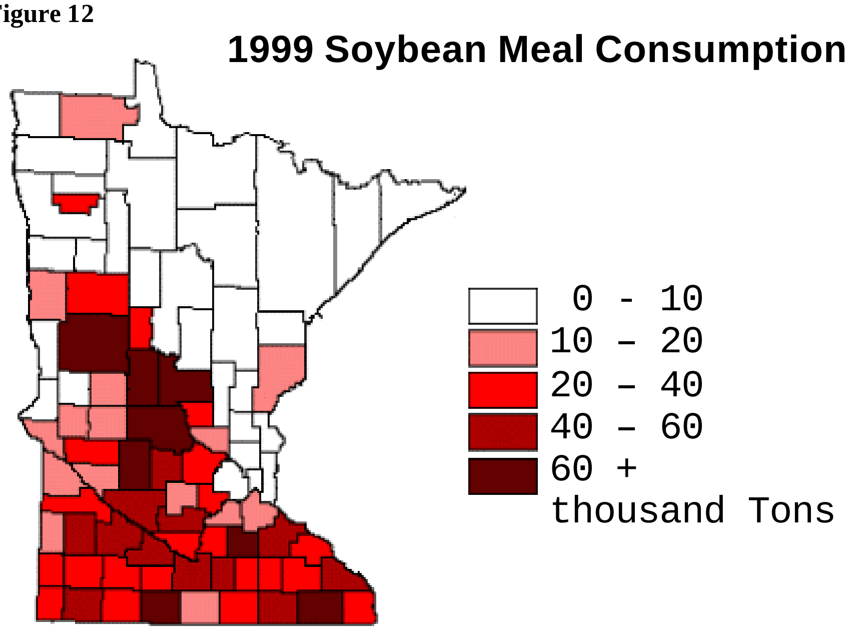
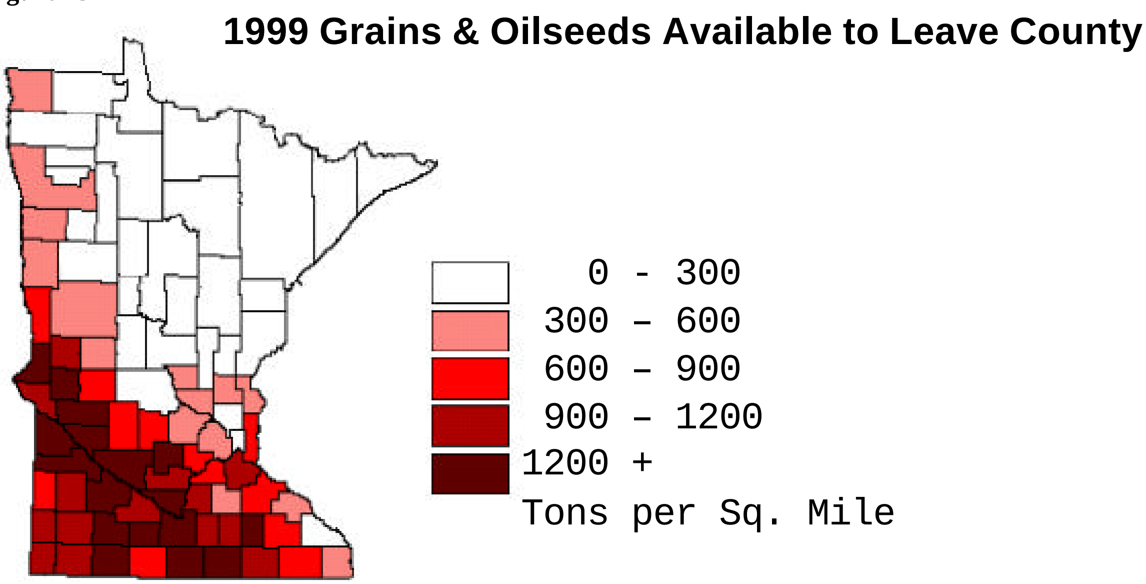


Figure 13 shows the tons of grain and oilseeds per square mile of farms that will have to be shipped from the county of origin to domestic or export destinations. There are 17 counties where 1,200 tons or more from each square mile will be shipped from the county. This does not include the return movement of soymeal from processing plants. This is the amount of production of each county that requires movement on the highways, railroads, and the navigable portion of the Mississippi River as well as local roads.

Figure 13



Chapter 4. A Comparison of 1999 Utilization with That of 1985

Figure 14 shows the ultimate disposition of the 1999 corn crop. About 29% was fed in Minnesota and 14% was processed for ethanol, sweeteners, etc. Both ethanol and the feed by-products have to be shipped over Minnesota roads or railroads to the ultimate users.

Figure 14

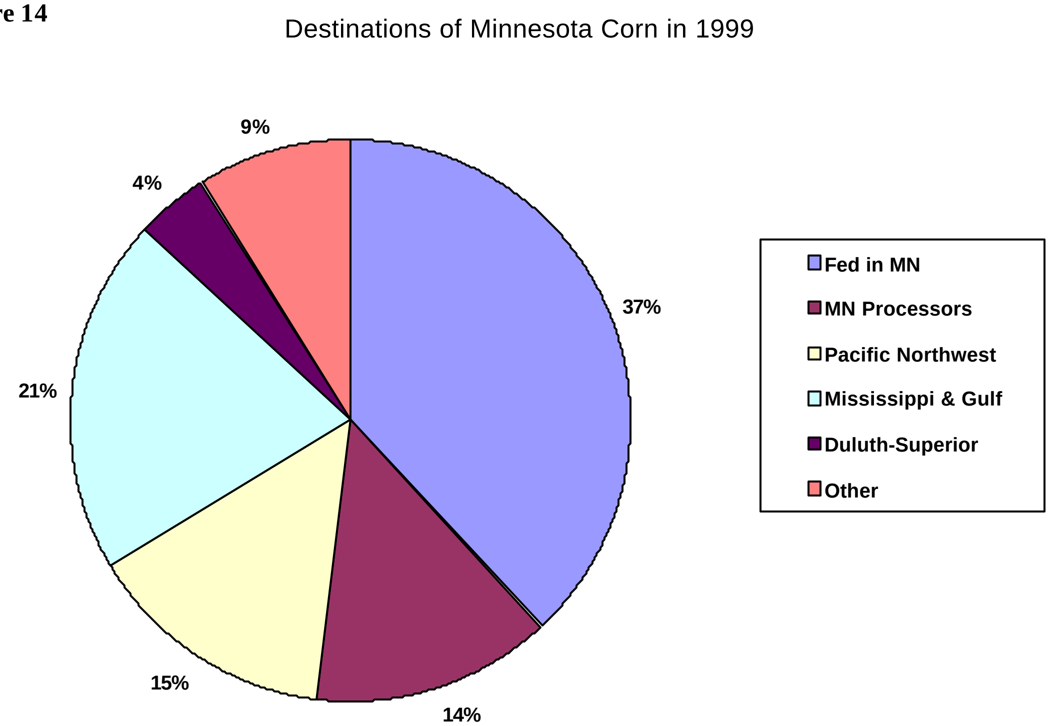
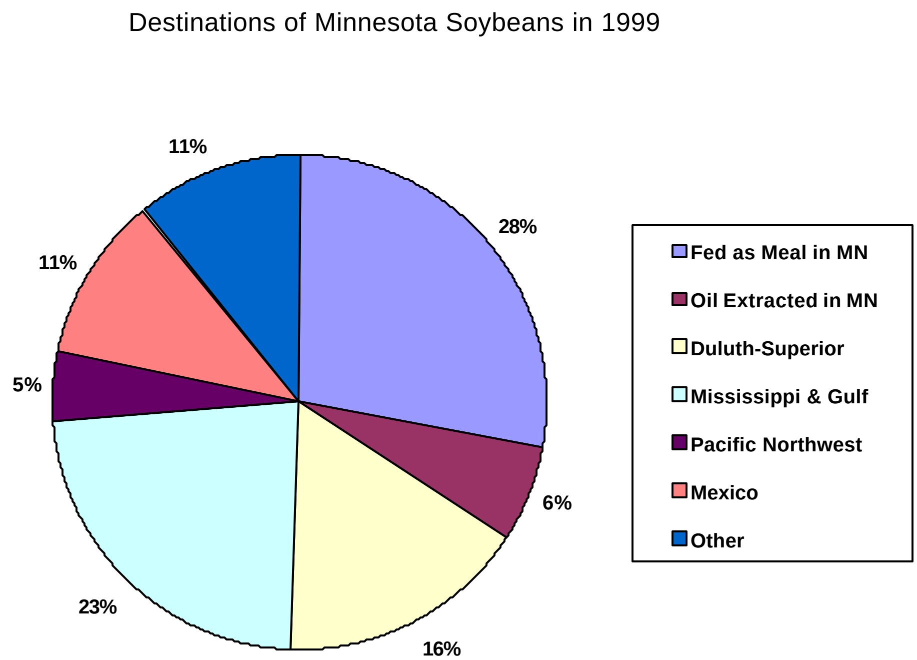


Figure 15 shows the ultimate disposition of the 1999 Minnesota soybean corp. The 28% of the crop fed in Minnesota as soybean meal approximates the output of Minnesota soybean processors. Minnesota soybean crushing capacity has been approximately equal to the demand for soybean meal. The oil obtained as a by-product is equal to about 6% of the volume of soybean crop. The meal is primarily trucked to Minnesota destinations. However, much of the oil is shipped by rail or truck to out-of-state destinations.

Figure 15



In an attempt to answer the question “How has the disposition of the Minnesota crops changed over the years?” the authors were able to obtain estimates of the disposition of the 1985 corn and soybean crops. (Data for wheat was not available.) Comparisons of 1985 and 1999 are shown in Figure 16 for corn and Figure 17 for soybeans.

Figure 16

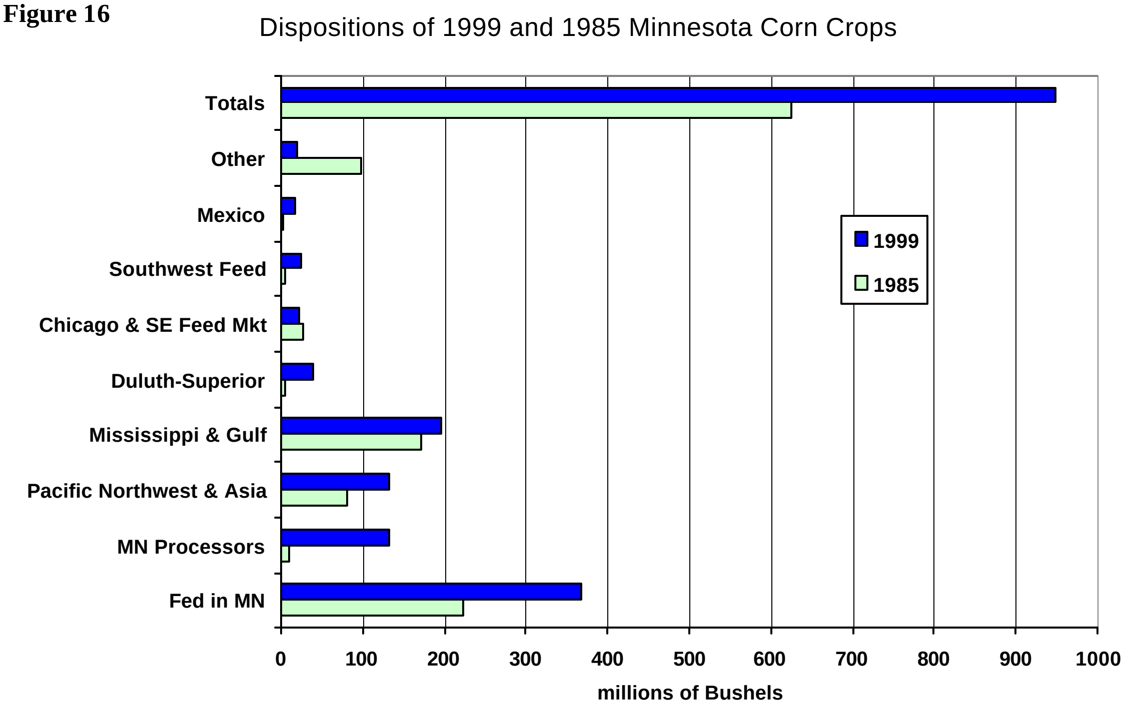
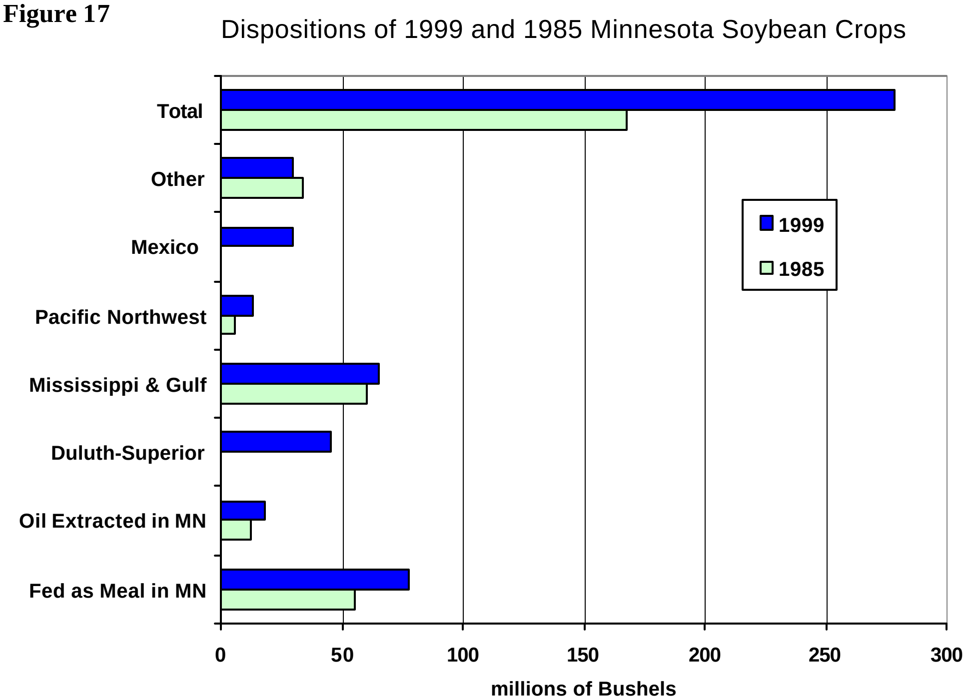


Figure 17



Major increases in the utilization of corn in value-added processing activities like ethanol and sweeteners manufacturing and in the amount consumed as livestock feed occurred between 1985 and 1999. However, this increase was not as large as the increase in crop size so that a greater volume of corn had to be shipped out of Minnesota in 1999 than in 1985. There was an increase in rail shipments to the Pacific Northwest for export. The increase in shipments down the Mississippi River was not as large as that to the Pacific Northwest. However, the River remains the most important outlet for Minnesota corn. The volume of corn to Duluth/Superior increased. Mexico is now a market for Minnesota corn as a result of NAFTA and will probably continue to grow barring trade disputes.

The volume of Minnesota's soybean crop increased proportionately more than that of corn from 1985 to 1999. However, unlike corn, where processing in 1999 increased both absolutely and as a percentage of the crop, Minnesota soybean processors increased the crush, but it was a smaller percentage of the crop in 1999 than in 1985.

The Mississippi River remains the most important destination for soybeans but the amount shipped to the river has not increased in proportion to the increase in crop size. A major reason for this is that Duluth/Superior and Mexico, which were insignificant destinations in 1985, have become much more important outlets for Minnesota soybeans.

Chapter 5. Observations and Conclusions

About 25 million tons or over 2/3 of the grain and oilseeds produced in Minnesota each year must be transported significant distances; half of the production is shipped from the state to national and international markets. This study found that

a) All modes of transportation remain important for Minnesota grain movements. Truck dominates movements from elevators to processors and plays a major role in moving grain to Mississippi River ports and Duluth/Superior from some CRD's. Unit and shuttle trains of 50 and 100 cars dominate the long-distance movements to the Pacific Northwest, Mexico and selected feed markets. However, 18 percent of all Minnesota elevator shipments move by rail in one to 26 car lots.

b) Although no longer as important in a relative sense as in the mid 80's, the Mississippi River now moves even more Minnesota grain in a typical year. In fact, the Mississippi Rive remains the most important transportation artery for Minnesota's surplus grain.

c) Livestock consumption of grain and value-added utilization increased between 1985 and 1999, but not as much as grain production. Further large increases in value-added processing of both corn and soybeans are currently planned. These increases will impact local markets, but not Minnesota's long established position as a major grain exporter. In the long-run, the growth or decline in Minnesota' grain exports will depend on its livestock industry and the demand for locally processed soybean meal and feed by-products of corn processing.

d) Since the implementation of NAFTA, Mexico has become an important growing market for Minnesota corn and soybeans. Like any international market, growth will be sporadic due to trade disputes and general economic conditions, but the die is cast for more growth as the U.S. and Mexican economies become more integrated. Similarly, we can expect more agricultural movements between Minnesota and Canada. However, these won't be as dramatic because of the similarity of the climate and land characteristics.

e) Duluth/Superior has become an important outlet for soybeans. Shipments of soybeans through the Twin Ports were virtually nonexistent in the 80s and early 90s. However, increased total production and the expansion of the soybean area into the Red River Valley and North Dakota has provided the impetus for the development of this new outlet for export beans.

f) The planned expansion of corn and soybean processing in Minnesota will reduce the quantities of unprocessed commodities to be shipped out of the state to national and international markets. However, additional quantities of distiller's grains, ethanol, soybean meal and soy oil from Minnesota will be entering the national market.

ENDNOTES

1. *Minnesota Agricultural Statistics 2000*, U.S.D.A., National Agricultural Statistics Services and Minnesota Department of Agriculture, p. 34-58.
2. Jerry Fruin and Douglas G. Tiffany, "Where Does Minnesota's Grain Crop Go? An Analysis of Minnesota Elevator Grain Shipments for the Period, 7/99 - 6/00." Minnesota Department of Transportation, St. Paul, MN, 2002, 37 p.
3. Douglas G. Tiffany and Jerry E. Fruin, "Filling the Feed Troughs of Minnesota and Beyond," Minnesota Department of Transportation, St. Paul, MN, 2002, 29 p.
4. *Minnesota Agricultural Statistics, 2001*, p. 91.
5. Farmgate price is the price paid by elevators and dealers who buy directly from farmers. Average farmgate prices for 7/99 - 6/00 were $1.70 for corn, $4.55 for beans and $3.05 for wheat.